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Feasibility of volleyball technics video in physical education for senior high school

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ABSTRACT

This study aims to (1) identify the needs of instructional video media in subjects related to physical education. (2) Designing instructional video media on subjects related to physical education. (3) Measuring instructional video media's validity, practicality, and effectiveness on Physical Education subjects. This study uses the ADDIE Research and Development Model approach, which is carried out through 5 stages, consisting of (1) the analysis phase, (2) the design phase, (3) the development phase, (4) the implementation phase and, (5) the evaluation phase. The research subjects were one teacher and 30 students. The results of the study are: (1) Identification of the need for instructional video media in physical education subjects shows that learning video media is needed as an alternative medium that can be used to support the teaching and learning process. (2) The design of instructional video media includes several stages, including conducting curriculum analysis, preparing teaching material scripts, and designing products. (3) Analysis of the validity, practicality, and effectiveness of learning video media products. The content/material validation results and design construct validation by experts obtained very valid categories so that learning video media products can be tested to determine the level of practicality and product effectiveness. The level of practicality and effectiveness of the product meets the criteria of being very practical and very effective.

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INTRODUCTION

Education is crucial in advancing society, mainly cultivating the younger generation as future leaders. To optimize this procedure, many techniques and instruments have been devised (Puspitarini et al., 2018). In the contemporary period characterized by advanced technology, multimedia is crucial in facilitating the comprehension of educational material by integrating visual elements and textual information (Tayoush et al., 2023). The information refers to the content from specific academic disciplines disseminated by an instructor to pupils via designated instructional media. In contemporary times, students fulfill a dual role in the communication process. They serve as passive recipients of communications and actively engage in storing and retaining those messages, transforming communication into a two-way process. The effectiveness of student learning outcomes can be enhanced by using appropriate learning media in learning activities (Suhairi et al., 2020).

Moreover, learning can be conceptualized as a dynamic process wherein students interact with their surrounding environment, resulting in a transformative change in their behavioral patterns towards a more desirable trajectory. Effective communication is crucial in disseminating knowledge (Hasibuan et al., 2018). The learning process is one of the determinants of whether or not the graduates produced by the education unit are competent, integrating the development of students' intellectual skills. Excellent and varied learning tends to have varied thinking skills as well. On the other hand, if learning is done monotonously and does not vary, the graduates formed are similar to the process that occurs.

All subjects in schools require variations in the material delivery method, which is also influenced by the learning media (Solihin, 2020). The more interactive the learning media, the more capable of conveying various forms of messages, such as text, images, sound, and audio-visual. Some subjects require media that can get complex messages, such as subjects that require much practice (Astuti et al., 2022). For example, physical education and health subjects have learning characteristics that are only sufficient if delivered theoretically. This requires media that can present material in various ways so that students can easily understand the basic concepts to practice material for these subjects. The subject of volleyball in physical education is one of the materials in class X, which has many internal terms that students need help understanding, and the amount of material that must be studied can also cause difficulties for students. Because volleyball is small, adequate learning media must support its learning efforts. Media development as a learning resource is crucial for physical education teachers (Ketaren et al., 2023).

The development of science and technology is currently developing rapidly and also influences the development of the world of education (Nurhikmah et al., 2021; Sukmawati et al., 2022; Nurhikmah et al., 2021; Nurhikmah et al., 2023). One of the influences of technology in education is its use in the learning process as a learning medium. Technology in the current learning process is very possible because most schools have facilitated tools to support using technology in the learning process (Imran et al., 2023). Utilizing technology as a learning medium can serve as a means to overcome the limitations in the learning process, maximizing learning objectives (Febriati et al., 2022; Imran et al., 2022). Learning media is everything that can be used to convey a learning message. This is to the understanding of media, which states that the media, if understood broadly, are humans, materials, or events that build conditions that enable students to acquire knowledge, skills, or attitudes. AECT (Association of Education and Communication Technology 1997) in Shoffa et al., (2021) defines media as the form and channel used to convey messages or information.

I am learning media as a communication tool in the learning process. Learning media are all materials and physical tools that may be used to implement teaching and facilitate student achievement towards teaching. Teaching media as a tool in the learning process can be used both inside and outside the classroom (Solihin, 2020). The media is used inside and outside the school (Nurhikmah et al., 2022). The media is used in the context of communication and interaction between teachers and students in the learning process through video learning media as a series of processes or activities to produce a learning media based on existing development theories (Daryono et al., 2021). Video learning media is developing spoken and written theories, which are converted into more interactive video media (Sinurat et al., 2022; Bakri et al., 2020). In designing learning media, several things need to be considered in the selection of learning media, namely: 1) learning targets, 2) learning materials, 3) learning techniques, 4) availability of equipment used, 5) teacher character, 6) students' desires and abilities, 7) learning atmosphere while walking.

Some previous studies stated that research on the importance of learning media greatly influences physical education learning outcomes (Mislan & Santoso, 2019). This study should help instructional designers and teachers make their videos as helpful as possible (Beege et al., 2022). findings for designing a video-based learning system aligned with the Socratic reflection prompts are discussed (Hsu et al., 2022).

The results of initial data collection through interviews, observations, and documentation with class X teachers of SMA Negeri 1 Takalar during the COVID-19 pandemic show teachers still need to be more varied in teaching volleyball game material, namely practice, without giving students primary volleyball game material. So that students cannot receive volleyball game material well. As for student learning outcomes, several problems were found, such as decreased student interest in

learning and boredom because they needed to have the opportunity to ask questions and get an explanation from the teacher. The teacher's role in achieving learning success during the COVID-19 pandemic must be supported by learning media products that can make students receive learning materials well.

Moreover, a need exists for more student engagement and attentiveness throughout the presentation of theoretical concepts and practical demonstrations in the context of volleyball games. There is a perception among specific individuals that this particular game has frequently been employed to the extent that they no longer find it necessary to actively engage with the instructional content provided by the teacher, resulting in a sense of boredom towards the repetitive pedagogical approach. In addition to exhibiting apathy towards pupils who perceive volleyball games as a means to avoid re-engaging with the teacher's explanations, many students show reduced levels of engagement in the domain due to experiencing monotony stemming from repetitive movements.

Based on the problems found, the solution that can be offered is the development of learning video media that will help students learn. The research aims to identify the need for learning video media, design learning video media, and measure the validity, practicality, and effectiveness of learning video media in class X physical education subjects at SMA Negeri 1 Takalar. The contribution of this research on learning media is that it will be easier for teachers to convey the material, and students will be more motivated in learning as we know. The benefits of using videos in learning include increasing student motivation, making students enjoy learning, and substituting teachers in explaining the material.

METHOD

This research used the type of research and development. Research and development is a research method used to produce a product. The ADDIE (analysis-design-development-implement-evaluate) model in Figure 1 model is the research model used in developing this instructional video media. The subjects in this study were two validators consisting of 1 validator, an expert in design/learning media, Dr. H. Abd—Haling, M.Pd, and one validator expert on content/learning evaluation materials, Dr. Suwardi, M.Pd. At the same time, the subjects for the practicality test were one teacher and a class X student of SMA Negeri 1 Takalar, which consisted of 5 students for the small group test and 30 students for the extensive group test. The object of this research is the development of video media.

Figure 1. ADDIE Model

The data collection technique is an integral part of the research process. This stage is carried out before the research proposal is approved until this research is completed. The data collection techniques used to collect data in this development research are questionnaires and interviews. Validity data was obtained through content validation and design construct tests by experts on the design of learning video products. The results of the content validation test and design constructs by experts using a scoring scale of 1 to 4. Suggestions from the validator then become material for improving the developed product. The created product design was revised based on several expert suggestions through product validation tests in the context of content, constructs, and media. Each suggestion is constructive, explaining the shortcomings and weaknesses of the teaching materials' product design.

Suggestions and input from the media validator are to improve the video quality that will be used in the learning process and reduce the sound of the music in the video so that students do not focus on the music but on the material displayed. Researchers have also made editing improvements based on these suggestions to improve product output. Suggestions and input from the content/material validator increase the duration of the video so that the material presented is more explicit and complete. Based on this suggestion, the researcher has improved by these suggestions and inputs. The footage includes learning objectives and information related to theory and practice on basic volleyball techniques. Practicality data was obtained from the responses of students and educators who directly observed the learning process in each meeting by assessing three practical aspects: ease of use, attractiveness of presentation, and product benefits. The purpose of the practicality test in this study was to determine the accuracy and ease of use of teaching materials that have been produced. Practicality data was obtained by using a score on a scale of 1 to 4 in each aspect of the observation. The effectiveness data was obtained by giving a linear test with the subject of the volleyball game as the material in the developed learning video. The goal is to find out the impact on the target users. It is considered adequate if the learning outcomes of class X SMA Negeri 1 Takalar students meet the minimum completeness criteria and or experience increased learning outcomes after using learning videos.

RESULTS AND DISCUSSION

Results

The current learning process requires many ideas and innovations; this is due to the outbreak of the COVID-19 virus, which causes learning to be carried out online. Based on the results of the needs analysis obtained through in-depth interviews by students who are taking physical education subjects and interviews with physical education subject teachers, it was found that the lack of knowledge of students in online learning during the pandemic because during the learning process, students did not understand the delivery of material and some This is due to differences in student characteristics in understanding the material presented and difficulties in accessing material in online learning platforms because they have to be online and require internet access.

As designed in the lesson plan, practical learning and a good knowledge transfer process must have an exciting core in this physical education subject. Based on one of these benefits, learning media can be used in the COVID-19 pandemic situation, which requires learning to be carried out online because it can make it easier for teachers to teach, especially in the process of delivering material (Sujarwo et al., 2020; Sukmawati et al., 2022). Then, the benefit for students is that it can make it easier to access and understand the material presented. This research produces a video learning media product that is valid, practical, and effective, so it is necessary to go through 5 stages in the order of the stages of the ADDIE development model, namely the analysis stage, the design stage, the development stage, the implementation stage and the evaluation stage which is described in detail as follows:

Description of the Need for Development of Learning Video Media in Physical Education and Health Subjects

The initial stage carried out on the ADDIE model is analysis. At this stage, observations and interviews were carried out in collaboration with the Pesjaskes subject teacher at SMA Negeri 1

Takalar to obtain the data needed to make learning video media products. These need to be analyzed are curriculum analysis, student character analysis, and needs analysis. The product developed by the author in this study is a learning media in the form of learning videos for students of SMA Negeri 1 Takalar for subjects in physical education.

This curriculum analysis was conducted by interviewing the Physical Education subject teachers at SMA Negeri 1 Takalar regarding the curriculum used, core competencies, essential competencies, and materials in physical education subjects in the 2013 curriculum. The following are core competencies and critical competencies used in learning physical education, the subject of volleyball, and the indicators the researcher has designed. Core competencies, necessary competencies, and indicators of learning material. The volleyball game in the physical education subject will be used as a reference for preparing material for the learning video.

This student character analysis was conducted to determine the knowledge and abilities of the students. This analysis was performed by seeking information from class X's physical education subject teacher. The research subjects used were class X students, a total of 32 students. According to the physical education teacher, the characteristics of the students in this class are active in the learning process. Students are engaged in discussing, asking, and communicating. Students will actively ask the teacher if they need help understanding the material. Students are also active in solving problems given by the teacher.

This material analysis will discuss the overall picture of the Volleyball Game Material given to students. Essential competencies and indicators in physical education materials will then be designed and compiled into learning videos. Developed. The sub-materials presented in the learning video include a basic technical introduction to volleyball games and a volleyball game movement technique tutorial. The allocation of learning time, especially on the volleyball game material in the physical education subject, is three and two weekly meetings. One meeting 3 hours of lessons (3 × 40 minutes). So, the volleyball game lesson material takes a total of 2 weeks. In the existing facilities at the school to support the running of learning media developed by researchers. At SMA Negeri 1 Takalar, supporting facilities are available, including computers, speakers, projectors, and wifi. In facility analysis, researchers interviewed the physical education teacher concerned through observation.

Overview of Design Development of Learning Video Media in Physical Education and Health Subject

This second stage in the ADDIE model is designed. The design stage is when we create an outline (skeleton) of the media that will be developed. Several more stages are carried out, including compiling a product design storyboard, selecting an initial design and format, and preparing a product design assessment instrument. Referring to the needs analysis, it is considered essential to design a learning video media that can support the implementation of the learning process during the pandemic to minimize the problems among students. At this stage, the researcher begins to design the learning video media that will be developed—preparing a learning video media framework using Cyberlink Power Director at SMA Negeri 1 Takalar. The framework in question is the opening section of the video, the content/material section, and the closing. The opening part will present the learning video and media about the essential competencies and learning objectives. The second part is the material's content on the learning video media. The next part is closing.

The tools menus on the software used in designing Cyberlink Power Director learning video media are Flypaper, Camtasia, and Snagit. Flypaper combines images, flash videos, transition animations, memory games, etc. This software can generate SWF files that are easily integrated with Lectore Inspire. Camtasia can be used to record steps performed on the monitor screen. This software can edit videos and publish them in standard formats. Snagit can be used to capture the monitor screen. Furthermore, Snagit can combine multiple images into one and post them in various image files. Designing learning video media begins with preparing teaching materials and video scripts, taking pictures, editing, and finishing. The storyboard for the design of learning video media development using Cyberlink Power Director software can be seen in Table 1.

Table 1. The Revisions

No.	Documentation	Information
1	 Figure 2. Slide 1	Initial View of the Concept of a Volleyball Game.
2	 Figure 3. Slide 2	Display of Volleyball Game Techniques.
3	 Figure 4. Slide 3	The Steps of the Game of Volleyball.
4	 Figure 5. Slide 4	Various Techniques in the Game of Volleyball.

Overview of Design Development of Learning Video Media in Physical Education and Health Subject

The third stage of the ADDIE development model, namely development, is carried out by combining all assets into a development product in the form of learning video media using Cyberlink Power Director software and will then be validated by experts from the content and construct aspects as well as media. The leading indicator in determining the feasibility of a learning product is the result of design validation. The design validation process is carried out by involving two experts to provide an assessment of the product design that has been produced. As for those who act as validators in evaluating product designs developed in research, namely the evaluation by the material expert validator, this learning video got a total score of 61 with an average of 4.35, including the outstanding category. If it is a percentage, the learning video receives a score of 87.14%, including the very valid category. The results of the assessment of the product design of instructional video media for the subject of physical education, the subject matter of volleyball, are described in Table 2 as follows.

Table 2. Content/Material Validation Results

No.	Aspect	No. Statement	Score	Average	Percentage	Criteria
1	Completeness	(1).(2).(3).(4).(5)	20	4	80%	Valid
2	Contents	(6).(7).(8).(9)	17	4.25	85%	Very Valid
3	Language	(10).(11).(12).(13).(14)	24	4.8	96%	Very Valid

Based on Table 2 above, the data obtained from the assessment results by material expert Validators showed that the average percentage was 87.14%.In validating material related to the design of the developed video media product, the learning implementation plan, which will be used in the learning process, is also included. Based on these data, it can be concluded that the learning video media on the subject of physical education, the subject of Volleyball, which has been developed, meets very valid criteria and can be tested. Still, some improvements must be made to the suggestions given by the expert validators.

Effectiveness analysis describes or provides an overview of the object under study through sample data without analyzing and making conclusions that apply to the public. The effectiveness of the learning video product was tested using a pretest and posttest for the tenth-grade students of SMA Negeri 1 Takalar. Ten multiple-choice questions cover all class X SMA Negeri 1 Takalar material. Implementation of pretest and posttest offline and distributed to students. The description of the test results for Class X students in the implementation of small-scale trials can be seen in Table 3 below.

Table 3. Analysis of Pre-Test and Post-Test Results for Small-Scale Trials

No.	Respondent	Pre-Test	Post-Test	Information
1	Subject 1	46.7	74	Complete
2	Subject 2	33.3	74	Not Complete
3	Subject 3	46.7	87	Complete
4	Subject 4	40	87	Complete
5	Subject 5	46.7	87.7	Complete

Table 3 shows that of the five subjects involved in the implementation of small-scale trials, there were five people, or as many as 87.0% of the total subjects, declared complete with a score above the minimum completeness criteria standard that was set, namely 76. Pretests and posttests were still carried out on large-scale trials by involving 30 different subjects with large-scale test subjects.

Discussion

The design stage of the media video product is designed in such a way that it can be helpful to and by the characteristics of students; this is by the opinion of Wibawanto (2017) about the benefits of learning media, namely with different characteristics and the material being taught is the same, it

can be overcome with learning media, namely giving the same stimulus, equating experience, giving rise to the same perception. This learning video media product was developed concerning the learning implementation plan, then a script/script that the narrator will use to deliver the material and take pictures/objects by involving the physical education subject teacher as an object in the video media.

The editing process uses three applications, namely Adobe Photoshop, to create visual effects and backgrounds, which will be included in the Learning Video Media product. Furthermore, a visual-based application, namely Canva, can be used to edit videos and images. This application is used to make intro videos so that the appearance the first time you watch Learning Video Media products becomes more attractive. Finally, the application that is used to combine video and rendering and to add animation and background effects is Cyberlink. The learning video media consists of 3 parts, namely learning video 1 discussing the basic Concepts of the volleyball game, the second video, the basic techniques of the volleyball game, and the third explaining the steps of the volleyball game.

The development of this learning video media product is by collecting previously recorded video capture materials and then entering the editing process using several applications that have been mentioned and making adjustments to the text and material for physical education subjects and lesson plans. The results of the design construct validity test by experts on this learning video media product obtained excellent qualification results from the experts. Aspects of the assessment of the suitability of the language used are pretty straightforward because the script that is prepared and refers to the lesson plan uses standard Indonesian so that it will make it easier for participants to listen to the material presented, the accuracy of the layout arrangement is arranged in such a way that students can watch media products. This learning video is comfortable and not too overedited; the color of the writing with the background is made by paying attention to the suitability of colors and color combinations with one another so that the writing looks straightforward to read,

Learning video media products also obtained assessment results that were in excellent qualification by content experts/materials for physical education subjects assessed from the aspect of the suitability of learning objectives to be achieved with learning video media because the script made in this learning video media refers to the learning implementation plan physical education subjects so that the products developed can help the learning process and can achieve the learning objectives to be achieved, the clarity of the formulation of learning achievement indicators with learning video media so that the learning indicators to be performed can be adequately implemented with the learning video media products developed. The suitability of learning outcomes for Physical and Health subjects with the duration of learning video media is made with the most efficient possible time so that students can easily understand the material presented without feeling bored. The time used in this learning video media product is about ±10 minutes.

The next stage is the trial stage to determine the practicality of the learning video media product developed. This learning video media product is then distributed to the teacher. This practicality test is carried out online by providing a questionnaire with the practicality test objective, namely to find out the ease of users in using the learning video media product to 10th-grade students taking physical education subjects totaling five people for a small group. The results obtained through the questionnaire are suitable qualifications so that the media can be tested for practicality in large groups. Then, in the large group trial obtained through the questionnaire, the qualifications were excellent, judged from the attractiveness aspect of the learning video display, which was designed to be more attractive so that students could be more interested in learning, adjust the learning sub-achievements of physical education subjects and the material presented on the media. Learning videos because this Learning video media product was developed in accordance with the learning implementation plan and adjusts the materials and media needed by students, the suitability of the themes used in this learning video media product is adapted to the characteristics of students and also adjusted to the proportional images used,the ease of reading text in learning video media is made by paying attention to color so that the color of the writing used does not blend with the background color, the clarity of sound in the learning video media has been refined so that there is no noise and can make it easier for students to listen to the material presented and not interfere with concentration in learning,and the last aspect of the ease of understanding the contents of the learning video media

is made by providing animation and transition effects so as not to make students bored in watching learning video media products and providing a little visual impact because in addition to attracting students' interest or attention in learning the products developed are also fixed. Pay attention to the element of convenience in learning so that this media video product can be an easy way for students to understand learning material.

This learning video media is flexible for teachers and students to share. In addition, this learning video media product can also be played on various devices such as Android, iPhone, iPad, and others. The suitability of writing color is used with the background color so that it can be read clearly; the clarity of the narrator's voice is recorded by paying attention to the clarity of the voice so that there is no noise in the video media, as well as the accuracy of the supporting audio used in this learning video media product using sound no copyright in addition to not violating copyright the use of supporting audio in this video also the audio used sounds quite relaxed and comfortable which is selected based on the audio category that is suitable for use in learning then the audio has arranged the level of clarity so that it sounds soft. The sound produced is not higher than the narrator's voice. The results were excellent qualifications in a practical trial by this physical education subject teacher. However, there was a slight improvement, namely the volume of the background or supporting audio that sounded higher than the voice of the narrator, so a revision was made to the learning video media product so that the product developed was of high quality.

Student learning outcomes experienced a significant increase in both small-scale trials and large-scale trials. These results indicate that the learning video media product is valid, practical, and effective as an alternative medium to support the teaching and learning process at SMA Negeri 1 Takalar. The results of this study are supported by the results of other studies that show that video learning media is feasible to use as a learning medium (Puspitarini et al., 2018), in line with further studies claiming that the output of this research is a video of learning that will be appropriate to be used as a medium for learning (Bakri et al., 2020). This is supported by other studies indicating that the feasibility of developing video animation on material expert perceptions obtained a value of 82.121%, included in the very feasible category (Daryono et al., 2021).

The advantage of this learning video media product is that it can help students with difficulties understanding physical health subject matter, especially volleyball game material. Using learning video media is also very easy if you want to use it in the online or offline learning process because this product can be distributed directly to students during the learning process, so students themselves can easily access the learning video media that has been provided. Has been provided by the teacher via their respective gadgets. This is because the product developed uses standard Indonesian, so it is easy to understand, and the presentation of the material involves physical education subject teachers so that students can be enthusiastic about independent learning.

CONCLUSION

Description of the need for developing instructional video media for physical education subjects. The biological education material begins with an analysis of conditions in the form of identifying potential and problems that occur; the information obtained through a direct interview process and processed to get an initial picture that will become a frame of reference in determining the initial design format of the product to be developed. The level of validity of using learning videos based on the results of the content validation test and design constructs by experts is a very valid criterion. The level of practicality of the use of these teaching materials is analyzed based on student response questionnaires and teacher/tutor response questionnaires, with the results shown being inefficient criteria, and the level of effectiveness seen from the assessment of learning outcomes based on the pretest and posttest of students with the results meeting the very effective criteria.

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Designing an educational game "Cleantopia" to increase students' awareness of environmental cleanliness at Mekarsari Elementary School

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ABSTRACT

In general, knowledge of the types of waste in Indonesia still needs to be improved. This is one-factor causing problems in Indonesia's waste management system. The importance of knowing the kinds of waste must start from childhood. With the child's good memory, the knowledge can be absorbed more efficiently so that the application in the surrounding environment can run optimally. This research aims to increase students' awareness of environmental cleanliness at school. The object studied is taking samples from class 4A students of Mekarsari Elementary School using the Multimedia Development Life Cycle (MDLC) method. Based on the data processing results from respondents, the results obtained show that this educational game application, 'Cleantopia,' can run well and attract students' attention. In addition, with this application, students become aware of cleanliness in their school through observations made by researchers of student activities that become more orderly in disposing of garbage in its place and maintaining classroom cleanliness.

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INTRODUCTION

Environmental hygiene is crucial in almost all countries (Mustafa, 2005). One of them is the school environment. Keeping the environment clean means creating a healthy environment free from impurities like garbage. The level of awareness of the school environment in children still needs to be improved. Based on the researcher's observation in one of the elementary schools in Bandung, cleanliness in the school environment still needs to be improved, especially on the issue of student awareness of managing waste. This can be important because environmental cleanliness can affect many things, especially health. Human vulnerability to health attacks is very diverse (Mustafa, 2005). According to Pranungsari et al., (2019), waste has characteristics that can be grouped into several types, such as organic and inorganic waste.

Based on the Law of the Republic of Indonesia Number 18 of 2018 concerning waste management, waste is the residue of daily human activities and or natural processes in solid form (Undang-Undang Republik Indonesia Nomor 18 Tahun 2008 Tentang Pengelolaan Sampah, 2018). Humans no longer use waste, so it is destroyed and discarded (Suseno et al., 2016). Although there have been many slogans, calls, and sanctions to prohibit littering, awareness of how to dispose of

waste in its place still needs to be improved (Ahsan & Faud, 2016). People think waste is disgusting and dirty and must be disposed of and appropriately burned (Mulasari, 2012). The types of waste based on their nature can be divided into three types: organic, inorganic, and hazardous (B3) (Putri, 2022). Littering can cause severe health impacts, such as becoming a breeding ground for disease-transmitting vectors. Therefore, human awareness is needed in managing waste (Manyullei et al., 2022). Waste accumulation is caused by excessive volumes exceeding landfill capacity and the need for positive impacts of waste management and government policy support (Hasibuan & Syafaruddin, 2021). Generally, in Indonesia, knowledge about these three types of waste is minimal, so many people throw garbage in its place but not according to its kind. The management needs to be maximized because it must be sorted again.

The importance of knowing the types of waste must start from childhood; with the child's good memory, the knowledge is more accessible to absorb so that its application in the surrounding environment can run optimally. Changing mindsets and increasing awareness are challenging, but if caught early, upbeat personalities and habits can be formed (Ramadhan et al., 2020). One action that can be taken is to provide health education (Lestari et al., 2020). It is important to emphasize to the elementary school community the importance of disposing of waste in its place and classifying waste according to applicable criteria (Asmara et al., 2023); by transferring universal moral values, it is hoped that students can respect the lives of others and become good citizens from an early age to adulthood (Kusrahmadi, 2007). Other researchers argue that Teaching awareness of the environment, including waste management, is essential from an early age. This habit can form a sustainable character until adulthood (Siregar & Sudarmilah, 2019). Plus, according to Pratiwi (2016), in the learning process, children will deeply understand and better understand the concepts taught by what they see (visually).

Putra et al., (2016), in their journal entitled "Making Educational Games for Smart Choosing Trash," explain that research on making educational games about smart choosing trash that is interesting and interactive can help parents educate and teach their children about disposing of garbage properly. Children in elementary school can be educated to become prospective golden successors who are intelligent and moral. According to Kusrahmadi (2007), educating children from elementary school can affect changes and form the forerunner of children's behavior so that children as adults will be more responsible and respectful of others and can face the challenges of dynamically changing times. Children's education is inseparable from education at school. Therefore, schools, in this case, also play an essential role in providing knowledge of the types of waste to foster awareness of environmental cleanliness in students. The development of the times with increasingly sophisticated technological advances can make it easier to provide knowledge of the types of waste students. This phenomenon will also affect game development (Febrianti & Prasetyo, 2023).

Games have many types, including educational games that combine games and knowledge. Using game media can significantly develop and improve student intelligence during the learning process (Nurseptaji & Prasetio, 2021). This educational game can be one of the learning companion applications used by students under teacher supervision. Efendi (2019) states that educational games are " made to learn not only to intend to entertain but are also expected to add insight into knowledge." Therefore, users not only feel happy with the game that is packaged, but they also learn to stimulate thinking by completing each level to increase knowledge and awareness of the environment, especially in the garbage. This research contributes to the development of game media regarding environmental hygiene insights that are interesting, interactive, and educational.

METHOD

The research method in developing interactive learning media, especially making this game, requires a method that focuses on software development (Mustika et al., 2017), so one method that can be used is the Multimedia Development Life Cycle (MDLC) method of the Luther model. the reason the author uses this method is that the MDLC model is very suitable for designing multimedia applications that integrate various types of media, such as images, sound, video, and animation. The

steps in this model can be flexibly adjusted or moved according to the requirements of the research project. According to Rengganis et al., (2022), it is designed in six stages, as follows in Figure 1:

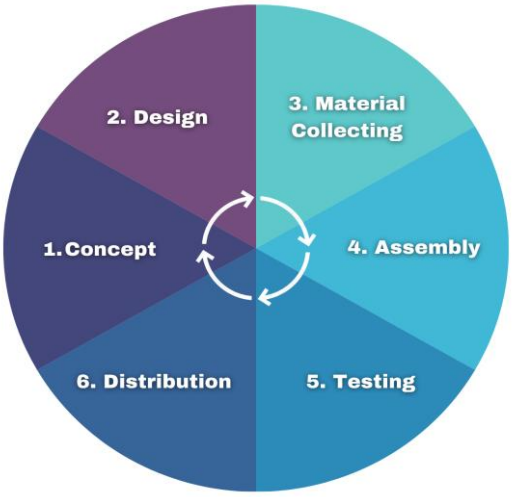

Figure 1. Multimedia Development Methods

The research method for developing interactive learning media, especially making this game, requires a method that focuses on software development (Mustika et al., 2017). One method that can be used is the Luther model's Multimedia Development Life Cycle (MDLC) method. The author uses this method because the MDLC model is suitable for designing multimedia applications integrating various media types, such as images, sound, video, and animation. The steps in this model can be flexibly adjusted or moved according to the requirements of the research project. According to Rengganis et al., (2022), it is designed in six stages as follows:

1. Concept
   This is the initial stage, where brainstorming is carried out by collecting ideas to determine the objectives and identify users of game products; this aims to make the appearance presented by the user's identity (Chusyairi, 2020). To the opinion above, at this stage, we brainstormed with the entire team, expressing their respective ideas; ultimately, we selected one idea that we would make: an educational game application targeting elementary-level students.
2. Design
   The design regarding the program architecture, appearance, and materials is carried out at this stage. This step includes a storyboard that explains the flow of the game. At this stage, we started making a rough storyboard with pencil and paper media. After it was deemed sufficient, it would be created digitally for this educational application; the storyboard can be seen in the Results and Discussion section below.
3. Material Collecting
   The stage where all product needs, such as logos, animations, and others, are collected is obtained by designing according to the design that has been made. At this stage, we started transferring all the assets we needed to create applications from manual form to digital form using the help of Adobe Illustrator software.
4. Assembly
   In this stage, all objects or materials in the game are created based on the design steps, such as storyboards, flowcharts, and navigation structures (Borman & Purwanto, 2019). At this stage, we started making the educational game using the help of Construct software. All assets that have been digitally created at this stage are arranged in such a way as to become an educational game that can be run.
5. Testing
   After completing the assembly stage, testing is carried out by running the game to the target users, namely elementary school children, to determine whether there are errors. At this stage, we went directly to Mekarsari Elementary School to test several students by trying to play

educational games that had been made in turn, which later, the results of this test we us conclude whether there needed to be improvements again or already be distributed to direct students. So that our research subjects know their mistakes in this educational game, we designed it like a garbage collection game where students have to collect garbage scattered on the road; students will be enriched with knowledge by reading pop-up information about the garbage taken from the road, to later reach a trash can, when participants arrive at the trash can, participants must choose which trash can is by the garbage that has been collected before, and if they have successfully managed into the appropriate trash can immediately proceed to the next level.

6. Distribution
   Distribution is the last stage, where the product application, in this case, the game, will be stored in storage media and distributed to students and teachers who need games about the types of waste. After seeing the results of the tests that have been carried out, we then spread the educational applications that have been made to the school so that they can be distributed directly to students of Mekarsari Elementary School.

RESULTS AND DISCUSSION

Results

In this section, the author will discuss the system design and the results of the user interface of the 'Cleantopia' educational game and will also differ the results of the testing that has been done to see whether there are errors, bugs, errors, or not in this educational game.

Navigation Structure

The navigation structure is a program flow that is an interconnected design between one area and another that can help organize all elements to create an application (Suharni et al., 2022). Researchers use a hierarchical navigation structure called a branched structure, where the data display is determined based on specific criteria.

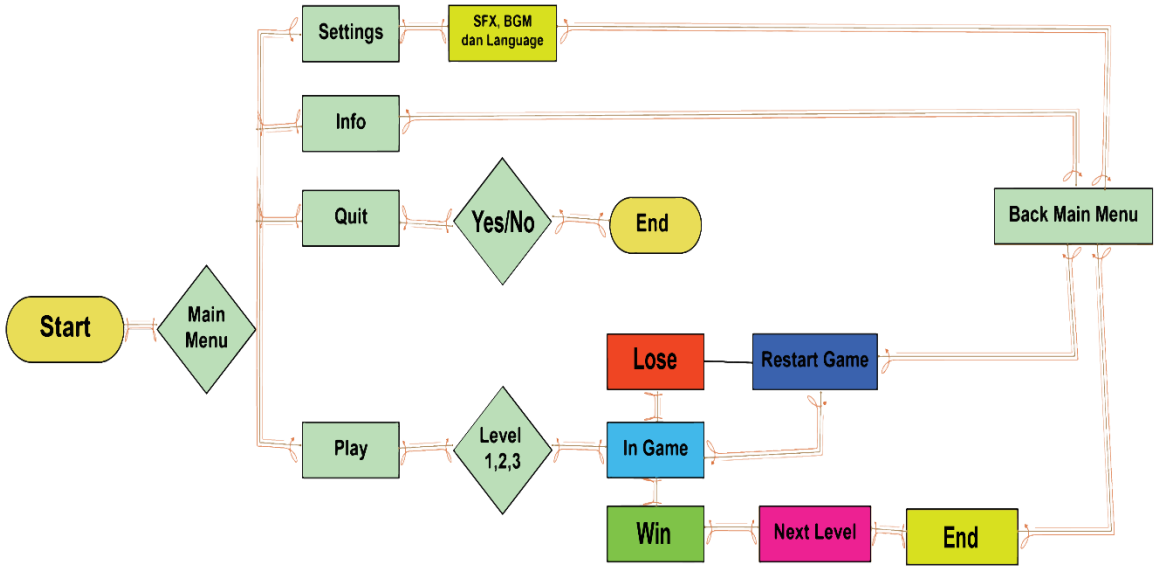

Figure 2. Navigation Structure of Educational Game

From the navigation structure in Figure 2 above, users can turn up or down the music in the game, select a language, view game info, open the game menu, and then close the application. The user can open the game menu, where three levels must be completed. The user must pass the given challenges to advance to the next level. When the user successfully passes all levels, the user will be directed to the main menu. Meanwhile, when the user loses, the user can restart the game so they can play it again.

Storyboard

According to Nurajizah (2016), a storyboard is a series of sketches presenting a story's flow. Storyboard is used to facilitate the design of the display in making Cleantopia educational games. A storyboard is also a reference in the making and can describe the path of the whole story from beginning to end (Huda, 2017). Analysis is carried out by media developers and learning designers who are accustomed to using storyboards (Kunto et al., 2021).

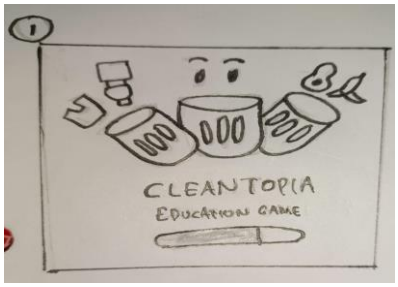

Figure 3. Displays the Loading Page Before the User enters the Next Page

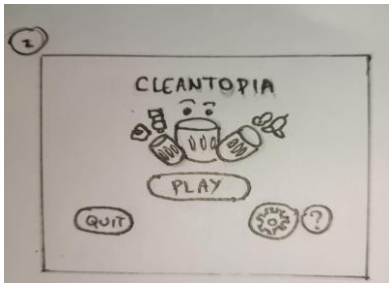

Figure 4. Play Menu Display

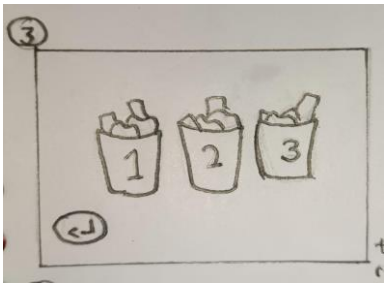

Figure 5. Display of user-selectable Levels 1, 2, and 3

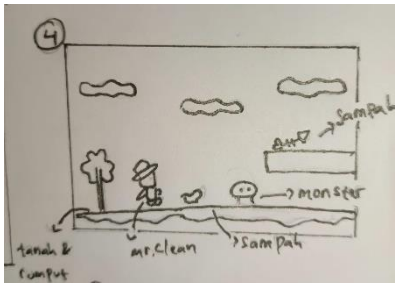

Figure 6. In Game View

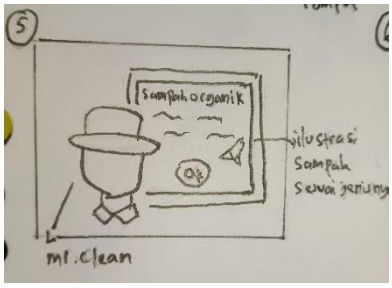

Figure 7. Pop-up Display of Information about Waste Types

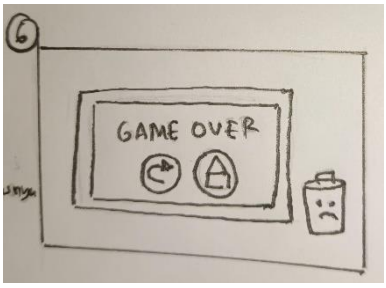

Figure 8. Pop-up Displays Losing or Winning Information When Playing

User Interface

According to Wibawanto & Nugrahani (2018), a User Interface is a tool or element used to manipulate digital objects. The user interface is good if it can function appropriately in the eyes of its users (Achmadi et al., 2017). The following displays the user interface of the "Cleantopia" educational game the author completed.

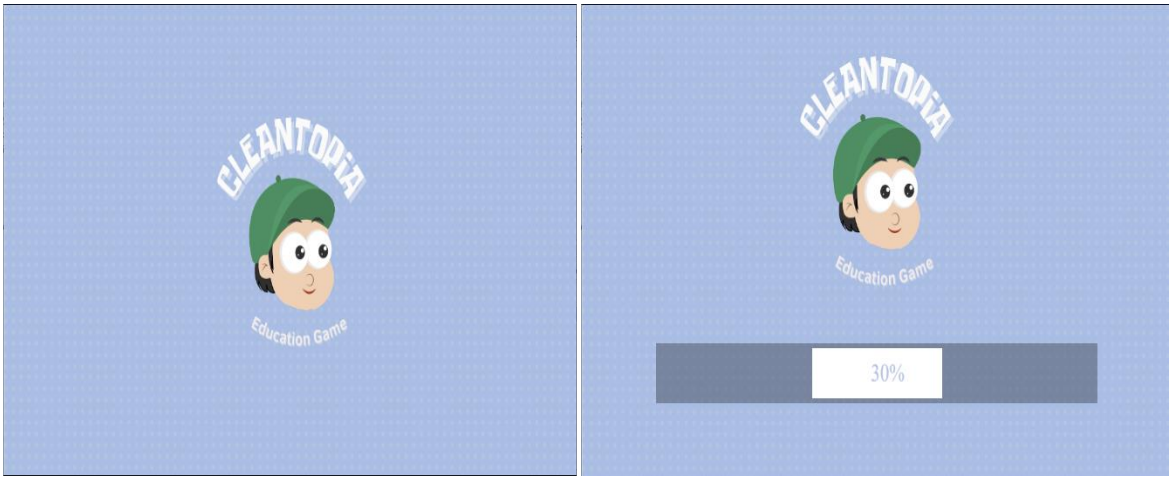

Figure 9. Game Start View

Figure 9 shows the appearance of the Splash Screen or the initial screen that is opened before the application is run, and the loading display in the 'Cleantopia' educational game will appear the first time the user enters this educational game.

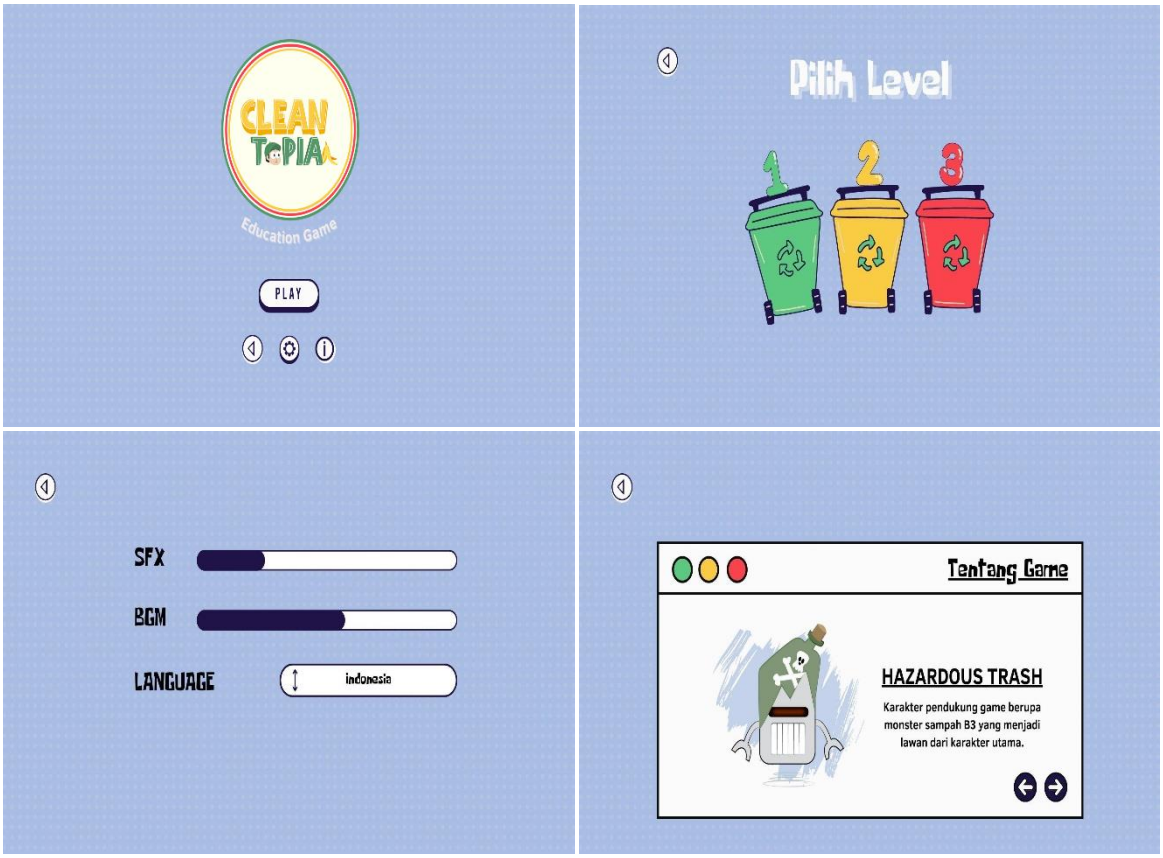

Figure 10. Game Menu Display

Figure 10 illustrates the main menu view, game menu view, settings menu view, and game info view. The main menu has four buttons that can be used. Play button, game info button, Setting button, and exit button. The play button contains three game levels. The game info button contains information about educational games, characters in educational games, and educational game makers. On the Setting button, the user can adjust the background and sound effects volume and change the language between English and Indonesian. This educational game will close automatically if the user presses the Exit button.

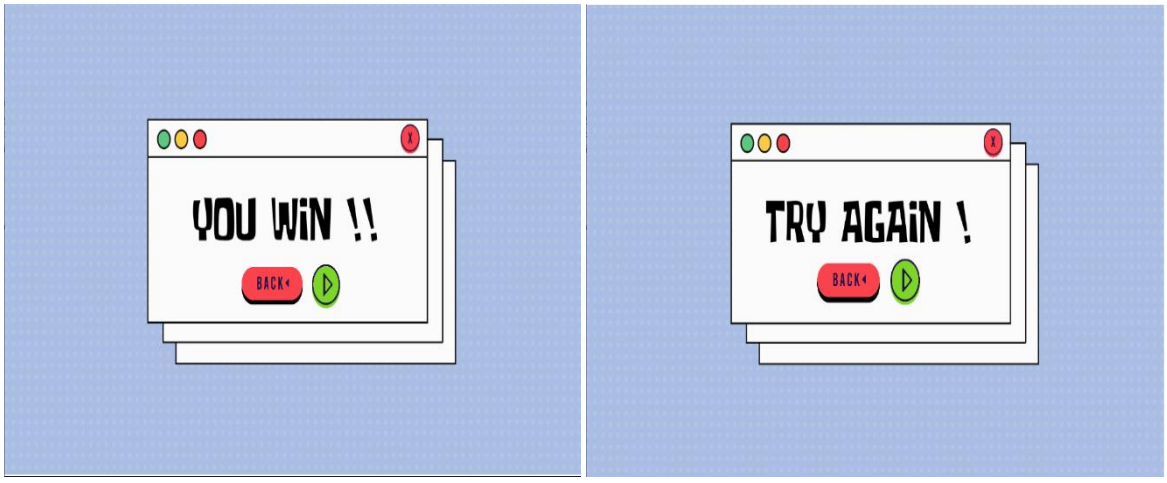

Figure 11. Content Display

Figure 11 shows the view that will appear if the user has successfully passed an obstacle in one of the levels, the view of failing to pass an obstacle at a certain level or has run out of time to reach the success point to be able to move to the next level, and the view that will appear if the user has successfully passed all obstacles in all levels available in this game.

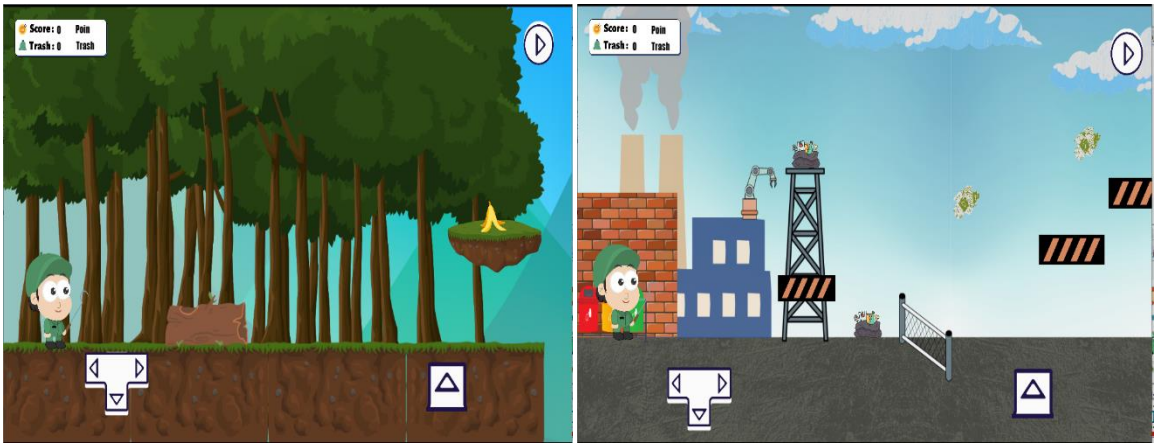

Figure 12. The Process of Creating Instagram Filters uses Spark AR

Figure 12 is a display of each level in the game. At level 1, there is a forest background where users collect organic waste, such as banana waste, apples, and dry leaves. Level 2 in this game is set in an industrial factory at level 2 where users will collect some inorganic and hazardous waste such as candy wrappers, bottles, and poison. Level 3 is set in an industrial factory. At level 3, the user will collect organic, inorganic, and hazardous waste, such as bananas, apples, dried leaves, candy wrappers, bottles, and poison. Whenever you collect trash, information about the garbage you get will appear. Score and trash will also automatically increase when the user collects the garbage.

Tasting

In making applications, testing is needed to determine the success of application functions (usability). The use of measuring instruments in this usability test is adjusted to usability components based on effectiveness, efficiency, and user satisfaction (Nurhadryani et al., 2013). In this testing process or testing, the author sees, ensures, checks, or finds whether there are bugs, errors, or errors while playing this 'Cleantopia' educational game. This testing was conducted by the author Mekarsari Cileunyi Elementary School on December 12, 2022, to 26 grade 4 students in Table 4. Testing is done by taking turns trying the 'Cleantopia' educational game and then being directed to fill out the Google form provided by the author. The distributed Google form contains assessments using a Likert scale of 1-5, which can measure the feasibility, checking, and evaluation of educational games from the student's point of view after trying to play this educational game. The author divides this test into three aspects to be assessed: the programming in Table 1, content in Table 2, and appearance in Table 3. These three aspects will be a reference for the author to determine whether this educational game is feasible enough to be disseminated to the public or requires improvement. In this process, the author can also see that students, after playing this educational game, become aware of the cleanliness of the garbage around them, and students become familiar with it, as shown by the instructions in Table 5 and the results in Table 6.

Table 1. Programming Aspect Test Statement

No.	Statement
1	Easy-to-use Game
2	Ease of Selecting the Settings Menu
3	Ease of Selecting the Info Menu
4	Ease of Selecting the Play Game Menu
5	Ease of Selecting the Level Menu
6	Ease of using the Buttons
7	Ease of using the Game's Exit, Login, and Replay Buttons

No.	Statement
8	Each menu button can function correctly.
9	No Bugs in the Game

Table 2. Content Aspect Test Statement

No.	Statement
1	The Language used is Easy to Understand
2	The Language used is Intriguing
3	It takes a Little Time to Understand how to use the Game
4	The Information Conveyed in the Game can be Received Quickly.

Table 3. Display Aspect Test Statement

No.	Statement
1	Balanced Placement of the Text And Images
2	Background Selection with the Game Theme is Appropriate
3	The Colors Match the Game Theme
4	The interface in this Educational Game is Easy to Understand and Straightforward.

Table 4. Calculation and Result of Application Testing on Respondent

No.	Respondent	Programming Aspect	Content Aspect	Display Aspect	Total
1	Respondent 1	40	19	20	79
2	Respondent 2	45	20	20	85
3	Respondent 3	41	20	18	79
4	Respondent 4	43	19	20	82
5	Respondent 5	39	19	20	78
6	Respondent 6	44	19	20.	83
7	Respondent 7	44	19	19	82
8	Respondent 8	45	18	20	83
9	Respondent 9	45	19	20	84
10	Respondent 10	45	20	20	85
11	Respondent 11	45	19	20	84
12	Respondent 12	45	19	20	84
13	Respondent 13	42	20	20	82
14	Respondent 14	45	19	20	84
15	Respondent 15	41	19	20	80
16	Respondent 16	44	18	20	82
17	Respondent 17	41	18	19	78
18	Respondent 18	45	20	20	85
19	Respondent 19	41	19	19	83
20	Respondent 20	44	20	20	84
21	Respondent 21	44	17	20	81
22	Respondent 22	43	17	19	79
23	Respondent 23	41	20	20	81
24	Respondent 24	45	20	20	85
25	Respondent 25	39	17	19	75
26	Respondent 26	45	20	19	84
Total		**1.121**	**494**	**512**	**2.131**
Maximum Score		**1.170**	**520**	**520**	**2.210**
Percentage (%)		**95.81%**	**95%**	**98.46%**	**96.43%**

$$\text{Formula overall percentage} = \frac{The\ number\ of\ scores\ that\ can\ be}{The\ maximum\ number\ of\ scores} \times 100\% \quad (1)$$

$$\text{Overall percentage} = \frac{2.131}{2.210} \times 100\% = 96.43\%$$

Table 5. Interview Questions

No.	Question	Assessment				
		5	4	3	2	1
1	Have you been able to Distinguish the Types of Waste?					
2	Have you Put your Trash in the Right Place?					
3	Do you Dispose of Garbage According to the bins based on the Types?					
4	Do you Realize Littering is Wrong?					
5	Do you Realize Environmental Hygiene is Important?					

The following answers were obtained based on interviews conducted with sample students of class 4A Mekarsari Elementary School, where the author worked through direct interviews on December 12, 2022.

Table 6. Calculation and Result of Application Testing on Respondent

No.	Respondent	Interview Result
1	Respondent 1	25
2	Respondent 2	25
3	Respondent 3	23
4	Respondent 4	25
5	Respondent 5	25
6	Respondent 6	24
7	Respondent 7	23
8	Respondent 8	23
9	Respondent 9	20
10	Respondent 10	25
11	Respondent 11	25
12	Respondent 12	25
13	Respondent 13	19
14	Respondent 14	19
15	Respondent 15	25
16	Respondent 16	25
17	Respondent 17	25
18	Respondent 18	25
19	Respondent 19	25
20	Respondent 20	25
21	Respondent 21	25
22	Respondent 22	25
23	Respondent 23	25
24	Respondent 24	25
25	Respondent 25	25
26	Respondent 26	25
Total		**626**
Maximum Score		**650**
Percentage (%)		**96.30%**

Overall percentage $= \frac{626}{650} \times 100\% = 96.30\%$

Discussion

This educational game 'Cleantopia' was developed in 5 stages: concept, design, material collection, manufacture, testing, and Distribution. At the conceptualization stage, brainstorming is carried out to put forward ideas until One idea is selected as the material for making applications, namely educational game applications regarding the introduction of waste with the target of primary-level students; at this stage, a navigation structure Is also produced, which is the flow of the program. The design stage begins with creating a storyboard to explain the game flow further and as an illustration of how the game will look.

After the concept and design have been completed, the next step is to collect materials for product needs, such as logos, animations, and other assets. In this stage, the creation uses Adobe Illustrator software. Entering the manufacturing stage, using Construct software, all the assets made are organized into an educational game that can be run. The testing stage is carried out to ensure that all the features in the game are running well. Testing was conducted on 26 students of class 4A Mekarsari Elementary School. The test results obtained 96.43%, and the results of testing with the direct interview method resulted in a percentage of 96.30%. After testing is carried out and produced at a reasonable rate, the next stage is distributing the application to students and teachers as educational material while playing.

CONCLUSION

Based on the research results in the form of observations and calculations of student response results to the 'Cleantopia' educational game application, it can be concluded that the game that has been designed is effective in increasing student awareness of environmental cleanliness at Mekarsari Elementary School Cileunyi and can be a companion or complement to teacher teaching materials. The results of tests conducted by the author on a sample of class 4A students of Mekarsari Elementary School Cileunyi based on aspects of programming, content, and game appearance have run well and attracted students' attention. After making an environmental hygiene educational game for elementary school children, the author recommends that evaluative research be carried out to assess the impact and effectiveness of the game on concept understanding, children's involvement, and potential changes in behavior related to environmental hygiene in schools and surrounding areas.

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Instagram filter with AR technology as an innovation for introducing fauna to Generation Z in Indonesia

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ABSTRACT

Fauna preservation is a crucial undertaking necessary for sustaining the survival of animal species globally. However, the issue of wildlife conservation often lacks widespread recognition, particularly among individuals aged between 13 and 28 years old, commonly referred to as Generation Z. To address this gap, the author proposes a solution utilizing Augmented Reality (AR) technology through Instagram filters to introduce fauna to the Generation Z demographic in Indonesia. Employing the Double Diamond method, consisting of four key stages (Discover, Define, Develop, and Deliver), the author aims to develop an effective solution for fauna preservation in Indonesia. The research findings indicate that Instagram filters incorporating AR technology significantly enhance the public's understanding of fauna in Indonesia. Furthermore, these filters successfully capture the attention of the public, particularly the younger generation, known for their preference for engaging and captivating content. Consequently, Instagram filters leveraging AR technology emerged as an innovative solution for fauna preservation in Indonesia.

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INTRODUCTION

Indonesia boasts abundant biodiversity, spanning its entire territory, owing to its geographical location in the tropical region. As a low country, Indonesia harbors high biodiversity and ranks among the nations rich in biological resources. One manifestation of this natural wealth is biodiversity, encompassing a diverse range of fauna comprising various animal species on Earth. Indonesia exhibits extensive faunal diversity despite occupying only 1.3 percent of the Earth's surface area. Approximately 12 percent of mammals, 16 percent of reptiles and amphibians, and 17 percent of bird species originate from Indonesia (Guntur & Slamet, 2019). Biodiversity, a term denoting the variety of life forms on Earth, includes habitat variation, species diversity, and genetic differences within existing species (Siboro, 2019). The presence of these faunal species is paramount for maintaining ecosystem balance, habitat regeneration, and ensuring the survival of the food chain. Additionally, certain faunal species hold significant cultural value in Indonesian society (Arifani, 2016).

Despite its reputation for extremely high biodiversity, Indonesia is confronted with a high rate of biodiversity decline. The country ranks second in terms of the number of endangered species, with

583 species at risk, notably with mammals topping the count at 191 species, followed by birds at 160 (Setiawan, 2021). The most substantial decline in wildlife populations occurs in tropical areas, witnessing a decrease of up to 56 percent. This underscores Indonesia's pivotal role as the world's largest low archipelagic country in the global decline of fauna populations (Budianto et al., 2020). The alarming state of wildlife in Indonesia is primarily attributed to excessive natural exploitation, mainly through deforestation, which is the primary driver of fauna population decline in the country. Despite possessing vast forests, including some of the world's most extensive, Indonesia experiences significant and escalating deforestation yearly. Deforestation, defined as the loss of forest cover and its contents, results in damage to the structure and function of the forest due to human activities (Chakimi & Abidin, 2022). Research by Forest Watch Indonesia reveals an increasing trend in deforestation over the years. The average forest loss was 1.1 million hectares yearly in 2000-2009, escalating to 1.4 million hectares annually in 2009-2013. In the period 2013-2017, deforestation reached a staggering 5.7 million hectares. Apart from deforestation, Indonesia grapples with various other environmental issues, including wildlife hunting, leading to the rarity or endangerment of many species. While hunting practices were historically driven by consumption, contemporary hunting serves purposes such as obtaining body parts for crafts, medicines, and cosmetics (Aristides et al., 2016). Another pressing environmental concern is the declining number of species in Indonesia due to the trade in protected wildlife (Nuraeni et al., 2018). Wildlife trade, with its lucrative potential, is driven by the higher prices associated with rarer species. Threats to wildlife populations emerge from hunting and forest fires, illegal logging, and urban development, collectively posing an imminent threat to their existence. Despite its crucial role in global natural wealth, this data underscores Indonesia's vulnerability to wildlife extinction.

Introducing fauna to the public, particularly in Indonesia, is critical. Public awareness regarding the importance of fauna preservation remains low, as evidenced by habitat destruction and the excessive exploitation of native fauna habitats. Therefore, concerted efforts are needed to elevate public awareness about preserving fauna and their habitats, particularly among Generation Z, the nation's future generation (Arifani, 2016). Raising public awareness about the existence and preservation of fauna in Indonesia can be achieved through various means, including educational programs, socialization campaigns, and developing more creative and effective learning methods and media (Sanaky, 2013). In the evolving landscape of technological advancements, conventional learning methods are often perceived as dull, and the presented material is less easily comprehended (Hidayat & Sriyanto, 2015).

To address this issue, the author researched to create and test an Instagram filter using Augmented Reality (AR) technology, aiming to innovate in introducing fauna to Generation Z. Generation Z is the target demographic due to their status as individuals born in the late 20th and early 21st centuries, allowing them to leverage technological changes in various aspects of their lives. Additionally, AR technology is undergoing rapid development, with one of its applications in the educational field being an interactive learning tool. This facilitates student interaction and social communication (Gudoniene & Rutkauskiene, 2019). As a technology, AR combines two or three-dimensional virtual objects into a natural three-dimensional environment, projecting these virtual objects in real-time (Paramarta et al., 2022). In application, AR can display information, such as labels or virtual objects, visible only through the camera on a mobile phone or computer, providing a more interactive and enjoyable experience for users (Saefudin & Ekasari, 2017). AR refers to an environment formed by merging the natural and virtual worlds through computer technology, blurring the boundary between the two (Kirana et al., 2023).

AR facilitates user interaction with the natural environment through displayed objects, enabling them to gain new perspectives (Ismayani, 2020). Objects previously confined to the virtual world can be seamlessly integrated into the real world in AR systems (Mustika et al., 2015). AR systems' primary focus is producing an interactive and realistic experience to aid users in various activities, such as gaming and education (Sufiatmi et al., 2020). Three main characteristics must be present in technology to implement AR. Firstly, the technology must merge the natural and virtual worlds, enabling users to see virtual objects in the context of the reality around them. Secondly, AR technology must provide information interactively and in real-time, allowing users to interact with

virtual objects. Finally, AR technology must display virtual objects in three dimensions, enabling users to view the object from various perspectives (Mustaqim, 2016). With these three characteristics, AR technology can provide an interactive and realistic experience, aiding users in multiple activities such as gaming and education. AR technology requires an object affected by detection distance indicators and light intensity to trigger the display of virtual objects within it. A marker is a real object in the environment used as a reference to bring up an object in AR applications, thus producing a Virtual Reality experience. Using this marker, AR technology can help users visualize virtual objects more realistically and integrate them with the surrounding environment (Hidayatullah et al., 2022).

Social media, an internet-based communication technology, is often called online media. Evolving with changing human needs, social media has transformed into a platform for entertainment, exhibitions, information dissemination, and marketing (Putra & Astina, 2019). The widespread global use of the Internet has significantly influenced social interactions between individuals, communities, and societies (Zolkepli & Kamarulzaman, 2015). Instagram stands out as one of the popular social media applications, accessible to various groups and boasting a high frequency of use (Lim et al., 2021). As a digital platform, Instagram facilitates real-time communication, allowing users to share content such as text, photos, and videos. Notably, Instagram features are usable by all users, prevalent among millennials who share their daily stories through temporary posts (Kylena et al., 2023). Instagram introduced its latest innovation in August 2017, namely Instagram Stories. This feature allows users to take photos and videos with digital filters and share them with followers. Using this feature is quite simple, just by opening the Instagram Stories icon and selecting the desired filter (Setiawan & Audie, 2020). This Instagram filter with AR technology is expected to help increase user interaction and memory in fauna recognition and become a fun educational tool for the Indonesian community. The author created a fauna recognition filter in a quiz or guessing format. In this format, a question box will appear above the audience's head for 5 seconds to guess the answer. After 5 seconds, the answer will be displayed so the audience can learn about the types of fauna in Indonesia.

Spark AR Studio is software enabling users to create unique face filters and special effects applicable on Facebook and Instagram social media platforms. Introduced in 2017, Spark AR initially functioned as a camera effect in a closed beta version, accessible only to an internal team for development targeting brands, celebrities, public figures, and other significant individuals (Sufiatmi et al., 2020). Later, Spark AR expanded into an open beta version in 2019. Compatible with both Windows and Mac operating systems, Spark AR is employed to create AR for the camera filter feature on Facebook and Instagram, focusing on AR development with a similar function to Photoshop or Sketch (Chacon, 2019). The open beta phase of Spark AR saw an increase in User-Generated Content (UGC), allowing users to contribute to the development of AR applications applied to the camera (Dwityas, 2016). With the introduction of Spark AR in the open beta phase, filter development for Facebook and Instagram cameras became more open to users. The User-Generated Content (UGC) concept, about collecting information from many users, has gained prominence on social media platforms and websites. Social media UGC has become a valuable source of knowledge for conceptualizing processes related to natural environmental sustainability (Sultan et al., 2021). This concept has brought about changes in website functionality, transitioning from a "Read Only" model to a "Read and Write Interaction," enabling users to create, evaluate, and distribute internet content and adapt internet applications to their needs.

Upon comparing various studies, it becomes evident that the three journals' analysis and results sections share a common focus on AR. Some studies even employ the same Spark AR application, publishing their results on Instagram. For instance, a survey by Baharuddin & Kusuma (2021) successfully developed the AR Instagram filter BPAC (Basic Physical Activity Challenge), emphasizing Instagram as one of the most frequently used and active applications for various purposes. Another study by Sartika et al., (2021) designed an AR-based Instagram filter for promoting soy milk products. Lastly, Kausad et al., (2022) created an AR filter for mental health education during the pandemic, demonstrating that filters are well-received by the public and are enjoyable to use. From these three studies, it can be concluded that Instagram, with its AR-assisted filter features, holds advantages in terms of widespread acceptance and use by the community,

facilitating the introduction of various phenomena such as products, programs, or, in this case, fauna to the community, especially to the Generation Z age group, whose daily lives are intricately tied to the Instagram social media platform.

Based on the background above, the research problem in this study revolves around understanding how Instagram filters with AR technology can effectively innovate in introducing fauna to Generation Z in Indonesia. The research aims to design and develop an Instagram filter, testing its effectiveness in introducing fauna to the Indonesian audience. The author will undertake several research stages to achieve this goal, including creating an Instagram filter with AR technology using Adobe Illustrator and Spark AR software. The filter will then be uploaded to the Meta Spark Hub for viewing and use by the audience. Subsequently, the filter will be tested by an audience comprising individuals from various backgrounds in Indonesia. The test results will undergo analysis to ascertain the effectiveness of Instagram filters with AR technology in introducing fauna to the audience. Thus, the research strives to examine the effectiveness of Instagram filters with AR technology as an innovative means of introducing fauna to Generation Z in Indonesia, with the hope of contributing to the development of education regarding the conservation of Indonesian fauna.

METHOD

In this research, we examined a population of 2600 individuals, with a sample of 412 avid users of the social media platform Instagram, representing various backgrounds, using the Double Diamond method. The Double Diamond is a holistic design model that divides the design process into four creative stages: discovery, definition, development, and delivery, as shown in Figure 1 (Gumulya, 2017). This model was first introduced by the Design Council in 2005 (Indarti, 2020). The method is named Double Diamond because its pattern resembles two adjacent diamonds. The visualization of the double diamond is used to represent divergent-convergent thinking, which is the method's core (Hananto et al., 2020). This method allows designers to avoid unnecessary constraints and evaluate existing designs. The goal is to identify weaknesses and strengths in the design so that improvements can be made, making it more suitable for the intended purpose (Priyantono & Ardiansyah, 2020).

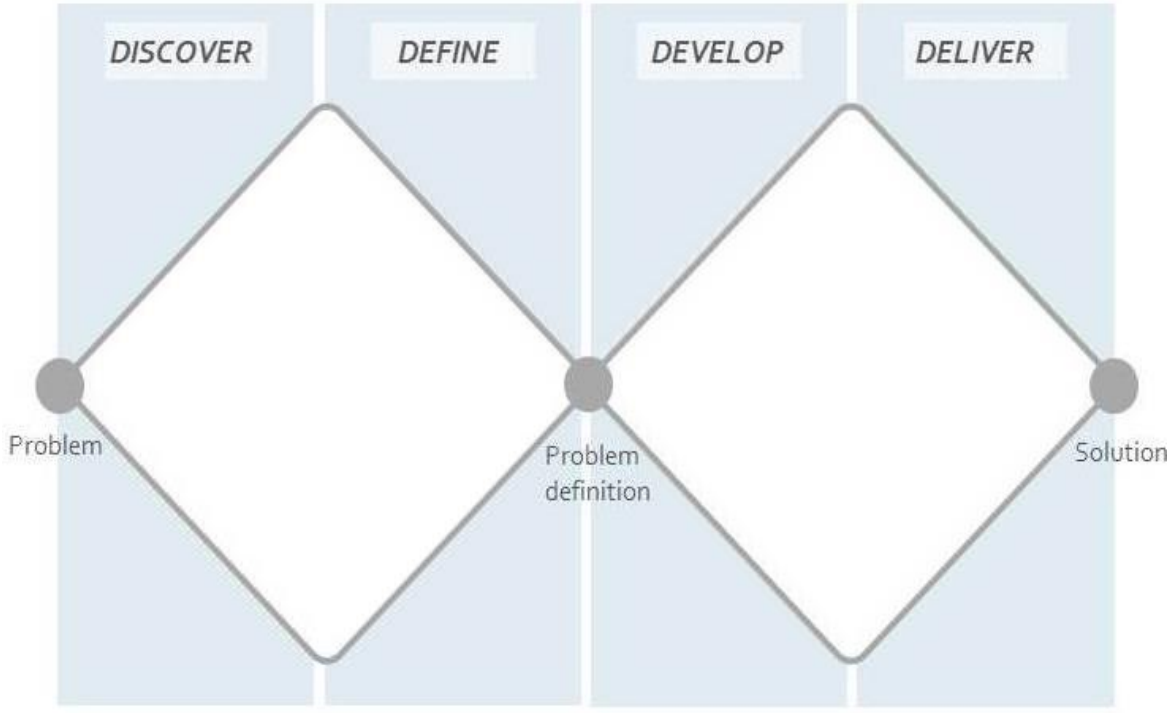

Figure 1. Double Diamond Method

This research's framework is based on the four major stages of the Double Diamond method. These stages include discovering, Defining, Developing, and Delivering in Figure 2, which generate outcomes from the provided input (Putra, 2020).

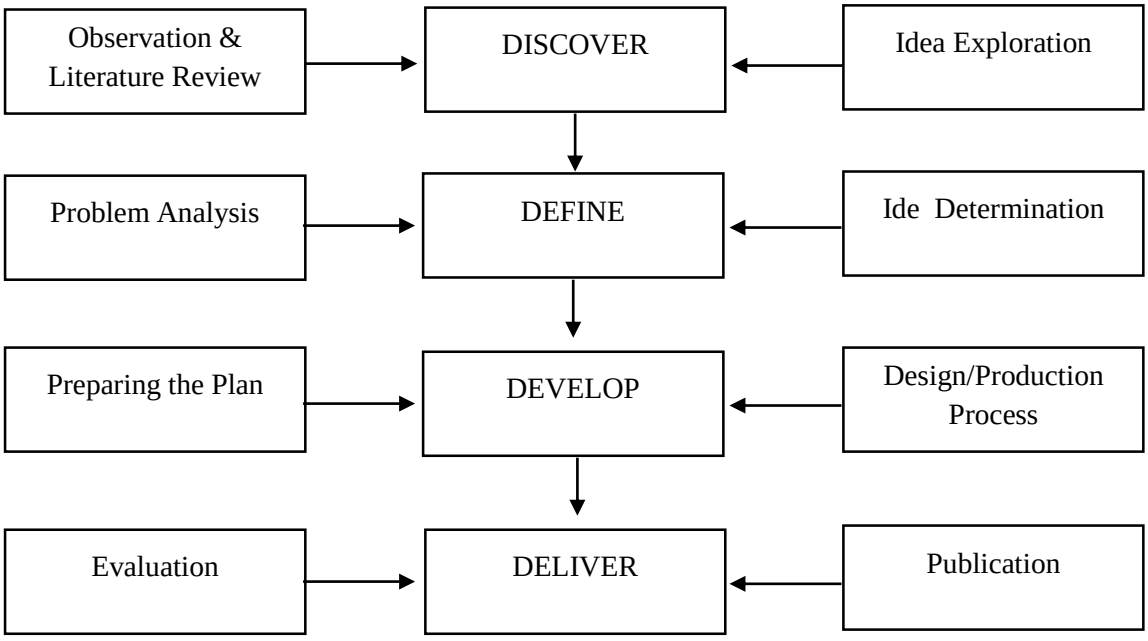

Figure 2. Framework of Thinking

RESULTS AND DISCUSSION

Results

The first stage, discovery, is conducted to understand better Instagram users' needs and interests regarding fauna introduction in Indonesia. The author performs observations and literature reviews related to the behavior and usage patterns of Instagram by the Indonesian population, AR technology, and existing Instagram filters. Additionally, the author gathers information about the fauna that would be introduced through this filter. This ensures that the created AR filter will provide accurate and helpful information regarding fauna in Indonesia. Here, the author compiles information about several animals with distinctive characteristics. Subsequently, idea generation is carried out through brainstorming to produce creative ideas related to the design and features of the AR filter.

The second stage defines and analyzes the problem to be addressed through this AR filter: the lack of knowledge regarding fauna in Indonesia among the younger generation. The author selects the most relevant idea that aligns with the problem to be addressed: introducing fauna in Indonesia through AR filters. The author designs an AR filter for guessing the names of fauna in Indonesia by providing the audience with questions about the characteristics of the animals. The audience is then asked to assume which animal possesses those characteristics.

The third stage, development, is carried out by creating the design for the AR filter, including its features and the technology to be used. The author designs an Instagram filter system with AR filter technology that can be used as an educational medium for fauna introduction as in Figure 3, Figure 4, and Figure 5. This AR filter is designed with several features in mind, such as image recognition of animals, guessing the names of animals, and providing brief information about the animals. The author also plans an intuitive and user-friendly interface for the Instagram filter to be used by audiences with various skill levels. Adobe Illustrator software creates graphic assets, such as frames, question boxes, and answer boxes, with attention to detail for each element to achieve an aesthetic and attractive appearance. Furthermore, in designing the Instagram filter mechanism, the author utilizes Spark AR software launched by Meta, allowing the filter to be published on Instagram, as in Figure 7.

Figure 3.The process of creating Question Box and Answer Box Assets

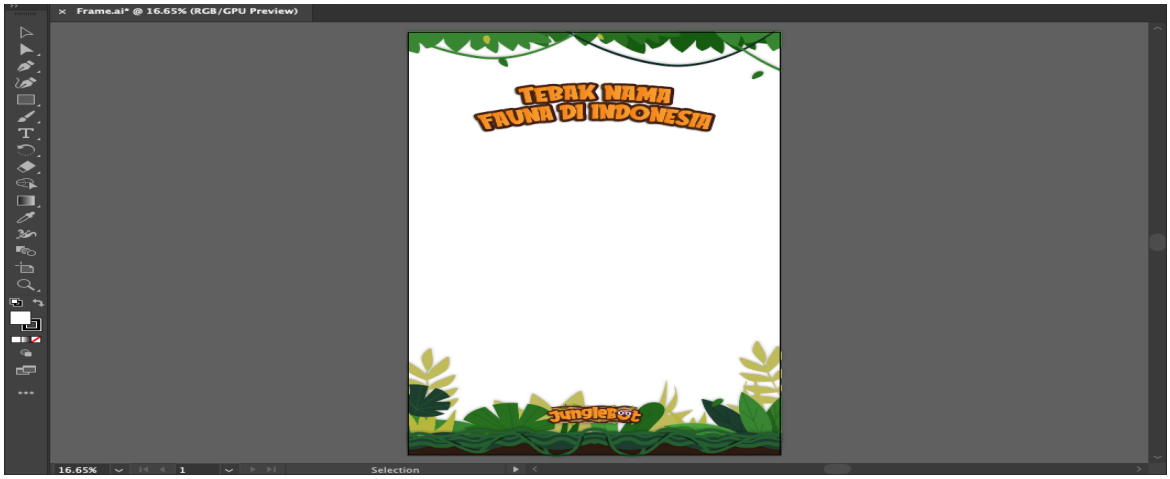

Figure 4. Process of Creating Frame Assets

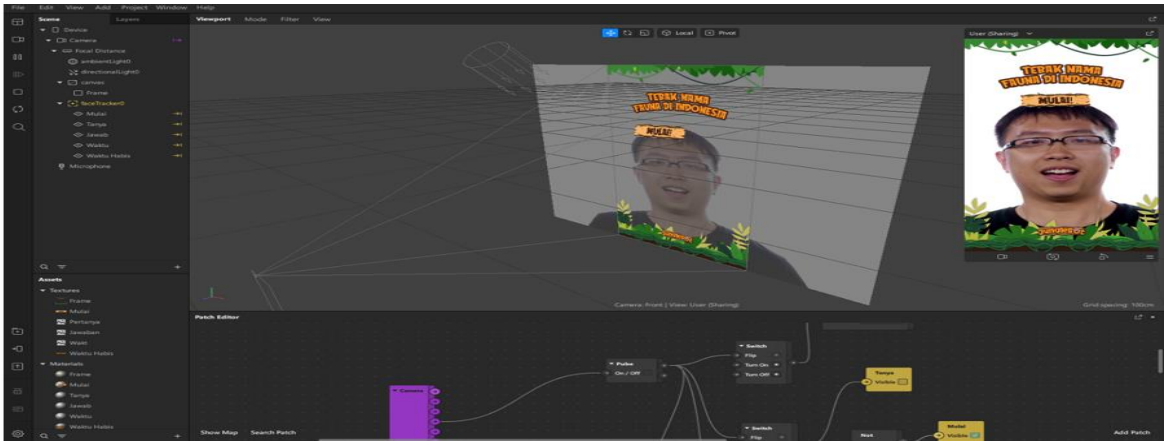

Figure 5. The Process of Creating Instagram Filters uses Spark AR

The fourth stage, deliver, is executed by publishing the AR filter to the Instagram platform through Meta Spark Hub so the audience can use it. The author has tested several audiences to evaluate the filter's effectiveness. The mechanism for using this Instagram filter involves presenting quizzes about the fauna that can be identified using AR technology when users press the "record store" button on the Instagram app, as in Figure 6 and Figure 7. The audience will be prompted to answer the given question within 5 seconds. After 5 seconds, the correct answer and information

about the fauna will appear, allowing the audience to evaluate their responses. The author also considers the audience's satisfaction with the Instagram filter using AR technology, as in Figure 8.

Figure 6. Fauna Nusantara AR Filter Display on Instagram

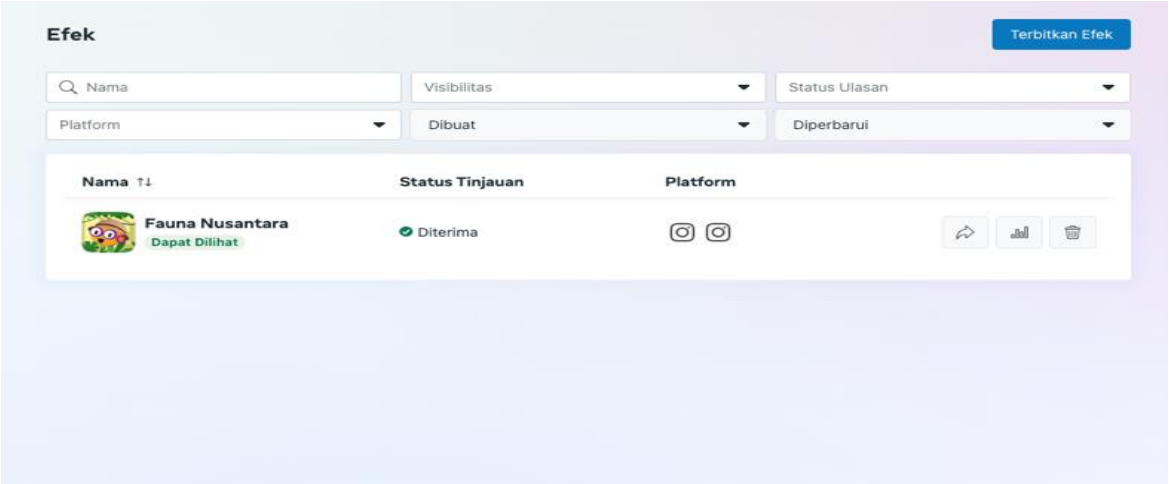

Figure 7. Publication Process via Meta Spark Hu

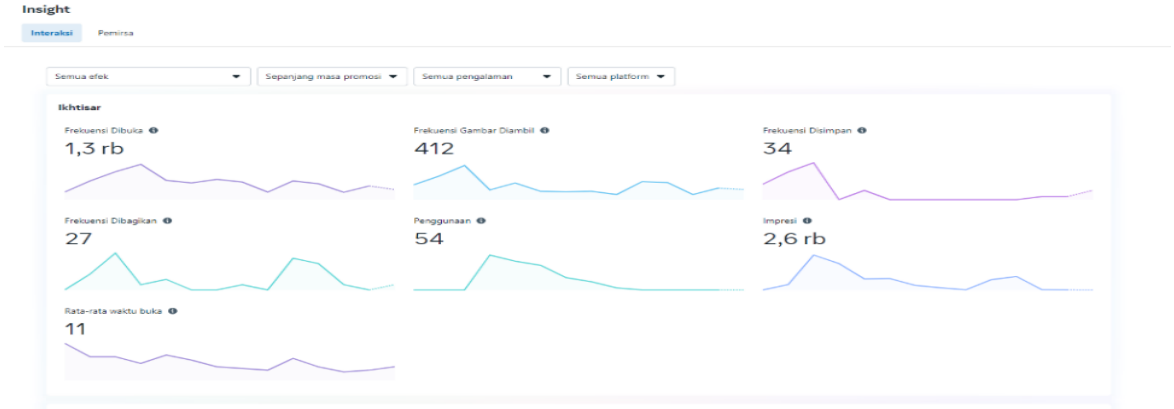

Figure 8. Insight Results from Fauna Nusantara's Instagram AR filter via Meta Spark Hub

The Instagram filter "Fauna Nusantara" utilizes AR technology as an innovation for introducing fauna to Generation Z in Indonesia. This filter takes the form of a guessing game about the names of fauna in Indonesia by presenting questions about the characteristics of the fauna and prompting users to guess the names of the fauna. The mechanism for using this filter is quite simple. The audience is invited to answer the given question within 5 seconds. After 5 seconds, the correct answer and information about the fauna will appear, allowing the audience to evaluate their responses. After completing the guessing game, users can save the filter used and share it to enhance public knowledge and awareness of fauna. In developing this filter, research and data collection on fauna in Indonesia were conducted, including names, characteristics, habitats, and unique features of each fauna type. This data was then processed and designed into engaging and informative user guessing games. The filter also includes attractive images of fauna to support the user's learning process.

Discussion

Based on the data from Meta Spark Hub, the Instagram filter "Fauna Nusantara" with AR technology has shown positive results in enhancing public knowledge and awareness of fauna in Indonesia. The filter was opened 1300 times, 412 times for picture taking, 34 times for saving, 27 times for sharing, and 2600 impressions during its average 16-second open period. These statistics show that the filter is widely used, drawing attention from the public and being valued by Instagram users. Additionally, the data analysis findings show how efficient this filter is at raising public awareness of Indonesia's fauna. The large number of image grabs implies that viewers are drawn to the wildlife on exhibit and are eager to learn more about it. The high frequency of saves and usage also suggests that the audience uses the filter frequently, which makes a consistent improvement in public knowledge and awareness possible.

However, this evaluation also suggests that efforts are still needed to enhance the filter's effectiveness as an educational tool. This could be accomplished by offering prizes or incentives to users who tell their friends about the filter. More research is also required to determine how well the audience understood the fauna shown and how the filter affected the general public's understanding and awareness of Indonesian wildlife. Overall, the results of this evaluation are crucial for enhancing the quality and effectiveness of the filter as an educational tool for introducing fauna to Generation Z in Indonesia. This evaluation can provide valuable input for the future improvement and development of the filter. By continually enhancing the quality and effectiveness of this filter, it is expected to positively impact increasing public knowledge and awareness of fauna in Indonesia.

CONCLUSION

Based on the results obtained from the Meta Spark Hub insights, it can be concluded that the Instagram filter with AR technology developed is quite popular and attracts the audience's attention. The high frequency of image captures indicates that the audience is interested in the displayed fauna and wants to learn more about these animals. Furthermore, the high frequency of saves and usage suggests that the audience finds the helpful filter and uses it frequently. However, attempts to raise the low sharing frequency are required to improve this filter's efficacy as a teaching tool. This can be accomplished by offering prizes or incentives to viewers who tell their friends about this filter. Overall, the study's findings suggest that using Instagram filters with augmented reality could be a novel way to introduce Indonesia's Generation Z to wildlife. The filter is quite effective in increasing knowledge and awareness of Indonesian fauna. However, efforts are still needed to improve the sharing frequency and audience interaction with this filter to enhance its effectiveness as an educational tool.

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The effect of self-directed learning (SDL) in higher education: Increasing student independence and achievement

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ABSTRACT

This study aimed to examine the effect of the self-directed learning (SDL) model on universities in increasing student independence and achievement. The samples used were 50 students, consisting of 25 control class students and 25 experimental class students. The results of this study show that the application of the SDL learning model can increase student independence. The independent t-test results showed a significant difference in student independence between the control and experimental groups ($t = 3.76$, $p = 0.001$), with a percentage difference in independence scores between the two groups of 25%. The experimental group that received learning using the SDL model experienced an increase in independence scores by 21.4%. The results of the data normality test using Shapiro-Wilk showed that the data used in this study were normally distributed with a significance value of 0.05 ($p > 0.05$). SDL has increased student independence, with the experimental group experiencing an increase in independence scores by 18 points, while the control group only increased by 3 points. The improvement in academic achievement was also noticeable, with the experimental group improving 12 points compared to the control group.

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INTRODUCTION

In this study, education is a crucial factor in human life that is considered necessary by every Indonesian citizen and is expected to be given to them (Ngah et al., 2022; Suryana., 2017). Self-quality is expected to be improved through education (Manizar, 2017). Various kinds of learning models were developed to enhance the quality of education (Asyafah, 2019). One of the learning models currently being developed is self-directed learning (SDL) (Handayani, 2017), where students are expected to become more independent in their learning process. Significant changes caused by the COVID-19 pandemic have affected various fields, including education and student learning styles. Face-to-face teaching is shifting to online or distance learning. In this context, lecturers and students face challenges in adapting to the new learning environment, and as a result, self-initiated learning (SDL) is increasingly popular in universities (Chudari, 2017).

Online learning had two significant differences before and during the pandemic (Yensy, 2020). First are the broader learning options. Before the pandemic, some institutions provided online courses as an additional option, while most learning was still done face-to-face. However, online learning

became the only option available to many students during the pandemic. This creates challenges because not all students are familiar with or suitable for online learning (Argaheni, 2020).

Second, there are different social interaction opportunities. During face-to-face learning before the pandemic, students had the chance to interact with fellow students outside the classroom, such as through extracurricular activities, study group meetings, or informal discussions. However, during the pandemic, social interaction outside the school has become limited or non-existent. As a result, social interaction during online classes becomes a more critical factor in determining student engagement in learning. This becomes more significant, especially for new students who still need an established informal social network (Sutisna & Widodo, 2021).

Online learning during the pandemic is an unavoidable emergency response (Arifin, 2021). While it has advantages regarding time flexibility and accessibility of learning materials, online learning can also be more difficult for students to stay motivated to learn. Therefore, the SDL learning model Avani (2017) is essential in helping students become more independent in learning and overcoming challenges related to online learning during the pandemic.

Learning is a lifelong process (Ardiansyah & Nana, 2020). To continue building a knowledge base, learners of all ages must extract information from their environment with or without explicit direction (Nugroho et al., 2020). During life, most learning takes place outside the classroom. Self-triggered and self-directed learning allows one to build unique knowledge structures (Hendri, 2020) and not be limited by learning experiences directed by others, such as in classroom settings or formal educational institutions.

Previous research has shown that independent learning (SDL) has a positive relationship with five related constructs essential for effective workplace learning. Meta-analysis research conducted over 30 years in five countries and various academic disciplines shows that SDL is positively associated with internal control, motivation, performance, self-efficacy, and support. In addition, an actual SDL project loss two sales management courses at the undergraduate level, and MBA and MBA levels are used to provide supporting evidence and practical advice for educators who want to use SDL to improve students' lifelong learning skills-directed learning (SDL) is an essential concept in problem-based learning and student-centered learning. Although often considered "self-learning," SDL is complex and should be viewed as a learning process involving students' responsibility and inquiry approach. This SDL concept also emphasizes the teacher's role in helping students become independent learners.

Researchers have conducted studies to explore the relationship between self-directed learning (SDL) and academic achievement, comparing self-directed learning between online and conventional university learning. The study used a specially developed survey to collect data from students attending online and traditional distance learning. The study population consisted of all students from the Faculty of Education at one university offering online degrees and one university offering conventional degrees.

The number of students enrolled in online universities was 1139, while in conventional universities, there were 1809 students in spring 2019. Of the 2948 students, as many as 590 (20% of the population) were selected as research samples using simple random sampling techniques. The collected data were analyzed using t-tests and Pearson r correlations to look for relationships between the variables studied (Dasriani et al., 2022).

The results showed a significant difference between students' independent learning at online and conventional universities. In addition, the correlation between independent learning and high academic performance differs between students who learn through online learning and students at traditional universities. This study recommends using an independent learning approach (SDL) to develop students' ability to organize themselves in the learning process. Future research may broaden the sample and examine the influence of other variables that influence the relationship between independent learning and academic achievement, such as learning motivation and learning environment.

Relevant past research, in particular, has shed light on how adults learn and develop independent learning skills. In his study, Tough found that adults who succeed in independent learning generally have specific characteristics. One of them is a strong desire to continue learning and developing their knowledge and skills (Djumena, 2016). In addition, adults who can do

independent learning also can overcome obstacles that arise in the learning process (Wahyuhastufi, 2016). They have high resilience and motivation to face challenges and difficulties that may occur during learning. This ability allows them to remain persistent and committed to achieving their learning goals.

In addition, adults who are successful in independent learning also have skills in building and maintaining mutually supportive social relationships in the context of education. They can establish positive relationships with fellow learners, facilitators, or mentors who can help them learn. This social interaction provides valuable support, feedback, and perspective to enhance learning (Oktavia & Dewi, 2021). This study provides essential information in our understanding of how student readiness for independent learning can be affected by personal and social factors. These findings can aid in developing courses and learning environments that support independent learning skills (SDL). Thus, educators can design learning strategies that facilitate SDL skill development and support effective learning outcomes (Yustiani, 2016).

In addition, the SDL project has also shown that self-directed learning can assist students in developing self-learning skills required in the workplace (Suknaisith, 2014). Through independent learning, students can hone their skills in self-organization, managing time, taking initiative, and overcoming challenges that arise in work. Therefore, SDL is vital in supporting lifelong learning and assisting students in developing independent learning skills essential to achieving adequate learning outcomes in the workplace. Several studies have been conducted on independent learning (SDL) and its relationship with academic achievement, but little research still discusses the SDL learning model's effectiveness in increasing students' independence. This can help in developing aspects of student independence after the pandemic ends. Therefore, future research can focus on identifying personal and social factors that contribute to students' readiness to develop independent learning skills and how these factors can be improved to support more effective learning to evaluate the effectiveness of the SDL learning model in increasing student independence in learning.

This research is expected to contribute to understanding independent learning (SDL) in the context of higher education in Magelang. It reinforces previous findings by detailing SDL's positive association with five key constructs: internal control, motivation, performance, self-efficacy, and support.

METHOD

The type of research is an experiment involving university students in Magelang and using an experimental design with a control group and an experimental group. The sample used was 50 students, consisting of 25 control class students and 25 practical class students. Sample selection using purposive sampling techniques with the criteria of active students enrolled in the same course in the same semester. The data collection instrument used was a student independence scale questionnaire, which was tested for validity with content and construct validity techniques and reliability with Cronbach alpha techniques, and a reliability coefficient of 0.87 was obtained, indicating a good confidence level. The population of this study included university students in Magelang. The population selection is based on the context of the academic environment relevant to the research focus, assuming that students from this region can provide representative insights related to student independence and achievement in learning (Siswanto & Yulaikah, 2023).

RESULTS AND DISCUSSION

Results

The results showed that there was a significant difference in student independence between the control group and the experimental group. The results of the independent t-test showed that the t-value was 3.76 and the p-value was 0.001 ($p < 0.05$) (Liu & Wang, 2021), which indicates that the SDL learning model has a significant effect on increasing student independence. In addition, the results of the data normality test using Shapiro-Wilk showed that the data used in this study were normally distributed with a significance value of 0.05 ($p > 0.05$)(González-Estrada & Cosmes, 2019).

Table 1. T-test results

No.	Group	Sum	Average	Standard Deviation
1	Control	25	71.52	5.45
2	Experiment	25	79.36	4.88
3	Total	50	75.44	7.25

Table 1 of the independent t-test showed a significant difference in student independence between the control and experimental groups ($t = 3.76$, $p = 0.001$). In addition, the results of the data normality test using Shapiro-Wilk showed that the data used in this study were normally distributed with a significance value of 0.05 ($p > 0.05$) (Shapiro & Wilk, 1965). These results show that the Self-Directed Learning (SDL) model significantly increases higher education student independence.

In the data analysis, the average score of student independence in the experimental group (79.36) was higher than in the control group (71.52). This shows that the application of the Self-Directed Learning (SDL) learning model has a positive effect on increasing student independence in higher education (Robinson & Persky, 2020). In addition, the standard deviation value in the experimental group (4.88) was also lower than the standard deviation value in the control group (5.45), which shows that using the SDL learning model can also reduce the variation in student independence scores. From the independent t-test results, a p-value of 0.001 ($p < 0.05$) shows a significant difference regarding student independence between the control and experimental groups. In other words, the SDL learning model can significantly increase student independence in higher education.

The results of the data normality test using Shapiro-Wilk showed that the data used in this study were normally distributed with a significance value of 0.05 ($p > 0.05$). This suggests that the data used in this study is valid and used to analyze the difference in student independence between the control and experimental groups. From the results of the data analysis, it can be concluded that the self-directed learning (SDL) learning model has a significant favorable influence on increasing student independence in higher education.

The validity of the questionnaire in this study was tested through expert judgment (Udedi et al., 2019), and the trial was limited to 10 students. The assessment of the specialist judgment shows that the questionnaire used in this study meets the validity criteria, which is relevant and representative of the construct studied. In addition, limited trials also showed promising results with Cronbach's alpha reliability coefficient value of 0.82 (Taber, 2018). This indicates that the questionnaire used in this study has a relatively high level of reliability. The following questionnaires were used in this study to measure the level of independence of 10 college students in Table 2:

Table 2. Student Independence Questionnaire

No.	Inquiries
1	I can Create a Self-Study Plan
2	I can Set Learning Goals Independently
3	I can Search and use Learning Resources Independently
4	I can Organize Study Time Independently
5	I can motivate myself to Learn Independently.
6	I can Reflect on The Results of Learning Independently
7	I can Evaluate my Learning Progress Independently
8	I can Make Decisions in Choosing Learning Resources Independently
9	I feel confident in Learning Independently
10	I feel Comfortable Studying Independently

Respondents were asked to give answers on a Likert scale of 1-5, with one indicating "strongly disagree" and five indicating "strongly agree." After that, the independence score is calculated by averaging all the answers to get the student's score.

The assessment of the expert judgment shows that the questionnaire used in this study meets the criteria of validity, which is relevant and representative of the construct studied. In addition, limited trials also showed promising results with Cronbach's alpha reliability coefficient value of 0.82, as in Table 3.

Table 3. Results of the assessment of the validity and reliability of the questionnaire

No.	Criterion	Valuation
1	Validity	Valid Relevant Representative with the Construct Under Study
2	Reliability	Tall Cronbach's Alpha = 0.82

Table 3 above shows the results of assessing the validity and reliability of the questionnaire in this study. The assessment of the expert judgment shows that the questionnaire used in this study meets the criteria of validity, which is relevant and representative of the construct studied. In addition, the value of Cronbach's alpha reliability coefficient of 0.82 indicates that the questionnaire used has a relatively high level of reliability.

Table 4. Increased Independence and Student Achievement

No.	Group	Score of Self-Reliance	Independence Final Score	Increased Independence	Early Achievements	Final Achievements
1	Control	65	85	3	75	78
2	Experiment	70	88	18	70	82

The data in Table 4 shows that the experimental group, which received learning using the SDL model, experienced a significant increase in independence scores by 18 points. In comparison, the control group only increased by 3 points. This indicates that the SDL model can contribute more to the development of student independence. In addition, changes in student achievement can also be seen. The experimental group showed an increase in achievement score by 12 points, while the control group only increased by 3 points. This indicates that the SDL model's application affects independence and can also improve student academic achievement.

Discussion

The steps of self-directed learning (SDL) learning can involve a variety of strategies and actions. The following are some steps you can take to implement self-directed learning.

Table 5. SDL Learning Steps

No.	SDL Learning Steps
1	Defining Learning Objectives
2	Identify Learning Resources
3	Set Up a Learning Plan
4	Learning Material Independently
5	Practice and Discussion
6	Evaluation and Reflection
7	Adapting the Plan

Table 5 above serves as a guide to track and monitor progress in carrying out SDL learning steps. In addition, you can also add additional columns to record notes or self-assessments related to each step that has been done.

1. Defining Learning Objectives: Determine what you want to achieve through SDL learning. Set short- and long-term goals that are specific, measurable, achievable, relevant, and time-limiting.
2. Learning Resource Identification: Search for and identify learning resources relevant to the topic or subject you want to study. This could include books, articles, videos, online courses, discussion forums, or experts in the field.
3. Set up a Learning Plan: Create a structured and detailed learning plan. Determine what topics will be studied, the order of learning, and the schedule allocated for studying. Set realistic learning targets and consider the availability of time and resources.

4. Learning the Material Independently: Start studying the material independently according to the plan that has been made. Read books, review online materials, take courses, and use other relevant resources. During the learning process, stay active and reflective of what you learn. Take notes, do not hesitate to look for additional explanations, and find the best way to understand the material.
5. Practice and Discussion: Practice what you have learned after learning the primary material. Do exercises, small projects, or relevant tasks to apply your newly acquired knowledge and skills. In addition, look for opportunities to discuss with others who have similar interests or are experts in the field. Discussion and collaboration can help deepen understanding and broaden perspectives.
6. Evaluation and Reflection: Conduct a self-evaluation of learning progress. Review the goals set and see how far they have come. Identify strengths and weaknesses in this learning. Reflect on the learning process, and consider what has worked and what may need improvement in the future.
7. Adapting the Plan: Based on the results of evaluation and reflection, make adjustments to the lesson plan. Set new goals if needed, rearrange priorities, and update study schedules. These changes can help optimize time and effort in achieving learning goals.

Based on the study's results, the Self-Directed Learning (SDL) learning model can increase student independence in higher education. This is evident from the independent t-test results, which show a significant difference between the control and experimental groups in increasing student independence in Figure 1. The percentage difference in independence scores between the two groups was 25%, with the experimental group that received learning using the SDL model experiencing an increase in independence scores by 21.4%.

Figure 1. SDL Student Activities in the Library Room

Figure 1 above illustrates students actively seeking relevant reference sources for their problems to learn effectively. In this context, the SDL model allows students to take charge of the learning process and define learning objectives and methods that suit their preferences. In addition, the SDL model also encourages students to actively seek information and solve problems independently, thereby increasing their independence in learning. This is in line with what was conveyed by (Knowles, 1975), who stated that Self-Directed Learning (SDL) is a skill in which a person can determine his own learning goals, plan strategies, solve problems, manage self-management, and evaluate thoughts and performance that have been done. These skills can enhance an individual's knowledge, expertise, and achievement (Knowles, 1975). This definition of Knowles

is widely accepted, but the SDL process remains to be clarified; SDL occurs in communities of practice that cannot be viewed in isolation.

The questionnaire used in this study was also declared valid and reliable, with the expert assessment showing that the questionnaire was relevant and representative of the construct studied, and the value of the Cronbach alpha reliability coefficient was relatively high. This study has several limitations, including the relatively small number of samples and the absence of tighter control over outside factors that can affect student independence. Therefore, subsequent studies can take a larger sample and pay more attention to external factors affecting the results. Overall, this study's results contribute to developing learning models that can increase student independence, which can positively impact achieving educational goals in higher education.

The results showed that applying the self-directed learning (SDL) model significantly increased student independence and achievement in the university environment. The experimental group, which followed learning with the SDL model, showed an increase in autonomy of 18 points, while the control group only experienced a rise of 3 points. This indicates that the SDL model effectively develops students' ability to organize and direct learning independently. In addition, the academic performance of students in the experimental group also improved significantly, achieving an increase of 12 points compared to the control group. These results strongly support integrating SDL learning models into the college curriculum to increase student independence and achievement.

CONCLUSION

Based on the results and discussion of this study, it can be concluded that using the Self-Directed Learning (SDL) learning model can increase student independence in higher education. This is evident from the independent t-test results, which showed a significant difference between the control and experimental groups in increasing student independence. The percentage difference in independence scores between the two groups was 25%, with the experimental group that received learning using the SDL model experiencing an increase in independence scores by 21.4%. In addition, this study also shows that the questionnaire used in this study is valid and reliable, with the assessment results from expert judgment establishing that the questionnaire is relevant and representative of the construct studied, and the value of Cronbach's alpha reliability coefficient is relatively high. The contribution of this research lies not only in increasing student independence but also in the validity of research instruments. Thus, this study provides a solid basis for recommending using the SDL model in higher education institutions as an effective strategy for developing student independence.

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Development of puzzle game learning media in social sciences subjects to improve student learning outcomes

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ABSTRACT

This research is aimed at (1) developing puzzle game learning media with material from the Asian Continent and Other Continents, (2) testing the feasibility of puzzle game learning media, and (3) testing the effectiveness of puzzle game learning media in improving student learning outcomes. The research uses the research and development (R&D) method with the ADDIE design. The research instrument is a questionnaire sheet and a multiple-choice question instrument. Data analysis was obtained from the pretest and posttest results, which were analyzed using the normality test, homogeneity test, and paired sample t-test. The results of this research and development are (1) the media developed is a puzzle game learning media, (2) the validity test shows that the puzzle game learning media has a "very suitable" category for further use in the social studies learning process, (3) effectiveness analysis, it can be concluded that the use of puzzle game learning media is efficacious in improving student learning outcomes in social studies subjects in one of the state schools in District X. Recommendations for further research and development include utilizing innovative AR (Augmented Reality) technology features, further developing elements of the quiz feature by adding several puzzle patterns at higher levels or more difficult levels.

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INTRODUCTION

Information and communication technology use marks the development of the 21st century. Information and communication technology, in its development, provides so much convenience quickly or in real-time (Baroya, 2018). Technology is used in education by creating innovative learning media that attracts students' interest. Updates to strategies and types of learning media must be carried out in learning activities, supported by technology that can create exciting and interactive learning conditions (Latifah et al., 2020). Subjects considered tedious and challenging to utilize various innovative, technology-based learning media include social studies (Ciputra et al., 2020). Social sciences is one of the scientific disciplines taught to elementary and middle school students. Learning about social studies covers various humanities and social sciences fields, as well as fundamental human behavior and analysis of historical events using generalizations about social phenomena (Ayssyah, 2019; Naisau et al., 2021). Students need an attractive, fun, interactive, inspiring, challenging, and motivating learning method (Fatmawati & Harmanto, 2019). With this, it

is necessary to provide variations in the learning process so that students can be interested in participating in learning.

Currently, there are still many teachers who use the lecture method in delivering material to students. The learning process of this lecture method could be more optimal because only a few students can memorize the material presented (Indriyanti et al., 2020). Based on the results of observations and interviews on Monday, April 26, 2021, at one of the junior high schools in Regency, It is known that students experience boredom because they do not have proper readiness in responding to learning material, the lack of level of student involvement in learning is also a problem for students in participating in learning. Apart from that, social studies subjects are known as rote lessons, and the material coverage needs to be narrower, making students bored with learning, coupled with the delivery of material by teachers, which seems monotonous and uninteresting. Teachers often use student books, worksheets, and PowerPoint during the learning process in class. Teacher-centered teaching methods that dominate learning can also cause students to become bored more quickly (Hardiyanti et al., 2020). In addition, because social studies is a subject with much information for everyday life, students are expected to be actively involved in their studies (Maslukhah & Abdullah, 2013).

The material on the Asian Continent and Other Continents has a broad scope of material, and there is much memorization, making students feel bored more quickly so that students pay less attention to the teacher's explanation of the material, resulting in less than optimal learning outcomes. Based on the results of the pretest, it was found that student learning outcomes were still below the specified minimum completeness criteria value. Snakes and Ladders learning media showed student learning outcomes and increased minimum completeness criteria scores by 45% (Syawaluddin et al., 2020). Students found it easier to gain understanding and motivate students to learn. It is necessary to develop creative and innovative learning media to support the learning process that refers to technological advances. Technological developments can make it easier to deliver teaching materials to students (Ciputra et al., 2020). Innovative learning media is beneficial in the learning process in the classroom; students are increasingly helped in understanding the material being taught, arouses students' learning motivation, triggers students' critical thinking power, and can create a conducive classroom atmosphere (Ciputra et al., 2020; Wulan et al., 2019). Game-based learning media is relatively underdeveloped for teaching and learning activities, even though it can encourage students to participate actively in learning (Hafidah et al., 2016; Husna et al., 2017).

Alternatives to using media in social studies learning are aimed at overcoming the shortcomings of learning media, namely puzzle media. The use of social studies media in one of the state junior high schools in District X needs to meet the needs of social studies teachers in developing game media. This is due to the need for more use of technology in learning activities and supporting infrastructure in schools. Social studies teachers tend to be limited in using the media provided by the school (Tunjung & Purnomo, 2020). However, examining puzzle media can train patience, hone thinking power, help students practice accuracy, and make memorizing more enjoyable (Khomsoh, 2013). Puzzle games can also increase students' desire to learn and make them more involved in learning in class because they directly participate in learning activities (Husna et al., 2017; Permata et al., 2017). Therefore, the development of social studies learning media based on puzzle game media needs to be developed to increase student's interest in social studies learning and the development of renewable technology. The development of this application-based puzzle game media provides much practicality for students and teachers because the puzzle media can be accessed in online and offline learning.

Researchers develop learning media that leads to sophisticated application-based technology with material on the Location and Area of the Asian Continent and Other Continents. This material is used because, in the material on the Location and Area of Asian Continent and Other Continents, students need accuracy and a good understanding of geography in analyzing and describing the Location and Area of the Asian Continent and Other Continents (Wahyuni, 2020). Puzzle games involve students directly in teaching and learning activities; therefore, the material can be conveyed well. Puzzle games in the form of pieces of images make it easier for teachers to get material and help students be more enthusiastic when participating in teaching and learning activities (Syafitri et

al., 2019). The media development is application-based and has various features, such as short videos, to support the material. Remember the learning material that is packaged attractively. There are also different practice questions in the puzzle game with added images of puzzle pieces that have been scrambled. Students must first arrange the pictures of the puzzle pieces provided. The random puzzle pieces set are the answers to existing questions.

Based on research conducted by Khomsoh & Gregorius (2013), the use of puzzle media in social studies learning increases teacher and student activity. Student learning outcomes also experienced an increase in the average score on formative tests. Students also show interest in the teaching provided. The weakness in this research is that the puzzle media was applied to fifth-grade elementary school students, so a similar application is needed at the junior high school level. Students' motivation to learn increased, the learning environment became more interesting and exciting, and it encouraged students to take an active role in teaching and learning activities thanks to the development of interactive whiteboard-based puzzle game media. The weakness of developing an interactive whiteboard-based puzzle game is that it can only be accessed using the interactive whiteboard in schools and cannot be accessed via smartphone. Meanwhile, other research by Ciputra et al. (2020) states that the puzzle map media, where the development utilizes Adobe Flash with the contextual teaching and learning method, is effectively applied in teaching and learning activities to improve student learning outcomes. However, this development only used the puzzle map media for fourth-grade elementary school students. This makes it necessary to develop similar media for junior high school students.

This research is vital because puzzle games are an effective teaching tool because they help students understand and discover lesson topics. Puzzle games also help students think critically and creatively when solving problems and help them fully engage in educational activities (Marfuah et al., 2014). Puzzle game learning media can also help change the learning method from previously using the teacher-centered method to student-centered. It is also a means of using innovative, technology-based learning media rather than previously using learning media such as textbooks or other conventional learning media. Based on this background, the objectives to be achieved are: (1) developing puzzle game learning media with material from the Asian continent and other continents, (2) testing the feasibility of puzzle game learning media in improving student learning outcomes, and (3) testing the effectiveness of learning media puzzle games in improving student learning outcomes. Development research contributes to increased interest and motivation in learning and helps improve learning outcomes.

METHOD

This research uses an R&D (Research and Development) approach with an ADDIE design (Branch, 2009). The researcher chose the ADDIE design because this research design is easy to understand, and the research activity procedures are structured systematically like Figure 1, which can help in solving learning problems related to learning media that are tailored to the needs and characteristics of students (Masturah et al., 2018; Ratnawati et al., 2021).

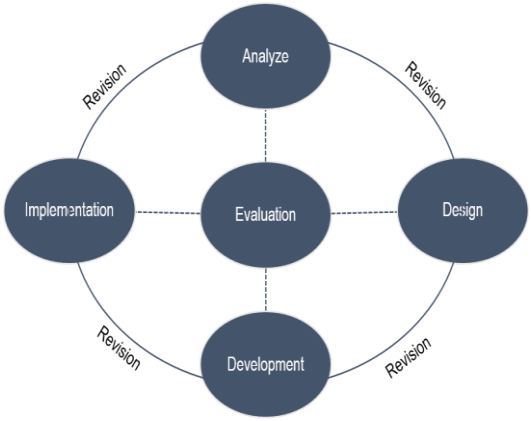

Figure 1. Research and Development Procedures

Qualitative and quantitative data were obtained directly from research subjects. The subjects of this research and development are class IX students at one of the State Middle Schools in District X. The research instrument used to collect research data was a questionnaire validation, student response questionnaires, and multiple choice test questions. The instruments used in this research and development are an open questionnaire in the form of qualitative data regarding criticism and suggestions given by validators and students and a closed questionnaire in the form of quantitative data regarding the assessment of products that have been developed (Febrianti et al., 2021). Research data analysis uses validity analysis and statistical analysis. Validity analysis uses the Formula 1:

$$P = \frac{\sum x}{\sum xi} \times 100\% \quad (1)$$

P is validity Percentage, $\sum x$ is the assessment score in one item, $\sum xi$ is the ideal assessment score in one item, and 100% is constant. After analyzing the data, further explanation is carried out, and conclusions are obtained by assessing Table 1 (Akbar, 2017).

Table 1. Product Validity Level Assessment Criteria

No.	Percentage	Criteria	Category
1	81 - 100%	Very Worth it	No Revision
2	61 - 80%	Worthy	Partial Revision
3	41 – 40%	Decent Enough	Revision (Retest)
4	21 – 40%	Not Worth it	Total revision (Retest)

Statistical analysis in testing normality, homogeneity, and paired sample t-test. Statistical analysis was done using pretest and posttest scores in the experimental and control classes. Before the paired sample t-test, normality, and homogeneity tests are carried out. The pretest and posttest results were analyzed using the paired sample t-test for hypothesis testing. The results of the paired sample t-test were then compared with a significance value of 0.05 (5%) to determine whether the puzzle game learning media was influential in use.

RESULTS AND DISCUSSION

Results

Analysis

The previous analysis was used as a guide and material for consideration when preparing puzzle game learning media. The analysis carried out includes complexity analysis and user needs analysis. Complexity analysis is used to determine and group the problems that schools face related to materials and types of learning media. Complexity analysis includes analysis of core and essential competencies and analysis of material concepts. Interviews with social studies teachers showed that textbooks or worksheets were used most often in delivering material using the lecture method (teacher-centered learning). The social studies teacher also said that the choice of media used in learning influences students' interest and motivation to learn. The interview results also prove that there is material that is difficult for students to conceptualize, namely in the chapter on interaction between Asian countries and other countries with the sub-chapter location and area of the Asian continent and different continents. Apart from that, students quickly get bored if the learning process is carried out only with the help of PowerPoints or textbooks. To increase enthusiasm for learning, students' motivation to learn and reduce boredom, and innovative learning media that can support the learning process are needed.

User needs analysis is carried out to determine the learning media students need to improve the quality of learning. The user-required analysis questionnaire was distributed online using Google Forms. Distribution using this Google form was chosen because it can speed up the distribution of questionnaires and has a broad reach. Questionnaires were distributed to students in class IX at one of the State Middle Schools in District X. Based on Figure 2 of the questionnaire results, as a follow-up to the analysis of student needs, it can be interpreted that if the teacher has utilized learning media, it is only in the form of student textbooks or worksheets. This shows the need to use other learning

media that are more innovative, increase learning motivation, increase students' interest in learning, and can improve learning outcomes when participating in class learning. Sutaryono & Santosa (2019) in his research, he explained that critical thinking skills and student learning outcomes had increased, driven by the use of creative and innovative media. Puzzle game learning media could be developed by adjusting the material students need. Previous research that supports this was conducted by Sutaryono & Santosa (2019) who developed a magic puzzle media based on visual auditory kinesthetic, based on problems found in class and then aligning it with the needs of teachers and students.

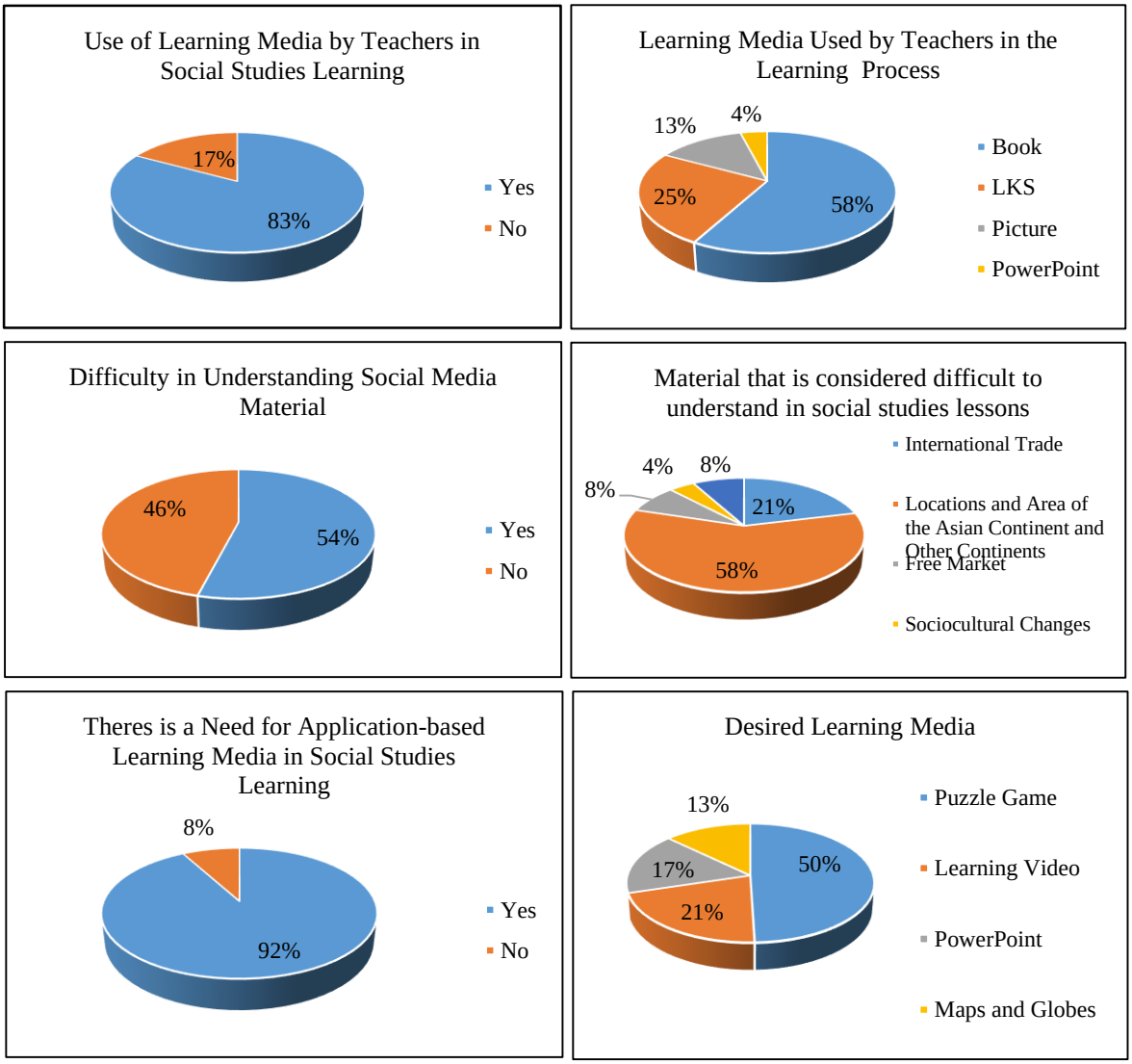

Figure 2. Results Analysis

Design

Puzzle game product design is designed according to students' usage needs at the analysis stage. Product design begins with media selection, which is done by selecting appropriate learning media to further develop into a learning media product that supports the learning process. Then, a storyboard is prepared, which functions as an initial description and design of the puzzle game learning media. Preparing storyboards also plays a role in designing the start page to the quiz page. I prepare material items by identifying core and essential competencies, determining the type of learning material used, and selecting learning resources for references. This learning media product is made as an application and stored in an extension file (exe) in landscape format.

Development

This development stage consists of product creation and feasibility testing of puzzle game learning media products developing puzzle game learning media products using Adobe Animate software. Developing puzzle game learning media products begins with learning objectives, preparing material according to the syllabus, developing puzzle game learning media according to the storyboard, and evaluating (including practice questions). The puzzle game learning media has several display menus, such as the initial display in Figure 3, the material page menu in Figures 4 and 5, and the quiz page in Figure 6. This development stage results in a puzzle game learning media product structured according to competencies and a questionnaire sheet to measure the validity of the media and user responses.

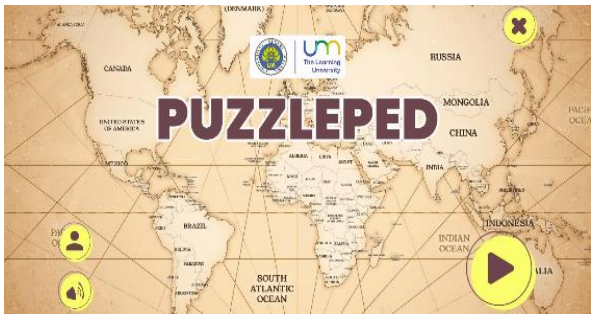

Figure 3. Initial View

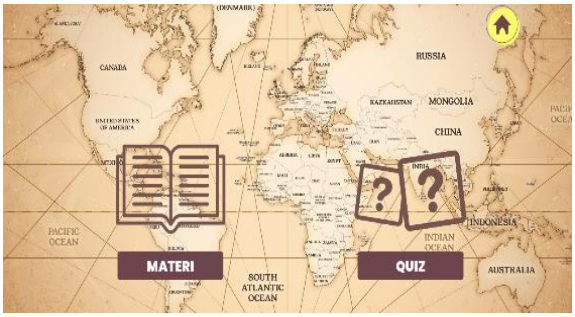

Figure 4. Initial Menu Display

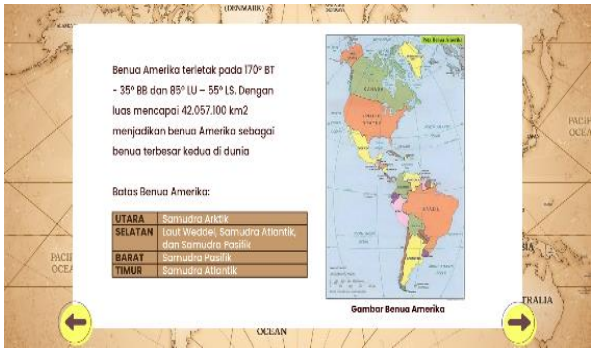

Figure 5. Material Menu Display

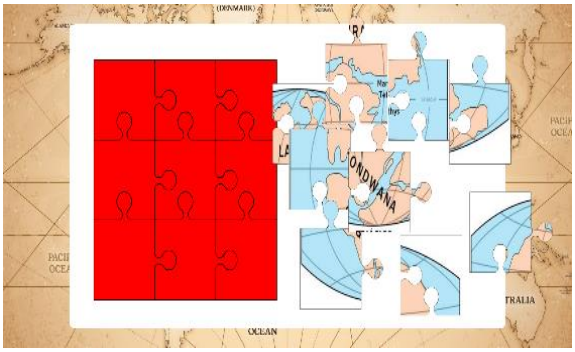

Figure 6. Quiz Menu Display

The material expert is Fatiya Rosyida, S. Pd., M. Pd., a Lecturer in the Department of Geography, Faculty of Social Sciences, State University of Malang. The validation test was carried out on June 30, 2022. Validate the material used for assessment by attaching a questionnaire sheet with suggestions and a comments/suggestions column.

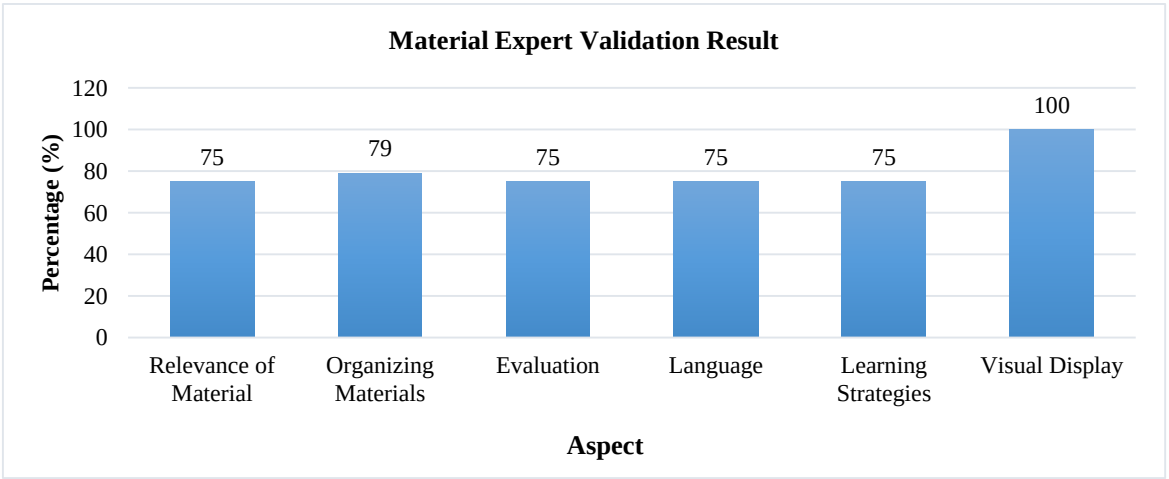

Figure 7. Material Expert Validation Results

Based on the data in Figure 7 above, the percentage of material aspects is 81%. This percentage shows that the material in the puzzle game learning media meets the eligibility criteria of being "very feasible." This indicates that the puzzle game learning media material has been arranged in detail, clearly, and by students' needs. So, exposure to puzzle game learning media material can help students understand the material better. As a means of delivering material in the classroom learning process, learning media is needed. Without utilizing learning media, the delivery of material will be abstract, and student's understanding of the material will also decrease because students cannot visualize the material being taught (Tunjung & Purnomo, 2020). These results show that the material can be used in puzzle game learning media products and is suitable for testing with educational practitioners and students. However, there are several improvements to improve the material before the trial.

Agung Wiradimadja, M.Pd, conducted the feasibility test by media experts as a Lecturer in the Social Sciences Education Study Program, Faculty of Social Sciences, State University of Malang. The media validation stage was carried out on June 28, 2022. Media validation uses an assessment by attaching a questionnaire sheet containing 20 statements and a comments/suggestions column. Assessment involves several things, including visual appearance, language, learning strategies, and software engineering.

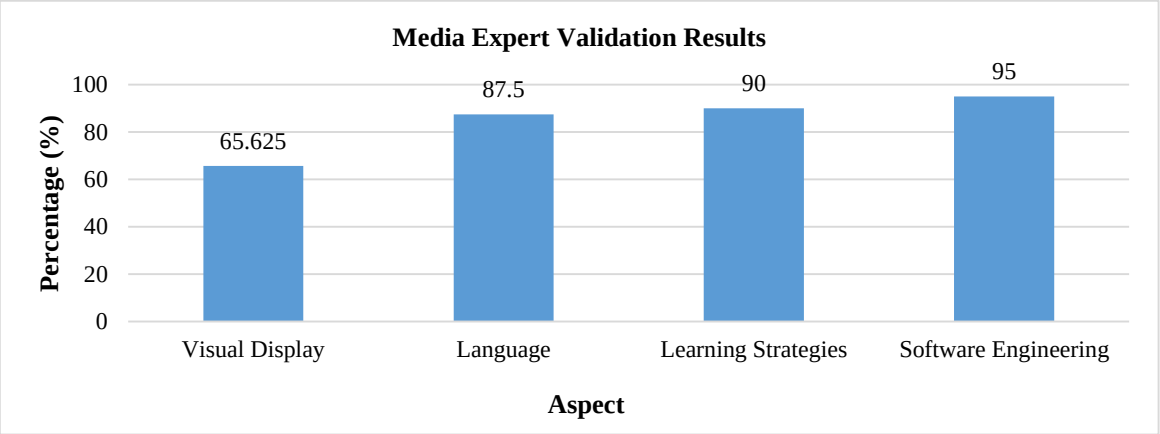

Figure 8. Media Expert Validation Results

The percentage of media suitability was obtained at 81%, as shown in Figure 8 above. The percentage shows that if you fall within the " very suitable eligibility criteria," qualifications can be tested for the product puzzle games. Puzzle game learning media provides learning experiences through visual symbols. So students can construct their understanding through pictures of continents and their appearance. According to Edgar Dale's cone theory of knowledge, learning activities using learning media using the five senses can be applied to the learning process (Nasrullah et al., 2021).

Classroom learning will be effective and can provide concrete experiences to students by using puzzle game learning media. Students can understand the material better through actual images, not just concepts or writing (Tunjung & Purnomo, 2020). The quiz menu is the puzzle game learning media feature that embodies this opinion. It can make students actively develop their senses so that they have skills and knowledge. Puzzle game discovering media places students as the subject of learning; students carry out learning activities independently based on the teacher's prepared activity plans. The teacher in the class only acts as a facilitator to accompany the students. Based on constructivism theory, a facilitator has the skills to help students learn to achieve learning goals (Djamaluddin & Wardana, 2019). Based on the media validation results, puzzle game learning media products can conduct trials with educational practitioners and respond to student use.

Implementation

Puzzle game learning media is applied to users after validation by expert validators, which is carried out at the development stage. The implementation phase involved teachers as educational practitioners and 32 students in class IX-A as the experimental class.

Trials by educational practitioners were carried out to determine the response of educational practitioners, namely Andrie Astutik, M.Pd, as a social studies subject teacher at one of the State Middle Schools in District X. The trial was carried out on June 28, 2022. The assessment of the trial stage was done by attaching a questionnaire sheet containing 20 component statements and a comments/suggestions column. Assessment consists of several things, such as language, puzzle game application components, material organization, and overall presentation.

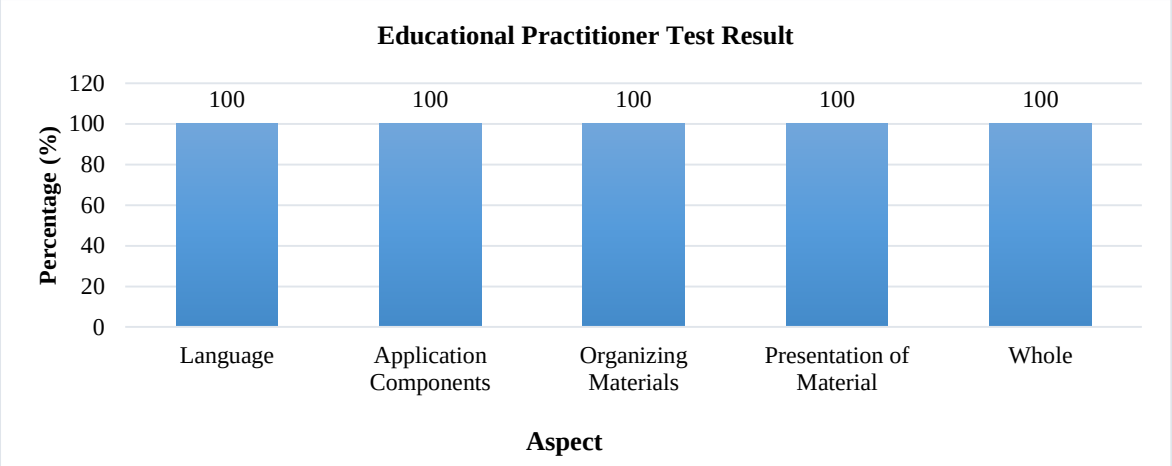

Figure 9. Education Practitioner Test Results

The results of trials conducted in Figure 9 by educational practitioners obtained a percentage of 100%. This percentage shows that the puzzle game learning media product has the eligibility criteria of "very feasible" with the qualification that it can be tested. Based on the results of trials by educational practitioners, puzzle game learning media products can be tested on students.

Data collection was carried out in the learning process outside the network and was held in three meetings facilitated by the class IX social studies teacher. Before the trial, students must download and install the puzzle game application on their Android smartphone. Next, the puzzle game learning media is applied according to the material prepared in the learning activity. After the learning process is complete, student response questionnaires are distributed containing statements to obtain information on the appropriateness level of the learning media being tested.

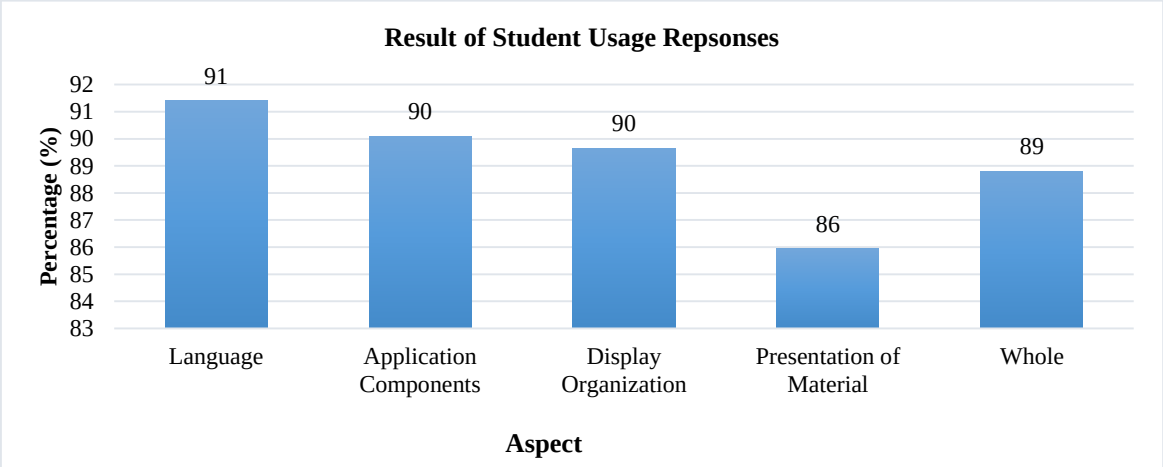

Figure 10. Results of Student Usage Responses

Based on the data in Figure 10, puzzle game learning media products have a feasibility percentage of 89%. This percentage shows that the puzzle game learning media, regarding trial use, has reached the "very feasible" criteria. The results of student responses show that the puzzle game learning media is very interesting and can encourage motivation. Knowing and understanding the

material and its operations will be easier for students. Therefore, puzzle game learning media is suitable for learning activities on the location and area of the Asian continent and other continents.

Evaluation

Evaluation is the final stage in the ADDIE development model, which aims to evaluate whether existing learning media developed successfully by the initial objectives of the research. The ADDIE model evaluation stage is carried out as the final stage in a series of learning media development where there are several series of activities that need to be carried out. The following is an explanation of the evaluation carried out by researchers at each stage of ADDIE. a) Evaluation of the analysis stage: after conducting a complexity analysis and analysis of student needs, the supervisor will evaluate the analysis of the objectives obtained. b) Evaluation of the design stage is done by consulting the results of learning objectives, material formulation, questionnaire sheet instrument design, test question instrument design, and storyboards with the supervisor. c) Evaluation of the development stage is carried out by an expert validator using a questionnaire sheet to measure the suitability of the puzzle game learning media. In the expert validator review, deficiencies were still found, such as many typos, the images not being specific, and the material in the learning media not encouraging high-level thinking. d) Evaluation of the implementation stage is done by filling out a questionnaire by educational practitioners and students. Reviews from educational practitioners show that using puzzle game learning media is interesting because it invites students into the material so that it can be conveyed well. However, it is still necessary to be more varied in its implementation. Reviews from students show that puzzle game learning media helps students understand the material with the help of the features provided. However, shortcomings still need to be found, including unavailable sound in the video and map images that cannot be zoomed. Evaluation is carried out at all stages of ADDIE model development.

Effectiveness Analysis

The effectiveness test was carried out to measure the level of success in using puzzle game-based learning media to improve student learning outcomes. The effectiveness level was analyzed by conducting a pretest and posttest on the test subject class, namely the experimental class, namely class IX A, and the control class, namely class IX B. The pretest is used to determine student learning outcomes before it is given treatment using puzzle game learning media. Meanwhile, the posttest assesses student learning outcomes after being treated using puzzle game media. Implementing puzzle game learning media was carried out in three meetings. In the first meeting, a pretest was given to students to measure learning outcomes and students' understanding of the material on the Asian Continent and Other Continents. At the second meeting, learning was carried out in the experimental class using puzzle game learning media. Meanwhile, for the control class, the learning process is carried out using conventional methods using student books as media. At the third meeting, students in both the experimental and control classes were given posttest questions to see the increase in student learning outcomes and understanding after using puzzle game learning media for the practical class and conventional methods for students in the control class.

Students' pretest and posttest results were analyzed using normality and homogeneity tests. In the normality test, the results showed that the experimental class pretest value showed a value of (Sig.) 0.108, the experimental class post-test showed a value of (Sig.) 0.109, the control class pretest showed a value of (Sig.) 0.78 and the control class posttest showed a value of (Sig.) 0.135. The results of the Kolmogorov-Smirnov normality test for students' pretest and posttest in both the experimental class and control class, the data shows (Sig.) > 0.05, so the students' pretest and post-test data can be said to have a normal distribution.

Pretest and posttest homogeneity tests for students in all classes showed a value (Sig.) of 0.065. The homogeneity test results show 0.065 > 0.05, so it can be said that the students' pre-test and post-test score data are heterogeneous in Table 2. Once it is known that the results of the normality test in both classes are proven to be normally distributed and the results of the homogeneity test in both classes are heterogeneous, then the paired sample t-test can be carried out to test the hypothesis that has been prepared previously.

Table 2. Paired Sample T-Test Results Pretest and Posttest Results

No.	Pair	Mean	Std. Deviation	Std. Mean Error	95% Confidence Interval of the Difference		t	df	Sig. 2 tailed)
					Lower	Upper			
1	Experimental Pretest – Experimental Posttest	-25.156	15.160	2.680	-30.622	-19.691	-9.387	31	.000
2	Control Pretest – Control Posttest	-13.438	15.525	2.744	-19.035	-7.840	-4.896	31	.000

Based on the paired sample t-test Results in the SPSS application with a significance level of 5%, the Sig value is obtained two-tailed and shows the e $\leq$ 0.05. The probability results indicate hypothesis H0 is rejected and Ha is accepted, meaning there is effectiveness in using puzzle game learning media in improving the learning outcomes of class IX students in one of the State Middle Schools in District X.

Discussion

Puzzle game learning media is effectively used in the classroom learning process to become an alternative solution to problems primarily related to the learning process. The lack of innovative and varied learning media can make students easily bored, lose learning motivation, and reduce student interest in learning (Ciputra et al., 2020). The use of puzzle game learning media stimulates active student involvement. Apart from that, students are encouraged to be more enthusiastic and enthusiastic about the learning process from start to finish to improve student learning outcomes (Fitra & Maksum, 2021). In their research, Kusuma et al., (2021) revealed that using gamification for learning can significantly increase student motivation and learning achievement. Meanwhile, the Gestalt Puzzle game allows players to reflect on the knowledge they have gained by describing and including this knowledge in the Gestalt Puzzle so that it can encourage students with FI-CS to play with knowledge related to learning (Hong et al., 2023). Valiente & Kim (2020) revealed that geometry games are fun to use in mathematics lessons and make learning mathematics less boring. Based on the research findings and discussion results, this study shows the same results, namely the development of game-based learning media; apart from being able to reduce the level of boredom and increase student learning motivation, the development of game-based learning media can also improve learning outcomes significantly and make learning activities more enjoyable, interactive and fun because students can be directly involved in learning activities.

CONCLUSION

Based on the findings in this research, the development of puzzle game media is by the complexity analysis and user needs analysis that researchers have carried out. Through statistical analysis, using the paired sample t-test, the results were found to be Sig. Two-tailed 0.000 < 0.05 means that Ha is accepted and H0 is rejected. This means that there is effectiveness in using puzzle game learning media in improving the learning outcomes of class IX students at one of the State Middle Schools in District X. The use of puzzle game teaching media in the learning process has been proven to improve student learning outcomes. There is a difference between the results of the pretest scores for the experimental class and the control class and the posttest scores for the practical class and the control class, where in the suitable class, there was a higher increase in scores compared to the control class.

The following are some suggestions made in connection with the development of puzzle game learning media. Obstacles that arise when using puzzle game learning media include the limited use of cellphones at school so that the learning process becomes slightly disrupted, time constraints, and accessing puzzle game learning media where not all students can download the application. Based on these obstacles, the method used by researchers is to use an LCD projector that displays puzzle game learning media. Consider the duration of learning time so that teaching and learning activities

are completed on time. The researcher lent the researcher's cellphone to students who needed help downloading the puzzle game learning media application so that students could continue paying attention to the lesson.

Based on the findings of this research, there are several limitations in this research and development, namely the use of only one sub-material so that there is a need to expand the material, the implementation of the use of puzzle game learning media in only one experimental class, the lack of elements in puzzle game teaching media such as not there is a scoreboard or ranking board for all players that reflects student performance, a limited number of quizzes, no world explore feature in the material menu display. Recommendations for further research and development include adding material, utilizing innovative AR (Augmented Reality) technology features and adding digital videos with a more attractive appearance, being able to further develop elements of the quiz feature by adding several puzzle patterns at a higher level or a more challenging level, adding a scoreboard or leaderboard that allows students to continue the game at a higher level, adding references to the material menu and product presentation to create more interactive and innovative products according to student's needs so that students are more motivated to use learning media products in the learning process.

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The effect of inquiry-based learning assisted by story-map on students' spatial thinking skills in seismic studies

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ABSTRACT

Fundamental changes in 21st-century learning impact geography learning, which must be balanced with students' spatial thinking ability. This ability is a core ability in geography that students must have in the process and results of learning geography. The inquiry-based learning model, with the help of story maps, is an alternative way to stimulate students to develop the ability to think spatially. This study aims to determine how applying inquiry-based learning using story maps affects spatial thinking abilities, especially in seismic studies. The method used in this study was an experiment with a quasi-experimental type using a posttest-only control group design. Data collection techniques in this study used a test in the form of posttest and observation to observe the learning process during the study. Posttest data were obtained from 66 class X students of SMAN 1 Genteng, divided into control and experimental classes. The data were analyzed using the classic assumption regression test, and further hypothesis analysis was done using a simple linear regression test. The results of this study show an influence of the application of story map-assisted inquiry-based learning on students' spatial thinking abilities at 16.7%, as assessed by R Square. In addition, the findings in this study show that the average scores for each indicator of thinking ability are diverse. The highest average in both control and experimental classes, namely analogy and transition indicators. While the lowest average in both courses is the comparison indicator.

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INTRODUCTION

21st-century education has changed the learning paradigm from teacher-centered to student-centered, focusing on students' active contributions to learning. Adjustments to the learning curriculum at school are needed to achieve learning with students as the main subject. Currently, the curriculum used in learning is the independent curriculum. The characteristics of the separate curriculum focus on learning by developing character and competence and honing students' talents (Fitriyah & Wardani, 2022). In other words, the independent curriculum is an effort to achieve

three main competencies in the 21st century, namely competence to think, act, and competition in the world of work (Stehle & Peters-Burton, 2019).

Implementing an independent curriculum in academic units must be balanced with implementing an appropriate learning model regarding student needs and learning objectives. Learning models that are by the character of the independent curriculum must be able to accommodate the four primary skills of students, which include critical thinking, communication, collaboration, and creativity (Indarta et al., 2022). Inquiry is an alternative learning model that can be implemented in an independent curriculum. The inquiry-based learning model aims to implement learning by actively involving students in authentic scientific discovery based on logical thinking skills (Pedaste et al., 2015).

Inquiry-based learning was first publicized by Richard Suchman in 1962 as an action to create a fun process by conducting research and explaining phenomena that have never been known before (Maknun, 2020). The syntax of this model includes orientation, conceptualization, investigation, conclusion and evaluation, and discussion (Pedaste et al., 2015). The syntax represents learning activities by designing authentic learning designs to attract students' interest, inviting them to gather information independently and identify problems through group learning. Furthermore, it directs students to present and evaluate the findings in groups.

Inquiry-based learning is classified as a learning model that can stimulate geographical understanding. Students must understand the information they encounter by connecting their current experience and new knowledge (Roll et al., 2018). Inquiry-based learning benefits students in terms of communication, collaboration, creativity, and deep thinking mendalam (Kriewaldt et al., 2021). Through this model, students memorize facts and information and understand concepts and methods to answer questions collaboratively through group learning activities (Schleicher, 2012).

Implementing an inquiry-based learning model can create deeper learning to strengthen conceptual understanding. This model also facilitates students to act as professional experts in conducting investigations, for example, thinking and acting like mathematicians, scientists, or geographers (Kriewaldt et al., 2021). This model allows students to engage thoroughly in learning as they can learn through independent activities. By engaging in inquiry practices, students learn to formulate disciplinary questions and how to find, connect, and interpret data to build knowledge. This ability is essential in the 21st-century curriculum as it expands students' capacity to think independently and allows them to develop (Kuisma, 2018).

Previous research that examines the application of inquiry-based learning models in geography learning in environmental knowledge in schools was conducted by (Refualu et al., 2022), with the results showing that 92.8% of students who get a mastery score ≥ 70 and only 7.1% of students are classified as learning achievement scores ≤ 70 with learning success standards if the learning group has ≥ 80% of students obtaining mastery achievement scores ≥ 70. In addition, research was also conducted (Rosita, 2019) with results showing that the value of t count> from t table, so it was concluded that there was an influence of the application of inquiry-based learning models on students' critical thinking skills. Based on this research, the application of inquiry-based learning significantly affects the dependent variable that the researcher has formulated.

The advantage of inquiry-based learning models lies in the syntax that directs students to develop cognitive, affective, and psychomotor abilities in a balanced manner. The application of inquiry-based learning in geography has a high relevance because geography provides many opportunities for students to conduct investigations during learning activities both in and outside the classroom (Schlemper et al., 2019). This model focuses on results and the gradual learning process that utilizes inquiry to obtain and present data through communicative information (Adnan et al., 2021). Thus, the geography learning process becomes more meaningful because students are directly involved in seeking and finding information independently (Adawiyah & Haolani, 2021).

There are also disadvantages to using this model in terms of implementation and application in the learning process. Inquiry-based learning requires classroom management that must be carried out with complex processes, and teachers need to provide appropriate orientation so that students do not have difficulty finding factual information; there is a possibility that students who have better competence tend to be actively involved in learning than other students (Holden & Sahyar,

2015). In addition, applying this model requires careful planning procedures, longer learning duration, and media that can help the learning process based on inquiry but still needs to be evenly disseminated (Komalasari et al., 2019).

Combining appropriate learning media is necessary to support the application of inquiry-based learning in learning. A story map is the relevant alternative media to be incorporated into the syntax of inquiry-based learning. Story maps are websites that communicate and explain spatial information in a concise and easy-to-understand format (Vollstedt et al., 2021). Teaching with story maps can improve geographic literacy or spatial thinking in various science, technology, engineering, and 21st-century career support (Cope et al., 2018). The content on this website is constructed based on maps organized with informative content in the form of text, pop-ups, graphics, maps, and videos. In addition, story maps also offer an experience to translate and visualize scientific data to complex data with easier access, both for learning and general interests (Kerski 2015).

In theory and practice, spatial thinking skills are a core part of geography geography (Huynh & Sharpe, 2013). Spatial thinking ability combines spatial properties, spatial information, and spatial thinking processes (Lee & Bednarz, 2009). Students with good spatial thinking skills can accurately project, classify, and synthesize a phenomenon or spatial information on Earth (Yani et al. 2018). Schools still need to improve students' spatial thinking skills due to the low awareness of studying geography (Subhani & Agustina, 2018). Low awareness of studying geography is also caused by learning activities in geography subjects considered unattractive to students because learning is still focused on the teacher (Astawa, 2022).

Indicators are needed to accurately interpret spatial thinking components to determine and measure spatial thinking ability. According to the Association of American Geographers (AAG), this study uses spatial thinking indicators, including comparison, transition, analogy, and association. The use of AAG indicators has been adapted to the material used in the study. This indicator was chosen because it is more accurate and has also been studied for its application to school students (Aliman, et al., 2019). Previous research that has used this indicator includes spatial thinking skills in 21st-century learning (Wijayanto et at., 2020) and the effect of project-based learning assisted by Google Earth on spatial thinking skills (Oktaviano, 2017). Based on the results of these studies, this indicator is more accessible and can be adapted to learning models and geography materials at school.

This study uses class X lithosphere dynamics material on geological energy material in the form of seism. In the research, the material used includes various impacts arising from all exogenous and endogenous processes, such as plate tectonics, with impacts arising from landslides, earthquakes, and tsunamis. However, this research focuses on earthquake disasters and utilizes spatial information on Indonesia's distribution of earthquake phenomena. The specialization of lithospheric material on geological energy in the form of seismics aims to enable students to conduct spatial investigations related to earthquake events by spatially identifying the causes and impacts. This study aims to determine the effect of an inquiry-based learning model assisted by a story map on students' spatial thinking skills. The contribution of this research is expected to enhance students' understanding of geology and earthquake disasters, as well as develop their ability to analyze spatial information and identify disaster risks.

METHOD

This study uses quasi-experimental research with data collection techniques using post-tests for both class groups, namely practical and control classes, without pretests. This study was designed with two groups of classes that were given a post-test after giving treatment. In the experimental class, treatment was delivered using an inquiry model assisted by a story map. In contrast, using a purposive sampling technique, the control class used a conventional model combined with the study's lecture method determination of experimental and control classes. The study, conducted in the even semester of the 2022/2023 academic year, used the subjects of students in grades X-7 and X9, with a total of 33 students in each class.

The research procedure was carried out with several steps in accordance with the syntax of inquiry-based learning which consisted of; 1) The opening activity is to prepare two class groups, namely the experimental class and the control class; 2) Orientation, namely giving students directions related to the material to be discussed using a story map and then forming discussion groups; 3) Conceptualization, namely students together with the group collect various information related to the phenomenon of earthquakes in Indonesia that has been presented in the story map; 4) Investigation, carried out by students by identifying the causes and effects of the earthquake phenomenon; 5) Conclusions and evaluation, carried out by students reflecting on the findings from the use of story map media on the topic of seism in groups then reflections are presented to the teacher; 6) Discussion, carried out by students making presentations and attaching written reports to discussion sheets; 7) The closing activity is the stage of doing the post-test by students.

The data collection results with test techniques processed in this study are the post-test scores of students' spatial thinking skills in closing activities outside of learning activities. The spatial thinking ability test instrument uses essay questions with four items based on indicators of spatial thinking ability developed by the Association of American Geographers. These indicators are comparison, aura, region, hierarchy, transition, analogy, pattern, and association. This research uses four indicators from these indicators, including contrast, transition, analogy, and association. The indicators in this study were chosen because they are most suitable for using the study material, namely those related to seism. The research instrument was first tested on students in grades X-8 and X-12 using validation and reliability tests for each item according to the indicator. The results of the question validation show a significance value <0.05, which means that the question can be declared valid. Then, the results of the reliability test showed a sig value. 0.692> 0.60, which means the question is declared reliable.

The research data analysis consists of 2 types: the classic assumption test and hypothesis testing using the regression model. The traditional assumption test consists of a normality test using One-sample Kolmogorov Smirnov with data declared normal when the significance value> 0.05 on the unstandardized residual value (Res_1). Furthermore, a linearity test is carried out with decision-making. If the significance value of linearity> 0.05, then a significant linear relationship exists between the inquiry model assisted by the story map and spatial thinking ability. After conducting the linearity test, we continued with the heteroscedasticity test with the condition that the significance value> 0.05 and no symptoms of heteroscedasticity were in the post-test data. This prerequisite test is carried out to determine the residual variance of each data. Hypothesis testing uses a simple linear regression test with the condition that if the significance value <0.05, the inquiry-based learning variable assisted by the story map affects the spatial thinking ability variable. Based on the hypothesis test results, it can be stated that H0 is rejected and H1 is accepted, or there is an influence of the two variables. In addition, to determine how much impact the independent variable has on the dependent variable, the value of R Square is used as a percentage.

RESULT AND DISCUSSION

Result

This research was conducted for four meetings: three central meetings for learning activities and one meeting outside the main learning hours for post-test. In learning activities, the experimental class used an inquiry-based learning model assisted by a story map, and the control class used a conventional model. The post-test was given to students with 50 minutes of testing time using the Google Forms platform. The following presents the post-test results from both class groups.

Table 2. Frequency Distribution

No.	Value Range	Qualification	Experiment Class		Control Class	
			Frequency	Percentage	Frequency	Percentage
1	91 – 100	Very good	9	27.2	2	6.0

No.	Value Range	Qualification	Experiment Class		Control Class	
			Frequency	Percentage	Frequency	Percentage
2	81 – 90	Good	16	48.4	14	42.4
3	71 – 80	Simply	8	24.2	16	48.4
4	0 – 70	Less	0	0	1	3.0
Total			**33**	**100**	**33**	**100**
Mean			**87.1**		**81.3**	
Min			**80**		**70**	
Max			**95**		**95**	

The information contained in Table 2 is related to the proportion and frequency of the results of the post-test scores in the control and experimental classes. This table is obtained from the post-test scores, which are then calculated as scores and deepened in the intervals according to the amount of post-test data. This table is helpful to make it easier to find the results of descriptive statistical analysis of the data set of posttest scores for spatial thinking ability before further calculating the average of each indicator of spatial thinking ability in the control and experimental classes. So, this table represents the overall results of the posttest scores of the two research classes more simply.

Table 3. Mean Values of Spatial Thinking Skills Indicators for Experimental and Control Classes

No.	Indicator	Information	Average	
			Experiment	Control
1	Transposition	Identify changes in place that occur gradually and irregularly	4.7	4.5
2	Association	Analyze the Symptoms of a Phenomenon in Pairs that Tend to Occur Together in Specific Locations	4.5	4.1
3	Comparison	Comparing the Location of a Phenomenon that has Similarities and Differences	3.7	3.1
4	Analogy	Analyze Locations that may have the Same Conditions	4.5	4.6
Total			**17.4**	**16.3**

Table 3 shows a difference in the average value between the experimental and control classes on each spatial thinking indicator. The difference occurred due to differences in treatment given between the two classes. In the practical class, before students take the post-test, they are given treatment by applying inquiry-based learning syntax for three meetings before the post-test and are equipped with worksheets that contain inquiry syntax. Thus, students get a more significant opportunity to stimulate spatial thinking skills appropriately when doing the post-test. In the control class, students only did a few activities independently, and the teacher still had complete control over the learning process.

The table also contains information on the average results of the most dominant or highest average spatial thinking indicators in both classes: transition and analogy. One of the reasons these two indicators get the highest scores is the characteristics of indicators that are more representative of stimulating students, especially in working on post-test questions. Thus, students tend to master these two indicators more. In addition, some indicators have the lowest average, namely comparison. The triggering factor is that performing and applying this indicator is more complex than others. To bring up this indicator in learning activities, students first need to recognize a phenomenon that has never been known. Then, students begin to observe the phenomenon until they can find and compare differences from a presented phenomenon.

Other information that can be found in the table, namely, the average value on the analogy indicator of the control class, is higher than that of the experimental class. The average value of other indicators tends to be higher in the practical class. The acquisition of these results is typical even though, in the learning process, students in the experimental class have a more significant opportunity to stimulate spatial thinking skills in all indicators. Measurement of spatial thinking ability cannot be represented in just one indicator but must be done as a whole. The table above shows that the experimental class tends to have a higher average spatial thinking ability than the control class, which can be observed from the total average produced.

Table 4. Classical Assumption Test

No.	Classic Assumption Test	Significance	Information
1	Residual Normality Test	Asymp.Sig. (2-tailed) .200	Normally Distributed
2	Kolmogorov Smirnov		
3	Linearity Test	Deviation from Linearity .972	There is a Linear Relationship Between Two Variable
4	Heterokedastisitas Test	Sig. .774	No Symptoms Occur Heteroscedelasticity

Table 4 shows the significance level in The residual normality test of 0.2 with a decision-making sig value> 0.05, meaning the post-test value data is usually distributed. Then, the linearity test has a significance value> 0.05, which is 0.972, which means a linear relationship exists between inquiry-based learning and spatial thinking skills. The heteroscedasticity test shows a significance value of 0.774 or > 0.05. So, it shows that the value of the post-test results does not offer any equality in the residual variance. Following the results of the classical assumption test above, the post-test results show a significance value> 0.05, meaning they meet the requirements to proceed to hypothesis testing using simple linear regression.

Table 5. Hypothesis Test

No.	Model	R	R Square	Adjusted R Square	Sig.
1	1	.408[a]	.167	.140	.018

Based on the results of the hypothesis test calculation seen from the R square in Table 5, it is known that the R square value is 0.167, which means that the effect of variable X (inquiry-based learning) and variable Y (spatial thinking ability) is 16.7%. As a basis for decision-making by comparing the significance value with a probability value of 0.05, it is stated that the inquiry-based learning variable affects the spatial thinking ability variable because of the sig value. 0.18 > 0.05.

Discussion

The study's results based on the R Square value show an influence of 16.7% of the application of inquiry-based learning assisted by story maps on spatial thinking ability. The existence of the influence is also shown in the comparison between the significance value and the probability value, which shows the result of 0.18> 0.05. The research results that show the effect are supported by the characteristics of the inquiry model that can develop in-depth thinking skills through the findings of the results of the investigation carried out gradually to form a conclusion (Favier & Van Der Schee, 2012). In addition, the inquiry-based learning model can also stimulate students' curiosity in learning through investigative activities (Mieg, 2019). Using story map media with seismic material can facilitate students in thinking comprehensively about earthquake disasters because the story map is packed with visualizations that can describe the actual conditions when the earthquake occurred in Palu, Mentawai, and Cianjur. The material contained in the story map is equipped with pictures and maps to provide illustrations to students to represent the material being studied (Egiebor & Foster, 2019).

The components used in the story map media consist of 7 sections, which include 1) a Dashboard section that presents a description related to the location of the earthquake along with supporting information such as earthquake strength, earthquake type, and earthquake impact; 2) Tools that display the story map to full screen; 3) A simple map legend that pops up when clicked; 4) Search tools used by students to find information on the story map, but only limited to the content that has been provided; 5) Display of sub-materials from the story map content; 6) Legend of the disaster distribution map presented in the story map; 7) Tools used to enlarge and reduce the size of the map. The inquiry-based learning model assisted by a story map improves spatial thinking ability because students can be directly involved in conducting investigations and discoveries using the concept of thinking independently. In addition, this model consists of the teacher as the main subject and invites students to identify related earthquake phenomena, including causes, consequences, and actions that students can contribute as prospective geographers in minimizing the impact after an earthquake. These learning activities can be found in the syntax of the inquiry-based learning model, which includes 1) Orientation or identifying a phenomenon, 2) Conceptualization, 3) Investigation, 4) Conclusion and evaluation, 5) Discussion or conveying the results of the investigation (Makar & Fielding-Wells, 2018).

In the learning process, the first activity carried out by students is identifying a phenomenon (orientation). At this stage, the activities stimulate students by listening to the content of the earthquake phenomenon contained in the story map. In addition, a simple map related to the distribution of earthquakes that occurred in several regions of Indonesia was also presented. By presenting the story map content, learning activities become more attractive to students and provide an initial description of the phenomenon being discussed (Groshans et al., 2019). After listening to the material in the story map, the teacher instructs students to respond or ask questions. From the results of learning activities through this syntax, students allowed to ask questions and answer the material in the story map have indirectly carried out one of the spatial thinking indicators: a comparison. This indicator is the ability to compare the location of a phenomenon that tends to have similarities and differences according to the phenomenon being discussed (Wijayanto et al., 2020). This is because the content at the beginning of the media provides an overview of the impact of earthquake phenomena. The emergence of comparison indicators in the orientation syntax is characterized by several students who can provide statements following the intent of the material content. For example, students can correctly describe the pre- and post-earthquake conditions in several different locations according to the aerial photos presented in the story map content.

Entering the core part of the inquiry-based learning syntax, the teacher divides students into eight groups, each getting one discussion sheet containing guidelines and instructions for learning activities adapted to the syntax of the inquiry-based learning model. Discussion sheets are distributed in groups to stimulate and hone the ability to think in groups (Aldilha, et al., 2019). Each group consists of 4 people so that the division of tasks in the group is more organized. Then, the teacher explains the activities during the learning process. In this activity, eight groups get three different earthquake case studies. This means that two groups will get 1 of the same topic. The topics in this learning activity are related to earthquakes in Mentawai, Palu, and Cianjur. The aim is for groups with the same topic to complement the information obtained. In the second stage, students seek and gather information conceptually and factually according to the case study topic of each group. At this stage, students carry out the second syntax of inquiry-based learning, namely conceptualization. This syntax is a student activity in collecting information through theories and phenomena (Pedaste et al., 2012). This information is gathered from various sources, both from articles and content on the story map. In this stage, students discuss the division of labor with each group and write down the details. In this stage, the teacher has the task of guiding and supervising students in gathering information through the problem formulation provided on the student discussion sheet.

The third stage is investigation. At this stage, students are asked to identify the causes and impacts of earthquake phenomena in several regions of Indonesia, especially in the Mentawai region. Palu and Cianjur. This syntax is an activity carried out by students to analyze and investigate the information that has been collected previously (Pedaste et al., 2012). So, this

investigation activity is carried out by students using the findings of information sourced from story maps and articles previously carried out at the conceptualization stage. At this stage, each group can obtain data from articles, papers that can be accounted for, and story map content. Through this stage, students can build and discover their knowledge concepts (Oktavianto, 2017). Students will be stimulated to bring up spatial thinking indicators in this syntax. Namely, association (correlation) is the ability to analyze symptoms of a paired phenomenon that tend to occur together in specific locations. In addition, there is also a transition or the ability to identify changes in places that occur gradually and irregularly, and analogy or the ability to analyze locations that may have the same conditions (Wijayanto et al., 2020).

Some examples of activities carried out by students that give rise to these indicators are: 1) Students can correctly write the results of the analysis of the case study, which includes the causes, impacts, and minor natural disasters that may occur as a result of earthquakes; 2) Students can correctly reconstruct an understanding of the relationship between earthquakes that occur in the same place in different periods; 3) Students can correctly identify the differences in the causes of earthquakes according to different case study locations. Based on the findings of these activities, this syntax most influences students' spatial thinking skills because it can stimulate three indicators of spatial thinking in one syntax. The fourth stage is the conclusion and evaluation. In this syntax, the activities conclude and evaluate the investigation results (Pedaste et al., 2012). In this stage, all group members will discuss and write down the findings in the worksheet. Each group that has collected data from the literature review process is then summarized in a discussion worksheet according to each group's topic. The activities carried out by students in this stage not only carry out the syntax of inquiry-based learning but also the attitudes reflected in the profile of Pancasila students, which include critical reasoning, creativity, respect for differences of opinion, and collaboration. In addition to stimulating spatial thinking indicators, at this stage, students can also implement the Pancasila learner profile after implementing the independent curriculum at school.

The next stage is students presenting the investigation results through a simple presentation. At this stage, all data and information that has been collected has passed the stage of secondary data review, which has been analyzed. This final stage determines whether the investigation results are based on the collected data and information (Pedaste et al., 2012). Students in groups make presentations and take notes on the results of other groups' presentations. At this stage, students also make conclusions on the investigation results by combining all information from the results of group presentations presented in concept maps and tabulations. The purpose of the conclusion part of the presented results is so that students can reconstruct spatial thinking indicators comprehensively. Finally, at the conclusion and evaluating and discussing syntax stages, spatial thinking indicators can be stimulated simultaneously. This is because, in the two syntaxes of the final stage, students have carried out disclosure activities with the results in the form of information related to the complete case study. All stages of the inquiry-based learning model and the achievement of spatial thinking indicators in each syntax can be represented in the following flowchart.

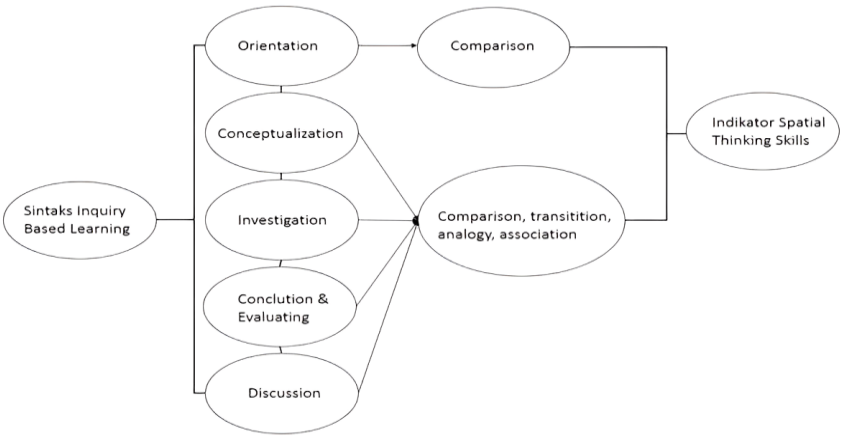

Figure 1. Flowchart of Inquiry-Based Learning

Based on the flowchart, orientation is the syntax that influences the comparison indicator the most. In comparison, other syntaxes can appear together when applying four syntaxes after orientation. In addition, from the students' learning process conducted during the research, the comparison indicator can be stimulated in all syntaxes of inquiry learning. Another finding is the syntax that initiates the stimulation of all spatial thinking indicators, namely conceptualization. Although this syntax is the first syntax that can stimulate all spatial thinking indicators, there is an investigation syntax that can be more dominant. It has been explained in the previous section of the inquiry syntax stages that the activities of this syntax can thoroughly accommodate spatial thinking indicators, including comparison, conceptualization, transition, analogy, and association.

After conducting the entire series of research processes, the inquiry learning model can accommodate students to stimulate and think spatial because several syntax stages can be applied to indicators of spatial thinking ability. In addition, in the learning process, students conduct group investigation activities so that it is easier to find a concept that can be used as a way to identify a phenomenon. This learning model is also an appropriate means to develop students' thinking skills independently because the teacher provides facilities for learning. In addition, combining media as a story map in a spatial-based learning model makes students more interested because this is the first time they are presented with media similar to a story map. Because in this media, visualizations describe the actual location of the phenomenon (Egiebor & Foster, 2019). This visualization includes images, aerial imagery, and earthquake distribution maps adapted to seismic material.

The study results showed the effect of applying the inquiry-based learning model assisted by the story map on students' spatial thinking skills based on ¬R Square of 16.7%. These results prove that there is an influence but not yet significant. The results that have not been significant can be influenced by various factors that arise in research and data collection. Based on the results of observations by observers during the study, the findings include 1) Limited learning hours to shorten the syntax of investigation and discussion; 2) Constraints on school projectors that have an impact on the presentation of story map media so that in some syntax orientation students listen to media content using their respective devices; 3) Limited material content on story map media used in the learning process so that not all syntax of inquiry-based learning uses story map media. Therefore, it can be said that the inquiry-based learning model assisted by a story map can be implemented in learning activities in geography subjects as a modification to learning activities. However, more careful preparation and adjustments must be made regarding teachers, students, the availability of school facilities, and the material to be studied.

CONCLUSION

This research was conducted in 4 meetings divided into the first three meetings for learning activities using the inquiry-based learning model assisted by story maps, while the last meeting was to carry out a post-test to measure students' spatial thinking skills. The results of the post-test assessment showed that the most dominant indicators of spatial thinking ability, namely transition and analogy, were mastered by students in both experimental and control classes, as evidenced by the acquisition of the highest post-test average score. Meanwhile, the indicator of spatial thinking ability still has a lower average value than both classes, namely comparison. Based on the results of post-test data processing seen from R Square, the application of inquiry-based learning models assisted by story maps has a 16.7% influence on students' spatial thinking skills. In addition, the sig. Value shows the result of 0.18 <0.05, which means that there is an influence from applying the independent variable on the dependent variable. Suggestions for further research: Researchers should provide orientation to students at the beginning of learning related to the inquiry-based learning model. Thus, the application of learning syntax is more accessible for students. In addition, to apply the inquiry-based learning model, researchers can further customize the use of media and materials being studied.

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Validity of interactive media to strengthen understanding concepts in integer class vii

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ABSTRACT

This research aims to test the validity of interactive media to strengthen the understanding of concepts in integer material for class VII MTs. The method used is qualitative and descriptive. The research instrument used a questionnaire from 3 experts, two practitioners, and 13 class VII students at MTs At-Taawun. The research results show that according to interactive media design experts, it is valid with a percentage of 91.7%, media experts with 81.7%, material experts with 90%, media practicality with 85.4%, and student trials with a rate of 87.7&. Based on the research results, interactive media on integers was declared valid with an average of 88.9%, so interactive media was declared suitable for use. The results of this research can also be used as a reference for research regarding media validity testing. The media that has been created can be used as learning media during the learning process.

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INTRODUCTION

Many learning media in the 21st century are packaged using technology. That way, learning, especially mathematics, becomes more exciting and easier to understand. Apart from that, using technology-based learning media also creates effective learning and can even increase student motivation in learning. In the 21st century, the use of learning media by utilizing technology will become a widely used strategy (Peña-Ayala, 2021), with various types of learning that can foster creative, critical attitudes (Chrysti et al., 2021) as well as student interest and achievement (Ray et al., 2019). Learning media with technology is conceptually a teaching and learning process carried out directly (offline) with support from technology (Nursyam, 2019). various learning media can be created using technology in the 21st century, namely game media, digital video and animation, augmented reality, interactive media, and others.

The large variety of technology-based learning media can enable students to learn without the role of a teacher. Namely, students learn independently (Widjayanti et al., 2018). Students can interact with learning media that the teacher has previously provided. This media is called interactive media. Interactive media combines images, text, video, animation, and audio, presented

interactively in teaching (Tambunan & Siagian, 2022). In general, interactive media has the advantage that learning becomes more fun, students' learning attitudes improve, the learning process can be carried out in the place desired by the teacher, and the quality of student learning (Pebriyanti et al., 2021). Based on the interviews and observations conducted on mathematics teachers by researchers at MTs At-Taawun, the learning process for class VII (Seven) still uses a conventional approach. The Mathematics teacher also added that students experienced obstacles in solving problems related to positive and negative integers. Many students admit that mathematics is complex (Tambunan & Siagian, 2022). On the other hand, students also need help understanding the concept of integer material. This is caused by mathematics teachers needing to start using technology in the learning process, even though teachers must develop media to deliver material appropriate to the media used (Prasetiya, 2018).

Based on the observations above, implementing the class VII learning process at MTs At-Taawun requires innovations in delivering mathematics learning. This requires finding solutions to minimize the problems and difficulties teachers and students encounter during the learning process. Facing challenges requires fun solutions and innovations that stimulate students to learn, enable each student to receive the material, and help students know and understand the material the mathematics teacher has presented during the learning process. So, from this hope, researchers are interested in creating learning media. One learning medium that is fun and can improve student learning outcomes that researchers will use to achieve effective teaching and learning is video-based interactive media created through the Canva application (Muhammad, 2020).

The Canva application is a design application that can be accessed online or offline with graphic designs such as pamphlets, presentations, invitations, graphics, banners, Facebook covers, and posters (Tanjung & Faiza, 2019). Apart from having graphic design (Pelangi, 2020) revealed that Canva has many advantages for creating learning media, including (1) the designs for making media are numerous and exciting, (2) it can increase the creativity of students and teachers in creating learning media, (3) designing learning media can be done practically and saves time, 4) designing in Canva can be done using cellphones and laptops. According to (Wulandari & Mudinillah, 2022), the advantages of Canva make it easier for teachers to create learning media, especially video-based interactive learning media as stated by (Triningsih, 2021) that The Canva application can make it easier for students and teachers during the technology-based learning process, creativity. , and skills. This is because the results of the Canva application design make students study more actively with exciting teaching materials and materials.

Research on several lessons that use interactive media shows a good response. Research conducted by Novitasari, 2016 showed a good response where interactive multimedia influenced students' mathematical abilities. Another study conducted by Wulandari (2020), namely interactive media using the Macromedia Flash application, shows a positive influence on the formation of students' interest in learning, especially in mathematics lessons. Rahma & Nurhayati (2021) further explained that interactive media using the Kahoot application has implications for increasing student motivation and learning outcomes so that it is suitable for use. From the opinions above, interactive media can be used in learning to support practical learning. Unlike previous research, this research will develop interactive video media using the Canva application containing material on integer numbers for class VII MTs.

Video-based interactive learning media can be used online or offline. Hopefully, the benefits of this interactive media in the learning process will attract more students' interest in understanding integer material conceptually and contextually. Based on the background above, the researcher wants to test the validity of interactive media in class VII MTs At-Taawun integers and contribute to developing more effective and engaging teaching methods for students to understand mathematical concepts.

METHOD

This research was carried out using qualitative and quantitative methods. Qualitative aims to describe and explain facts based on ways of thinking and points of view (Sunismi et al., 2023). In this study, the researcher describes the validity test of interactive media in integer lessons so that it

is hoped that it can optimize students in the learning process activities. Meanwhile, quantitative research is in the form of numbers from the results of a Likert scale.

Based on the above, this research uses a questionnaire as an instrument. Next, questionnaires were given to subjects, including three experts, 13 students, and two practitioners. Three experts are design experts, material experts, and learning media experts. Meanwhile, subject two practitioners came from university lecturers and mathematics teachers. The questionnaire instrument is used so that the validation test that will be carried out is more focused and does not leave the interactive learning media created (Creswell, 2008). The questionnaire used aims to measure the validity of interactive media using integer material. Interactive media was tested for validity by design experts, media experts, material experts, and practitioners. After that, it was revised to improve the media quality according to validators' comments. The fixed media was tested on 13 class VII students of Mts At-Taawun using a questionnaire to determine students' responses to using interactive media on integers. The assessment aspects on the questionnaire sheet given to validators and trials are as follows.

Table 1. Validator assessment aspects

No.	Validator	Assessment Aspects
1	Design Expert	1. Media Engineering Aspects
		2. Visual Aspect
2	Material Expert	1. Aspects of Integer Material
		2. Aspects of Practice Questions
		3. Linguistic Aspects
3	Learning Media Expert	1. Aspects of Learning Objectives and Materials
		2. Aspects of Practice Questions
		3. Linguistic Aspects
4	Practitioner	1. Material
		2. Language
		3. Graphics
		4. Learning
5	Small Group Trials	1. Fill
		2. Display
		3. Learning

The collected validation data is then analyzed by calculating the scores on each questionnaire given to design and media experts, material experts, and practitioners. Previously, the researcher provided an interactive video with a validation sheet to the validator for assessment. Next, the researcher calculates the score from the validation results; from this score, the researcher interprets its validity. Meanwhile, analysis using descriptive percentage techniques uses a formula developed by previous researchers (Sunismi & Fathani, 2016). It can be seen in Table 2 and Table 3.

Table 2. Instrument Validation Criteria

No.	Final score	Validation Criteria	Decision
1	43 – 52	Very Good	Interactive Media can be used without Revision
2	33 – 42	Good	Interactive Media can be used with Revisions
3	23 – 32	Not Good	Interactive Media can be used but must be Consulted with Experts and Practitioners.
4	13 – 22	Not Good	Interactive Media cannot be used

Table 3. Product Validation Criteria

No.	Percentage (%)	Validation Criteria	Decision
1	90 – 100	Very Valid	Interactive Media is Ready to use
2	80 – 90	Valid	Interactive Media is Ready to use
3	70 – 80	Fairly Valid	Interactive Media can be used with Slight Revisions
4	60 – 70	Less Valid	Interactive Media is Revised and Completes Deficiencies
5	0 – 60	Invalid	Interactive Media is Failing and Must be Revised Entirely

RESULT AND DISCUSSION

Results

Interactive Media Display on Integer Material

On the main menu, there is a display that displays objectives, materials, videos, simulations, and quizzes. To use it, you can click on the menu you want so that you will be directed to the destination.

Figure 1. Main Menu

In the material section, there is an explanation of integer material and examples of integer numbers, which are given using video so that students can understand more about positive and negative integer numbers. The material display has a home button to return to the menu, an X menu to return to the whole thing, and an arrow to continue explaining the material. In the video display, there is a next button to continue to the next slide.

Figure 2. Exposure to Integer Material

Interactive simulations are provided so students can fully understand positive and negative integers. When students answer, there will be a picture that answers. If the student's answer is wrong, a sad cartoon will appear with the wrong answer, whereas if the student answers correctly, a happy cartoon will appear with the correct answer. To continue with the second example question, students click the arrow button at the top left for each answer.

Figure 3. Simulation Questions

The quiz was conducted to determine how well students understood the integer material that had been studied previously using a video display. The quiz consists of 10 questions on positive integers and negative integers. The results of students' answers will appear immediately after students have finished working on the questions (Harsiwi & Arini, 2020). Results will also go into the teacher's spreadsheet directly.

Figure 4. Integer Quiz

Questionnaire Validation

Before interactive learning media on integer material is used, the researcher conducts a validation test to determine whether this media is suitable for use. Validation of teaching materials is an assessment process carried out on a press to decide whether the media is valid so that the results can determine the validity of interactive learning media for use in the learning process (Ferdianto & Setiyani, 2018). This validation is used to determine the suitability of the instrument. If validation fails, the researcher revises the instrument until it is suitable. Material validation was carried out by class VII mathematics teachers and mathematics education lecturers. Assessment is

carried out by matching the results of the assessment aspects with the assessment indicators. The assessment questionnaire indicators are as follows.

Table 4. Validation Analysis of Product Assessment Questionnaire Instruments

No.	Component	Score				
		A	B	C	D	E
	Eligibility of Content					
1	The Statements in the Instrument are Clear	3	3	4	4	4
2	Statements with appropriate instrument answers	4	3	4	4	4
	Goal Achievement					
3	Teaching Materials with Statements Made Accordingly	3	4	3	3	4
4	Objectives with Appropriate Instrument Statements	3	3	3	4	3
	Format					
5	Statements on the Instrument (General-Specific) are Appropriate	3	4	3	4	4
6	Suitability of Instrument Writing Layout	3	3	4	3	3
7	The Columns used Correspond to the Size of the Paper used	3	4	4	3	3
	Language					
8	The Language used is by EYD	4	4	3	3	3
9	The Language used is Easy to Understand	3	3	3	3	4
10	The Language used is Appropriate to the Student's Ability Level	3	3	3	3	4
	Graphics					
11	Appropriate use of Letters	3	3	3	3	3
12	Proper use of Punctuation Marks	3	3	3	4	4
13	Correspondence of the Sentences in the Instrument with the Functional Elements of Writing	3	3	4	3	4
Amount		**41**	**42**	**44**	**44**	**47**

Information A is the design expert questionnaire score, B is the media expert questionnaire score, C is the material expert questionnaire score, D is the practitioner expert questionnaire score, and E is the expert questionnaire score for class VII students. From Table 4 above, design and media experts obtained a validation score of 41 and 43, 44 from material experts, 44 from practitioner experts, and 47 from students who were a small group from the research. The results obtained, checked with the assessment guidelines, showed that all questionnaires were outstanding. Therefore, the questionnaires could only be used to make improvements.

Product Validation

After the assessment questionnaire instrument is declared feasible, it is used to assess the product. At this stage, calculations are based on validation results from media and design experts. The aspects evaluated by design experts are media engineering and visual communication. Media and design experts assess the elements of media engineering, learning design, and learning visual communication. The results of the analysis by design and media experts can be seen in Table 5.

Table 5. Validation Data from Interactive Learning Media and Design Experts

No.	Aspect	Media Expert Score	Design Expert Score
1	Aspects of Learning Media Engineering	18	20
2	Aspects of Learning Design	14	17
3	Aspects of Visual Communication	17	18
Amount		**49**	**55**
Score Percentage		**81.7**	**91.7%**

In Table 5, the percentage of assessments by media experts shows that the interactive media on integer material developed is declared valid with an average score percentage of 81.7%. In comparison, the analysis results by design experts are 91.7%, so it can be concluded that the media interactive on integer material is very valid. Therefore, interactive learning media on integer material can improve students' understanding.

Based on the questionnaire scores, validation results by material experts are as follows.

Table 6. Material Expert Validation

No	Aspect.	Material Expert Score
1	Aspects of Learning Objectives and Materials	18
2	Aspects of Practice Questions and Competency Tests	14
3	Linguistic Aspect	17
Amount		**49**
Score Percentage		**90%**

Table 6 shows that according to experts, the interactive learning media material on integer material is valid with a score percentage of 90%. Therefore, interactive media on integer material can improve students' understanding.

The practicality test was carried out by two experts, namely a mathematics teacher and a mathematics lecturer. The results of validating the practicality of interactive media are as follows.

Table 7. Results of the Validation of the Practicality of Interactive Media

No.	Aspect	Expert 1	Expert 2
1	Material Aspects	17	18
2	Linguistic Aspect	14	12
3	Graphic Aspect	15	15
4	Learning Aspects	16	16
Amount		**62**	**61**
Score Percentage		**86.1%**	**84.7%**

Referring to Table 7, it can be concluded that Interactive learning media on material was proven valid by expert practitioner trials with a score percentage of 85.4%. Therefore, learning media based on interactive learning media on proper integer material is expected to make it easier for students to learn integers, and learning objectives can be achieved optimally. The validation results from a small group of 13 Mts At-Taawun students are as follows.

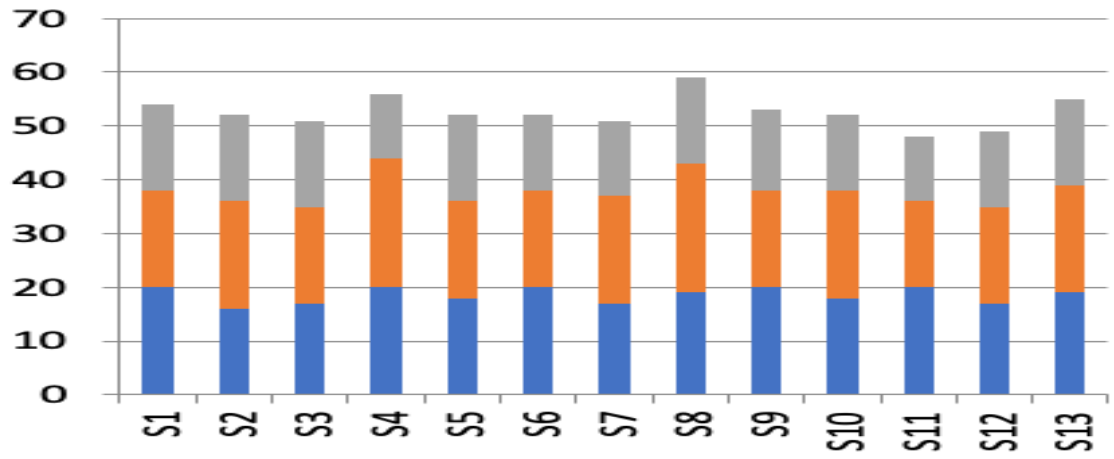

Figure 5. Validation of Small Group Trials

Information gray color for aspect instructional, orange color for aspect appearance, and blue col. or for aspect material Based on Figure 5, it can be concluded that learning media is based on interactive learning media with integer material on integer material declared valid by 13 students (small group trial) with a score percentage of 87.7%. Therefore, learning media is based on interactive learning media on integer material that can be used as a learning medium in the teaching and learning process. Based on assessments from validators, namely three experts, two practitioners, and 13 students, the validity of interactive learning media with integer material was produced with a total score percentage of 88.9% overall. So, the learning media is interactive in integer material, which can improve students' *soft* and *hard skills*.

Discussion

Based on the assessment analysis of learning media products based on interactive learning media on integer material, they are declared valid, so they are suitable to be used as a learning tool for students to understand integers. Interactive learning media makes it easy for students to access it; it is also easy to learn whole numbers because this media can be used independently. Apart from that, learning is no longer passive; it does not take long, it is simple and exciting, and the material is more accessible. Thus, interactive media can increase students' understanding. Media is a means to convey information from one person to another (Rahman & I Nyoman, 2020). Learning media is a teaching material that teachers use to get material and stimulate students' thoughts, attention, will, and attention, making the learning process more structured, controlled, and purposeful (Hakim & Haryudo, 2014). Media helps students and teachers realize the learning objectives to be achieved; media provides opportunities for students who have studied in class to implement specific skills (Susandi, 2017).

Halim Fathani et al., (2022) State that the role of learning media is: (a) being able to provide good explanations of integer material by relating it to real life; (b) providing learning motivation in completing exercises; (c) there are no limits on time, space and sensory abilities of teachers and students; (d) students are expected to be able to improve by engaging in social interactions and other learning sources. l; (e) Students can study many materials independently according to their abilities and interests. (f) Students can make improvements to their learning outcomes. Learning media can help students, especially those who struggle to understand mathematics. Interactive learning media is one of the learning media that can be used. However, before the media is needed, it is necessary to carry out a feasibility test on the media. The aim of the research (Rufaidah et al., 2018) is to develop media until it reaches media status that is suitable for use. The suitability of the media is carried out in various trials such as expert, practitioner, small group, and field trials, then revised and so on until the media developed is suitable for use in the teaching and learning process.

Assessment and testing of learning media based on interactive learning media on integer material obtained the assessment results of 3 experts, namely very valid design experts with a validity score of 91.7%. The results of the media expert assessment were good, with a validity score of 81.7%. The results of the material expert assessment are valid, with a validity score of 90%. The assessment results of 2 practitioners (mathematics teachers and mathematics lecturers) generally showed that learning media based on interactive learning media on integer material was suitable for use with a score percentage of 85.4%. The trial results were in a small group of 13 students, learning media based on interactive learning media on integer material worthy with a percentage score of 87.7%. So overall, interactive learning media on integer material is declared suitable for use with a total validity score of 87%, so it can be concluded that interactive learning media on integer material is proper to use. In line with research results (Kurniawati & Nita, 2018), theoretically, learning media created using interactive multimedia is suitable for use.

Learning media with integer material is appropriate as a learning medium because it is easy to understand and helps students solve integer problems (Arindiono et al., 2013). Not only that, interactive learning media on integer material will be able to foster student independence in the learning process and improve students' critical thinking skills (Zulhelmi et al., 2017). (Novita & Harahap, 2020) they revealed that interactive media effectively increases mastery of concepts and students' enthusiasm for learning (Putri & Sibuea, 2015). Based on these several statements, it can be concluded that interactive media as a learning medium has many advantages for student progress, especially in this case, strengthening understanding of concepts in integer material. In this way, the learning objectives designed by the teacher will also be achieved optimally (Dwiqi et al., 2020).

CONCLUSION

Based on the results of validation test data analysis by media experts, 81.7% of the criteria were valid, and design experts produced 91.7% of the perfect criteria. To test the validity of the material, a percentage of 90% was obtained. The practicality test by mathematics teachers received

86.1%, and mathematics lecturers got 84.7%. Additionally, interactive media was also tested on 13 MTs At-Taawun students, resulting in a percentage of 87.7%. The results of validity tests by media experts, design experts, material experts, and practitioners showed that interactive media was suitable for use, with an overall percentage reaching 88.9%.

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Development of social studies evaluation media based on minimum competency assessment "MELUAS" questions for students at SMPN 1 Besuki

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ABSTRACT

Minimum competency assessment is one of the government's efforts to improve students' literacy and numeracy skills. For this reason, teachers must support it by applying it to learning activities. This research aims to develop social studies evaluation media based on minimum competency assessment "MELUAS" questions. The method uses RnD with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. The subjects used to assess the suitability of this product were 32 students in class VIII C at SMP Negeri 1 Besuki. Based on the questionnaire, the responses show that MELUAS is "very suitable" for use by students. The existence of MELUAS can increase users' reading literacy, attract students to conduct evaluation activities, and encourage the quality of students' enthusiasm. Recommendations for further research are to develop evaluation media based on minimum competency assessment questions, equip them with videos and animations on the question text stimulus, and add features that discuss the correct answers.

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INTRODUCTION

One of the efforts made by the government to improve the quality of human resources is strengthening literacy and numeracy. For this reason, literacy and numeracy are the standard focus that students must have. The benefit of literacy and numeracy is that students can adapt to environments outside the classroom (Noerbella, 2022; Fisabillillah & Rahmadanik, 2022). However, currently, the literacy and numeracy skills of students in Indonesia still need to improve. Indonesia is ranked in the bottom 10 of 70 countries with low literacy levels (OECD, 2018).

In line with this, the government in Indonesia has implemented a minimum competency assessment. According to Permendikbudristek Number 17 of 2021 concerning National Assessment, the aim of implementing minimum competency assessment is to measure cognitive and non-cognitive learning outcomes and the quality of the learning environment in educational units. Implementing a minimum competency assessment requires basic skills that participants must

have regarding reading literacy and numeracy (Novianti, 2021). Teachers must support the minimum competency assessment program with this program (Rohimat, 2021). Teachers can make efforts to support this program by implementing it in learning and teaching activities. One implementation during teaching and learning is by giving the teacher minimum competency assessment-based evaluation questions. The evaluation questions are prepared based on essential competencies and indicators by the applicable curriculum (Apertha et al., 2018). Apart from paying attention to critical competencies and indicators, when making evaluation questions, you must also pay attention to the standards for preparing minimum competency assessment questions. The standards consist of levels or levels of questions, question forms, and stimulus texts comprised of content and context; the last standard is learning progression (Wijaya & Dewayani, 2021).

The implementation of minimum competency assessment has one aim: presenting problems in various contexts so that students are expected to solve these problems with their reading literacy skills (Mursabdo, 2021; Murni, 2022). For this reason, evaluation questions based on minimum competency assessment questions can be applied to social studies subjects. Combining several basic social sciences in social studies learning is expected to give students an attitude sensitive to social problems (Lestari, 2017). Many previous studies have been carried out to apply minimum competency assessment to learning activities. Spin Microsoft PowerPoint based on minimum competency assessment literacy studied by (Vachruddin, 2021) aims to introduce the term minimum competency assessment questions through learning media. The development of this media shows that the category is suitable for use. This was discovered after carrying out validation tests on material and media experts and conducting trials on students. The weakness of this medium is that the questions presented are only in the form of multiple-choice questions.

Efforts to support minimum competency assessment for learning activities are carried out by providing student worksheets based on minimum competency assessment questions, which Sari (2023) studied; these student worksheets aim to make it easier for students to work on minimum competency assessment questions. This student worksheet development is very valid and based on the assessment of expert validators and user responses. The disadvantage of this student worksheet is that the questions presented are multiple-choice and fill-in-the-blank questions. Efforts to support minimum competency assessment in learning activities were also studied by (Rohimat, 2021) by creating minimum competency assessment-based worksheets. Making minimum competency assessment-based worksheets aims to improve the quality of learning by teachers or educators. The development of this worksheet is very suitable for use based on validation tests and limited group trials.

Previous research explains that efforts to support minimum competency assessment in learning activities are essential. However, in earlier research, minimum competency assessment questions were primarily developed in multiple-choice and short answers. Apart from that, not all answers to questions that students have worked on get marks automatically. To create variations of the questions and be able to assess the questions being developed automatically, the researcher studied the development of social studies evaluation media based on minimum competency assessment "MELUAS" questions. Based on initial observations and interviews conducted at SMPN 1 Besuki on 4 and 6 July, teachers have not supported minimum competency assessment during learning activities, nor have evaluation questions been based on minimum competency assessment. Submission of evaluation questions given to students is in paper form and sometimes uses Google Forms. Implementing learning activities that still need to support minimum competency assessment makes it necessary to carry out this research. A social studies evaluation media based on minimum competency assessment questions, or MELUAS was developed to overcome this.

MELUAS contains minimum competency assessment-based questions, which consist of 4 types of questions. These questions include multiple-choice, complex multiple-choice, matching, and fill-in-the-blank questions. This evaluation media was created using an Articulate storyline, and the appearance of this evaluation media was using Canva. This research is expected to contribute positively to developing more interactive evaluation methods that align with the minimum competency assessment approach in social studies learning at SMPN 1 Besuki.

METHOD

The method used in this research is included in research and development or what is usually called research and development. This research aims to develop evaluation media based on minimum competency assessment questions created using the Articulate Storyline application. The development of this evaluation media adapts the ADDIE development model. The development steps in the ADDIE model in Branch's book have five stages: analysis, design, development, implementation, and evaluation, as shown in Figure 1 (Branch, 2009).

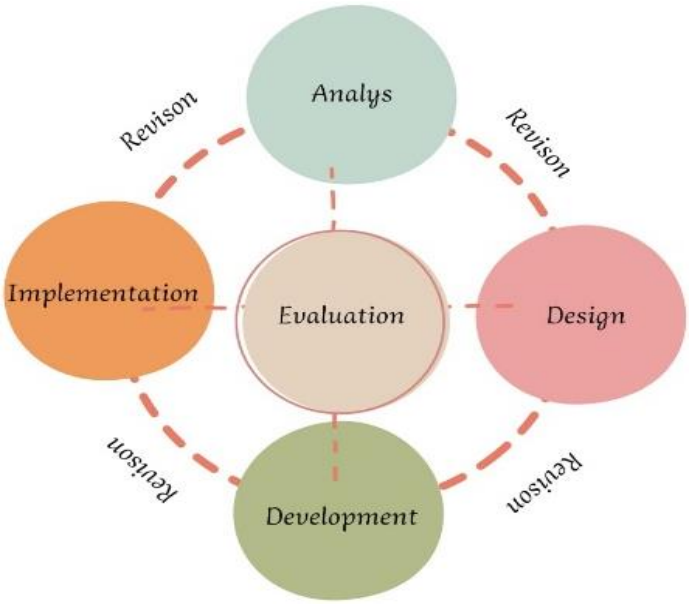

Figure 1. ADDIE Model (Branch, 2009)

The stages used are (1) Analysis, which analyzes the causes of performance gaps or problems and provides solutions to problems, which are used as the basis for developing MELUAS evaluations. (2) Design is used to verify the desired performance and determine the MEREAD test method. The design stage creates a list of tasks required in the next stage. (3) Development is used to develop and validate MELUAS that has been developed; once the media developed is valid, it can be continued at the next stage. (4) Implementation is the stage of preparing a learning environment that involves students. This stage involved 32 class VIIIC students at SMP Negeri 1 Besuki (5). Evaluation assessed the quality of the product before and after implementation. After carrying out the review, it can be seen that MELUAS is suitable for use as an evaluation medium during learning

The product produced in this research and development is social studies evaluation media based on minimum competency assessment "MELUAS" questions. This product is packaged in the form of an application for use on Android. This product specification was developed as an evaluation media based on questions in social studies subjects, taking subjects in class VIIIC at SMP Negeri 1 Besuki. MELUAS evaluation media was developed with two applications; the first, Canva, was used to design the appearance, and the second, Articulate storyline, was used to create the MELUAS application. The "MELUAS" evaluation media has several questions appropriate to the minimum competency assessment. The questions consist of multiple-choice, complex multiple-choice, matching, and fill-in-the-blank questions.

The data types obtained in this research and development are quantitative and qualitative. Quantitative data was obtained from the results of the MELUAS validation questionnaire, which consisted of language experts, evaluation experts, media experts, field trials, and feasibility tests.

Data analysis techniques in research and development are used to analyze quantitative data obtained from questionnaire scores by linguists, evaluation experts, media experts, field trials, and feasibility tests. Analysis can be carried out after all the necessary data has been collected. The results obtained from this data analysis are used to determine the validity and feasibility of the

evaluation media that has been created. To analyze the data using a formula adapted by (Akbar, 2013).

$$Va = \frac{\text{Tse}}{\text{Tsh}} \times 100\% \quad (1)$$

Information is the expert validity/field trial/feasibility test, Tse is the total empirical score, and Tsh is the total expected maximum score. After data analysis, interpretation and conclusions can be made according to Table 1.

Table 1. Data Analysis for Validation Tests, Field Trials, Feasibility Trials

No.	Value Achievement Criteria	Validity Level
1	81.00 % - 100.0%	It is valid, practical, and complete and can be used without correction.
2	61.00% - 80.00%	Valid enough, compelling enough, complete enough, can be used with minor improvements
3	41.00% - 60.00%	Less valid, less effective, less complete, needs major improvement
4	21.00% - 40.00%	Invalid, ineffective, incomplete, cannot be used
5	00.00% - 20.00%	Very invalid, very ineffective, very incomplete, not usable

Source: (Akbar, 2013)

RESULTS AND DISCUSSION

Results

Analysis

Analysis is carried out to identify possible causes of performance gaps (Branch, 2009). This identification is used to analyze problems that cause gaps. To achieve this goal, several processes must be gone through.

The first process is to validate the performance gap, or what is called validating the performance gap. Validating performance gaps is used to determine the leading causes of problems in the field. Determining this problem can be done by conducting interviews with teachers and students. The results of interviews with teachers concluded that the questions created did not meet the minimum competency assessment criteria due to a lack of time to develop these questions. The questions are usually taken from books and the internet and created by yourself, but they must meet the minimum competency assessment criteria. The conclusion obtained from the results of interviews with students is that the evaluation questions that are usually done still need to meet the requirements for minimum competency assessment questions. The evaluation media that students typically use in evaluation activities are paper and Google Forms. Criteria for evaluation questions that do not meet minimum competency assessment standards cause students not to have the knowledge and ability to master minimum competency assessment questions. Apart from that, using evaluation media that uses paper and Google Forms makes students feel less motivated when working on questions.

After finding this gap, the following process is to determine instructional goals. This stage is determining the solution to the existing problem. The solution is to create evaluation media using minimum competency assessment questions. This was chosen because the evaluation questions developed at that school needed to meet the minimum competency assessment criteria. The criteria for minimum competency assessment questions are that they have several forms of questions (multiple choice, complex multiple choice, short answers, matching), and there is stimulus text in the question reading, referring to a specific context (Wijaya & Dewayani, 2021). The evaluation media that will be created is named MELUAS. MELUAS is a social studies evaluation media abbreviation based on minimum competency assessment questions. The following Process confirms the intended audience or determines the target respondents. Social studies teachers and class VIII C students at SMPN 1 Besuki are the respondents to be addressed. The reason for choosing this class was that it was considered to be more conducive than other classes.

After determining the respondent, the process identifies required or desired resources. This step is used to determine the necessary resources. The resources are needed when creating and implementing learning using the evaluation media. The required resources include content resources consisting of minimum competency assessment-based evaluation media. Technology resources consist of laptops used in developing evaluation media and Android smartphones used by students so they can easily use the applications that have been developed. Facility resources require an internet network that is used in the process of creating and installing evaluation media applications. The human resources needed are expert validators (language, evaluation, and media); apart from that, students and teachers are used as research respondents.

The final process at the analysis stage is determining potential delivery or a possible delivery system. The possible delivery in this development research is minimum competency assessment question-based evaluation media created using the Articulate storyline. The articulate storyline was chosen because it has features for making several types of questions (Wahyuni et al., 2022), and the conversion results from this application can be an Android application that can be used offline (Febrianti et al., 2021). This stage is to prepare a plan according to the stages of ADDIE (Branch, 2009). This stage is made according to the estimated time in the ADDIE stage. The estimated time required from the analysis stage to the evaluation is approximately nine months.

Design

Design is the second stage to verify performance and determine appropriate testing methods (Branch, 2009). This stage is carried out after completing the analysis stage. The design stage has several processes in its implementation. Conducting a task inventory, or what is known as making a task list, is the process of recording what is needed to create minimum competency assessment question-based evaluation media. Several things are required to develop this media: lesson plans, question grids, minimum competency assessment questions, storyboards, application appearance design, and application creation using an Articulate storyline. Preparing this task makes it easier to create the evaluation media application. The process at this stage is used to develop performance objectives for making MELUAS. This performance objective has three expected components: what students do, the desired state of the performance objective, and the quality considered acceptable performance (Branch, 2009). This performance aims to develop MELUAS for students in learning activities to support the minimum competency assessment program. The following process is generating strategic testing or developing a testing strategy that will be carried out. This strategy includes the selection of expert validators for testing and designing the trials to be carried out. Language, evaluation, and media experts are the validators for assessing this media. Use individual, small group, and field trials for trial design. This stage of the process also creates the instruments used in this research. The expert validation instruments are in Table 2.

Table 2. Table of Validation Instruments

No.	Instrument		
	Language Validation	**Evaluation Validation**	**Media Validation**
1	Instructions for using language in the evaluation are clear	The level of relevance and assessment is by the curriculum	Media creativity and innovation
2	Use clear sentence structures.	Conformity of the contents of the evaluation questions to essential competencies	Ease of media operation
3	Accuracy and effectiveness in using sentences	Suitability of the contents of the evaluation questions with the learning objectives	Reusable or can be used repeatedly
4	The sentences used are clear and easy to understand	Conformity of the contents of the evaluation questions with learning indicators	Ease of button operation
5	Language content can motivate students.	The evaluation questions given are based on the material presented.	Use of typefaces in media
6	The language used is communicative.	The breadth and depth of the content of the evaluation questions	Consistent use of typeface in media
7	Encourage students to read.	The difficulty level of the evaluation questions is appropriate to the student's development.	Use of color
8	The language used in the	Clarity in instructions for working on	Use of button element

No.	Instrument		
	Language Validation	**Evaluation Validation**	**Media Validation**
	evaluation is appropriate to the student's development.	evaluation questions	layout in media
9	Accuracy of the spelling used	The questions presented in the evaluation questions are easy to understand	The use of image balance in media
10	evaluation sentences do not uses double meaning	Evaluation questions can support student independence	Use appropriate images
11		Encourage students' curiosity.	The attractiveness of media design
12		Able to increase students' knowledge	
13		Able to increase students' understanding	

(Source: Primary Data Processing, 2022).

After creating instruments for validation with linguists, evaluation, and media, the next stage is creating instruments for field trials. The field trial instruments are in Table 3.

Table 3. Field Trial Questionnaire Instrument and Response Test

No.	Indicator
1	I did not feel anxious when carrying out the evaluation using minimum competency assessment question-based evaluation media.
2	I understand the language in the minimum competency assessment question-based evaluation media text.
3	I understand the sentences in the minimum competency assessment question-based evaluation media text.
4	The sentences used in minimum competency assessment question-based evaluation media are explicit.
5	I can easily read the text on the minimum competency assessment question-based evaluation media.
6	Minimum competency assessment question-based evaluation media makes evaluation activities fun.
7	Minimum competency assessment question-based evaluation media is presented with an attractive appearance.
8	Minimum competency assessment question-based evaluation media increased my enthusiasm for reading literacy.
9	Minimum competency assessment question-based evaluation media makes me more enthusiastic about learning.
10	Minimum competency assessment question-based evaluation media needs to be developed in other materials/subjects.

(Source: Primary Data Processing, 2022).

Development

Development aims to develop and validate the media designed to be valid and suitable for application (Branch, 2009). The process at this stage is first to generate or create content. The content created is by the task list prepared previously. These tasks include lesson plans, question grids, minimum competency assessment questions, storyboards, application appearance design, and application creation using an Articulate storyline.

After all the task lists have been created, the following process is to select or develop supporting media, which means selecting or developing media. The press chosen to apply the evaluation media is an Android smartphone of at least version 7.0/7.1 Nougat 2016, with a minimum of 500 MB of free storage space. Developing guidance for the students is the process of creating guidelines for using evaluation media. Guidance is provided to the user separately before media administration. The aim is to prepare users to use the media that has been developed.

The following process is formative revision, a formative evaluation carried out by language, evaluation, and media expert validators. Language expert validator Della Fauziah Sari, S.Pd, is an Indonesian language subject teacher. The evaluation expert validator is a lecturer at the Bachelor of Social Sciences Education Study Program, State University of Malang, carried out by Khofifatu Rohmah Adi, M.Pd. The media expert validator is a lecturer at the Bachelor of Social Sciences Education Study Program, State University of Malang, carried out by Agung Wiradimadja, M.Pd.

After the validation results are declared valid, the next stage is conducting field trials. The field trial consists of 3 series: one-to-one trials with a total of 2 people, small groups with five people, and field trials with 20 people. Formative revisions are obtained by language expert validators, evaluation experts, and media experts. Additionally, one-to-one field trials, small group trials, and field trials are also carried out. The data obtained was obtained through a questionnaire that was distributed. Language validation was carried out on October 29, 2022, using 10 question components with added comments and suggestions columns. Data obtained from linguists can be seen in the following Table 4.

Table 4. Results of Quantitative Data Analysis by Linguists

No.	Expert	Percentage	Criteria
1	1st Stage Language Validation	77.5 %	Fairly Valid
2	2nd Stage Language Validation	90.0%	Very Valid

(Source: Primary Data Processing, 2022).

Based on the calculation data, 77.5% was obtained, included in the "quite valid" criteria. After improvements were made to the language aspect, revalidation was carried out, resulting in a percentage of 90.0%; the analysis results met the "very valid" criteria. Qualitative data and improvements in language aspects can be seen in the following Table 5.

Table 5. Qualitative Data from Language Expert Validation

No.	Error Type	Improvement Suggestions	Follow-up
1	There are no instructions for working on the questions that need clarification.	Give instructions on the problem	Provide instructions on questions
2	There are questions where the answer choices are not clear	give the correct answer to the question	Clarify the number of correct answers to the question
3	There is an incorrect sentence in the question, "What is the government doing to reduce society's barriers to social mobility?"	Correct the incorrect word.	What is the government doing to reduce society's barriers to social mobility at free public vocational schools?

(Source: Primary Data Processing, 2022).

The validation carried out by the evaluation expert consisted of 13 question components with added comment columns and scoring suggestions on the expert validator sheet with a Likert scale reference. This validation will be carried out on October 10, 2022, as shown in Table 6.

Table 6. Results of Evaluation Expert Quantitative Data Analysis

No.	Expert	Percentage	Criteria
1	1st Stage Evaluation Validation	90.38 %	Very valid
2	2nd Stage Evaluation Validation	96.16%	Very valid

(Source: Primary Data Processing, 2022)

Based on calculations in the language validation assessment, a percentage analysis of 90.38% was obtained, with the analysis results meeting the criteria of "very valid." The interpretation was declared “very valid”. Even though the interpretation results are announced as "very valid, " several things still need to be corrected according to the suggestions given by the validator. After making improvements, revalidation was carried out, resulting in a percentage of 96.15%, with the interpretation criteria declared "very feasible." From the results of these criteria, it can be concluded that the minimum competency assessment question-based evaluation media is suitable for testing without revising.

Table 7. Qualitative Data Validated by Evaluation Experts

No.	Error Type	Improvement Suggestions	Follow-up
1	Questions are not arranged based on question type	Questions should be set based on the question type	The questions have been sorted according to the question type
2	The word topic in one question differs from the competency	The word topic should be replaced with words related to the keywords related to	The follow-up action was to change the questions to

No.	Error Type	Improvement Suggestions	Follow-up
	and question grid. “The topic in the reading is	the question.	"Privilege is one of the driving factors in obtaining social mobility, the privileges obtained in this reading.
3	There needs to be an incorrect sentence in the question. "The things in the comic that are by the social mobility material are."	The sentences in the questions are replaced with social mobility concepts such as: "The following statement is related to the concept of social mobility in the comic."	The follow-up action was to change the questions to: "The following statement is related to the concept of social mobility in the comic."
4	There needs to be an incorrect sentence in the question. "If Nirmala school is Successful in implementing this program, then the factors that will encourage students at that school to gain Social mobility is."	The sentences in the questions are replaced with social mobility concepts such as: "If Nirmala School is Successful in carrying out the program that has been planned, then the factors that will encourage students to obtain a decent education are."	If Nirmala School successfully carries out the planned program, then the factors that will encourage students to obtain a decent education are.
5	There is an incorrect sentence in the question "Why is patriarchal culture mentioned in the reading?"		One of the factors inhibiting social mobility is patriarchal culture. Why is patriarchal culture mentioned in this reading?

(Source: Primary Data Processing, 2022)

Media validation consists of 10 question components with added comments and suggestions columns. Agung Wiradimadja, M.Pd, carried out media expert validation; the validation stage began on October 29, 2022. The presentation of quantitative and qualitative data can be seen in the following Table 8.

Table 8. Results of Quantitative Data Analysis by Media Experts

No.	Expert	Percentage	Criteria
1	1st Stage Media Validation	86.4 %	Very Valid
2	2nd Stage Media Validation	90.9%	Very Valid

(Source: Primary Data Processing, 2022)

Based on calculations from media validation, it produces a percentage analysis of 86.4% with an interpretation stated as "Very valid." Based on the results of these calculations, MELUAS was declared "very valid" for use. However, several things must be corrected according to the suggestions given by the validator. Based on the analysis of calculations in stage 2 media validation, the percentage was 90.9%, with the interpretation stated to be "very feasible." The media validation results concluded that developing evaluation media based on minimum competency assessment questions could be tested without revising. Qualitative data and improvements from media validation can be seen in Table 9.

Table 9. Qualitative Data from Media Expert Validation

No.	Error type	Improvement suggestions	Follow-up
1	The start button clicks are less noticeable.	Give instructions that the button must be clicked twice to start the application.	The click button starts to be edited according to the validator's suggestions.
2	The voice logo is not working.	The voice logo should function as a button so that the sound can be activated or muted	Check the voice button again
3	Not writing evaluation media for social studies subjects	Please also explain that This evaluation media is for social studies subjects; do more than write down the material.	The click button starts to be edited according to the validator's suggestions.

No.	Error type	Improvement suggestions	Follow-up
4	Give a name to the button below the participant's ID	The button has a different function on the evaluation page, even though the logo is the same. Please replace one of them	Changed button icon as per validator suggestion
5	Information buttons are presented on the home page (see image above)	It is best not to display it again	Removed button icon as per validator suggestion
6	The start button clicks are less noticeable.	Give instructions that the button must be clicked twice to start the application.	The click button starts to be edited according to the validator's suggestions.
7	The voice logo is not working.	The voice logo should function as a button so that the sound can be activated or muted	Check the voice button again
8	Not writing evaluation media for social studies subjects	Please also explain that this evaluation media is for social studies subjects; do not just write down the material	The click button starts to be edited according to the validator's suggestions.
9	Give a name to the button below the participant's ID	The button has a different function on the evaluation page, even though the logo is the same. Please replace one of them	Changed button icon as per validator suggestion
10	Information buttons are presented on the home page (see image above)	It is best not to display it again	Removed button icon as per validator suggestion
11	The writing on the questions instructions button is too close together.	Please adjust the font size and type	The font was revised according to the validator's suggestions
12	There are no user instructions for clicking the magnifying glass on the text.	Instruct students to click on the magnifying glass to read the text.	Added a hint for clicking on the validator suggestion magnifier

(Source: Primary Data Processing, 2022)

After experts conducted a validation assessment, field trials consisted of 3 series: one-to-one trials with two people, small groups with five people, and field trials with 20 people. The trial was carried out directly at SMP Negeri 1 Besuki. This trial was carried out by providing a response questionnaire to MELUAS evaluation media users. The response questionnaire consists of 10 components, filled out on a scale of 1 to 4. The questionnaire is a one-to-one trial with two people, as shown in Table 10.

Table 10. Field Trial Results

No.	Expert	Percentage	Number of Test Subjects	Criteria
1	One-to-one Trial	91.25 %	2	Very Valid
2	Small Groups	95%	5	Very Valid
3	Field Trials	98.63%	20	Very Valid

(Source: Primary Data Processing, 2023)

Based on the results of one-to-one trials, small groups, and field trials from the table, it can be stated that the social studies evaluation media based on minimum competency assessment "MELUAS" questions is very valid. This stage is used to prepare plans for the implementation stage of the product that has been developed (Branch, 2009). The strategy in the implementation stage involves teachers and students at SMPN 1 Besuki. Class VIII C will be involved in the implementation stage, totaling 32 students.

Implementation

This is the stage of preparing a learning environment that involves students (Branch, 2009). Implementation is aimed at preparing the students and teachers. The process of preparing the students and teachers can be used to determine the appropriate schedule for implementation. The schedule for the implementation stage is February 2 and 4, 2023, and it will involve 32 students who will provide response questionnaires. The teacher's response to MELUAS was obtained by

giving 12 questions and using a Likert scale reference. The response questionnaire to students involved 32 class VIII.C students using ten questions. The results of data analysis from user responses can be seen in Table 11.

Table 11. Results of response trials

No.	Response	Percentage	Criteria
1	Teacher Response	97.9%	Very Valid
2	Student Response	86.172%	Very Valid

(Source: Primary Data Processing, 2023)

The results of the response questionnaire were then analyzed. The analysis results from the student respondent questionnaire showed a score of 86.172%, categorized as "very feasible." The teacher's responses were then analyzed using percentage analysis techniques. The results of this analysis produced a percentage of 97.9%, categorized as "very feasible."

Evaluation

Evaluation is a stage that aims to assess product quality before and after implementation (Branch, 2009). Evaluation has several processes in its implementation. It is the determination of evaluation criteria in determining the media that has been created. The data obtained was processed to test the level of validity, field trials, and responses. The validity criteria and field trials are as follows: Formula 1.

Table 12. Data Analysis for Validation Tests, Field Trials, Feasibility Trials

No.	Value Achievement Criteria	Validity Level
1	81.00 % - 100.0%	It is valid, practical, and complete and can be used without correction.
2	61.00% - 80.00%	Valid enough, compelling enough, complete enough, can be used with minor improvements
3	41.00% - 60.00%	Less valid, less effective, less complete, needs significant improvement
4	21.00% - 40.00%	Invalid, ineffective, incomplete, cannot be used
5	00.00% - 20.00%	Very invalid, very ineffective, very incomplete, not usable

Source: (Akbar, 2013)

Conducting formative revision or selecting evaluation tools is a process in the second implementation stage. The tools used are validity questionnaire sheets, field trials, and feasibility. This questionnaire sheet contains quantitative and qualitative evaluation media assessments.

The final stage in the evaluation stage is an evaluation; at this stage, an assessment is conducted. This stage is carried out after all stages of ADDIE have been completed for necessary follow-up (Branch, 2009). The essential follow-up is to develop minimum competency assessment-based evaluation media on other materials or subjects.

Discussion

MELUAS needs analysis

This analysis stage validates performance gaps and solves these problems (Tambunan & Tambunan, 2023). The development of social studies evaluation media based on minimum competency assessment questions is one solution that can be used to solve problems at SMP Negeri 1 Besuki. The teacher still needs to implement minimum competency assessment in learning and teaching activities at this school. The function of implementing minimum competency assessment in learning and teaching activities is to enable students to recognize minimum competency assessment terms (Vachruddin, 2021). They apply minimum competency assessment in learning and teaching activities to help students answer minimum competency assessment questions (Sari, 2023). Learning activities that contain minimum competency assessment can also improve the quality of learning and teaching activities in the classroom (Rohimat, 2021). Implementing minimum competency assessments, including literacy and numeracy, can influence students' lives in the future (Skwarchuk et al., 2022). Literacy and numeracy skills can be used to develop the

knowledge they have so that they have the potential to provide benefits to society at large (Awgichew, 2022).

Evaluation media is needed by teachers and students in the learning process. The existence of evaluation media can make the learning process easier for teachers and students (Salsabila et al., 2020). The evaluation media is adapted to technological developments to make assessment easier (Prakoso & Rochmawati, 2020). Technology makes learning activities more interesting (Mada & Anharudin, 2019). The applications chosen to develop this evaluation media were Articulate Storyline and Canva. Articulate Storyline was selected because it can create evaluation media with various questions (Wahyuni et al., 2022). These questions are available in multiple templates that can be used according to needs (Rahayu & Ulumiyah, 2021). To make it easier for users to access the output from Articulate Storyline, it can be converted to HTML 5 (Daryanes, 2023); after being converted to HTML5, the resulting product can be made into an offline APK for smartphone users (Febrianti et al., 2021). Canva is a web-based application that can be used for free (Dogomeo & Aliazas, 2022). Teachers often use Canva to design graphic learning tools (Aiyedun, 2023). Canva has accessible and ready-to-use features such as ready-to-use templates, icons and illustrations, text and backgrounds, animation, duplication, download designs, and much more (Sari et al., 2020). Several benefits of Canva can make it easier for users to operate the application, so Canva was chosen to create the appearance of MELUAS.

User response in using MELUAS

Nowadays, students must understand reading literacy and numeracy, making it easier to adapt to the environment outside the classroom (Noerbella, 2022; Fisabillillah & Rahmadanik, 2022). Reading literacy and numeracy can be applied to learning activities (Yekple et al., 2021). For this reason, teachers must try to support minimum competency assessment in learning activities. One way to do this is to use reading literacy questions in learning evaluation activities. The learning evaluation must increase the user's enthusiasm for reading literacy. The learning evaluation process should be able to encourage the quality and enthusiasm for student learning (Idrus, 2019). The use of language is also adjusted to students' understanding to avoid misunderstandings of meaning by students (Fridayanti et al., 2022).

Implementing learning evaluations often causes anxiety for students. Students generally feel anxiety when carrying out evaluation activities; for this reason, evaluation tools or media are needed to make students feel comfortable using them (Latifah & Damayanti, 2022). Using pleased press means that the media can attract users, so learning evaluation activities can make students interested in doing them (Izza et al., 2020). Learning evaluations should be made innovatively and creatively so that students are interested and happy in carrying out these activities (Adhi, 2023). Besides being innovative and creative, learning evaluation activities should be interactive. The aim is to make students more enthusiastic about evaluating activities (Daryanes, 2023). MELUAS is an evaluation media developed to support the minimum competency assessment program. This media was designed to increase users' reading literacy, attract students to evaluation activities, encourage the quality of students' enthusiasm, and make users feel comfortable using it.

The feasibility test was carried out by giving a response questionnaire to students involving 32 class VIII.C students using ten questions. The assessment of each question item uses a Likert scale reference (Akbar, 2013). The results of the data analysis show a figure of 86.17%, which meets the criteria of "very feasible." Apart from being given to students, a questionnaire on the suitability of MELUAS evaluation media for use as learning was also given to teachers. The results of the teacher questionnaire were 97.9% with very adequate criteria.

CONCLUSION

The government's implementation of minimum competency assessment must align with the teachers' role in applying it to learning activities. However, not all teachers and schools implement this. MELUAS or minimum competency assessment question-based social studies evaluation media, is one of the products developed to support minimum competency assessment in learning activities. Based on user response tests from MELUAS, the results showed that this product is

suitable for use because it can increase the user's reading literacy, attract students to carry out evaluation activities, and encourage the quality of students' enthusiasm in carrying out evaluation activities. Suggestions for further research and development are to develop existing technology to obtain more interactive, creative, and innovative products according to students' needs. The following recommendation is to establish evaluation media with various questions, not only in the form of minimum competency assessment. The aim is to train the cognitive abilities of students.

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Primary school teacher education students' response to the use of Zoom meeting breakout rooms for small group discussions

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ABSTRACT

Learning that is carried out in class should be student-centered learning. One of the ways of student-centered learning is small group discussions. Developing technology also contributes to the development of the world of education. Learning using the small group discussion method can be presented online using Zoom Meeting. This application provides the Breakout Rooms feature, allowing users to create separate additional rooms in one meeting session. Therefore, this study aims to determine how students respond to using Breakout Rooms at Zoom Meetings. The research was carried out at the Primary School Teacher Education Study Program, Jambi University, in the even semester of 2023. This research was conducted on 34 semester four students. Research subjects were selected using a cluster random sampling technique. This research is descriptive. Data was collected using a questionnaire given to students via Google Forms. The data were analyzed by calculating the percentage of each statement on aspects of student response. The results of student responses are that Breakout Rooms are easy to use, helpful in supporting the learning process, making learning fun, and making discussions more focused and productive.

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INTRODUCTION

The learning process is all collaborative efforts between educators and students in processing information so that the knowledge gained is helpful for students and becomes a foundation for further learning and a driver for changes in students' behavior for the better (Nugraha, 2018). The learning process is also a process of interaction between educators and students and learning resources in a learning environment so that the process of acquiring knowledge, mastering skills, and forming attitudes occurs (Yestiani & Zahwa, 2020). So, the learning process is the interaction between lecturers and students in a learning environment in obtaining information and knowledge, mastering skills, and forming attitudes. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 3 of 2020 states that the characteristics of the learning process in higher education consist of an interactive, holistic, integrative, scientific, contextual, thematic, practical, collaborative, and student-centered nature. Student-centered means that graduate learning outcomes are achieved

through a learning process that prioritizes developing creativity, capacity, personality, and student needs and developing independence in seeking and discovering knowledge (Kemendikbud, 2020). Based on the Regulation of the Minister of National Education, the learning carried out in the classroom should be student-centered learning.

Student-centered learning is learning that focuses all learning activities on students. A student-centered learning process provides learning opportunities and experiences in building knowledge to obtain a deep and meaningful understanding (deep learning). Besides, lecturers change their function from teachers to learning partners, facilitators, and motivators. Therefore, it is essential to implement student-centered learning (Lestari & Sukanti, 2016; Wijayanti, 2011; Lathifah et al., 2021). One type of student-centered learning is small group discussions. Small group discussion is a process that involves a group of individuals in an interaction to exchange information, solve problems, and make decisions (Fikri et al., 2021). Learning through the small group discussion method can increase students' enthusiasm and activeness in the learning process (Ratnadi, 2018; Rusmiati, 2022). Small group discussions are a suitable method to apply if you want students to exchange ideas, think for themselves, respect each other, argue, and have critical thinking skills (Anggreni, 2019; Fauzan et al., 2022; Kurniawan & Roniwijaya, 2015). In the small group discussion method, educators will act as facilitators and motivators; apart from that, educators must also be able to control so that discussions align with learning objectives (Perawati, 2021; Suandi, 2022). Learning using the small group discussion method is usually applied to offline learning.

Learning had to be done online when the COVID pandemic hit or when the haze disaster occurred, which often hit the island of Sumatra, including Jambi Province. Rohima et al., (2021) stated that educators rarely held small group discussions during the COVID-19 pandemic because educators needed help creating a discussion space for each group and needed more time. Those teachers who still carried out discussion methods usually had classical discussions. Considering the importance of small group discussions in learning, during the pandemic, some educators created small group discussion groups for students whose homes were close by (Prasetyo, 2022; Rizal et al., 2022). Research on online discussions has been conducted (Sari et al., 2021). The media used was WhatsApp groups, but during the discussions, concerns arose from educators that students would carry out discussions outside the groups provided. These problems show the challenges of presenting small group discussion methods online but do not rule out the possibility of carrying them out online in line with the rapid development of technology.

Technology is developing very rapidly and has contributed to the development of the world of education. Learning using the small group discussion method can be presented online using Zoom Meeting. This application provides a Breakout Rooms feature, allowing users to create additional separate rooms in one meeting session. This feature can divide the class into several small groups to discuss in different rooms. Based on the description that has been presented, the author wants to know how students respond to the use of breakout rooms and Zoom meetings for small group discussions.

METHOD

The research method used in this research is descriptive. The descriptive research method is an activity to collect information and describe the situation and circumstances when the research was conducted (Zellatifanny & Mudjiyanto, 2018). The research was carried out at the Jambi University Primary School Teacher Education Study Program in the even semester of the 2022/2023 academic year. The research population was 177 students in the 4th semester of the 2022/2023 academic year from 5 classes. Research subjects were selected using cluster random sampling techniques. The research subjects in this research were 34 students in room 2.

The data in this research was collected using a questionnaire instrument. A questionnaire is a data or information collection technique that provides a set of questions that respondents will fill in to obtain responses that will be analyzed (Cahyo et al., 2019; Rahman, 2019). Questionnaires were given to students via Google Forms. Data were analyzed by calculating the percentage of each statement in the student response aspect. The data is presented in descriptive statistics as graphs,

automatically available in the completed Google Forms results. The validity and reliability of the questionnaire were calculated using SPSS 25. The questionnaire used in this research is listed in the following Table 1.

Table 1. Student Response Questionnaire

No.	Statement	Disagree (1)	Agree (2)	Strongly agree (3)
1	Breakout Rooms on Zoom are helpful for Learning			
2	Breakout Rooms on Zoom are easy to use			
3	Using Breakout Rooms on Zoom for group Discussions makes Learning fun.			
4	Using Breakout Rooms on Zoom can increase Productivity in Group Discussions.			
5	Using Breakout Rooms on Zoom makes Discussions more Focused without being Distracted by other Groups.			

RESULTS AND DISCUSSION

Results

Research data was obtained by distributing questionnaires to 34 students consisting of 5 Statements. These indicators were selected using the disagree, agree, and strongly agree criteria. Data on the results of distributing the questionnaire can be seen in Table 2.

Table 2. Recapitulation of Questionnaire Results

No.	Statement	Disagree (1)	Agree (2)	Strongly agree (3)
1.	Breakout Rooms on Zoom are helpful for Learning	6	20	8
2.	Breakout Rooms on Zoom are easy to use	6	23	5
3.	Using Breakout Rooms on Zoom for Group Discussions makes Learning fun	5	17	12
4.	Using Breakout Rooms on Zoom can increase Productivity in Group Discussions	3	18	13
5.	Using Breakout Rooms on Zoom makes Discussions more Focused without being Distracted by other Groups	6	15	13

From the questionnaire data obtained, the questionnaire's validity is calculated using SPSS 25. The results of the questionnaire validity test using SPSS can be seen in Table 3.

Table 3. Questionnaire Validity Test Results

No.			Correlations					
			P1	P2	P3	P4	P5	Total
1	P1	Pearson Correlation	1	.329	.516**	.179	.422*	.701**
		Sig. (2-tailed)		.058	.002	.311	.013	.000
		N	34	34	34	34	34	34
2	P2	Pearson Correlation	.329	1	.245	.192	.663**	.679**
		Sig. (2-tailed)	.058		.162	.278	.000	.000
		N	34	34	34	34	34	34
3	P3	Pearson Correlation	.516**	.245	1	.347*	.336	.707**
		Sig. (2-tailed)	.002	.162		.045	.052	.000
		N	34	34	34	34	34	34
4	P4	Pearson Correlation	.179	.192	.347*	1	.392*	.600**
		Sig. (2-tailed)	.311	.278	.045		.022	.000
		N	34	34	34	34	34	34

No.			Correlations					
			P1	**P2**	**P3**	**P4**	**P5**	**Total**
5	P5	Pearson Correlation	.422*	.663**	.336	.392*	1	.810**
		Sig. (2-tailed)	.013	.000	.052	.022		.000
		N	34	34	34	34	34	34
Total		**Pearson Correlation**	**.701****	**.679****	**.707****	**.600****	**.810****	**1**
		Sig. (2-tailed)	**.000**	**.000**	**.000**	**.000**	**.000**	
		N	**34**	**34**	**34**	**34**	**34**	**34**

A statement is valid if the calculated r is greater than the r table. The r table value for a sample size of 34 people at a significance level of 5% is 0.339. The calculated r value for Statement 1 (P1) to Statement 5 (P5) is 0.701, 0.679, 0.707, 0.600, and 0.810. So, all statements in the questionnaire are valid.

These valid questionnaire statements were then tested for their level of reliability using SPSS 25. The results of the reliability test can be seen in the following Table 4.

Table 4. Questionnaire Reliability Test Results

No.	Reliability Statistics	
	Cronbach's Alpha	**N of Items**
1	.742	5

The questionnaire is reliable if Cronbach's Alpha value is above 0.60. The Cronbach's Alpha value in the reliability test was 0.742. This shows that this questionnaire is reliable.

The research results on student responses to the statement "Breakout Rooms on Zoom are useful in learning" can be seen in the graph in Figure 1. Based on the graph, 17.6% of students disagree, 58.8% agree, and 23.5% strongly agree with this statement. This means that Breakout Rooms in Zoom Meetings are helpful in learning.

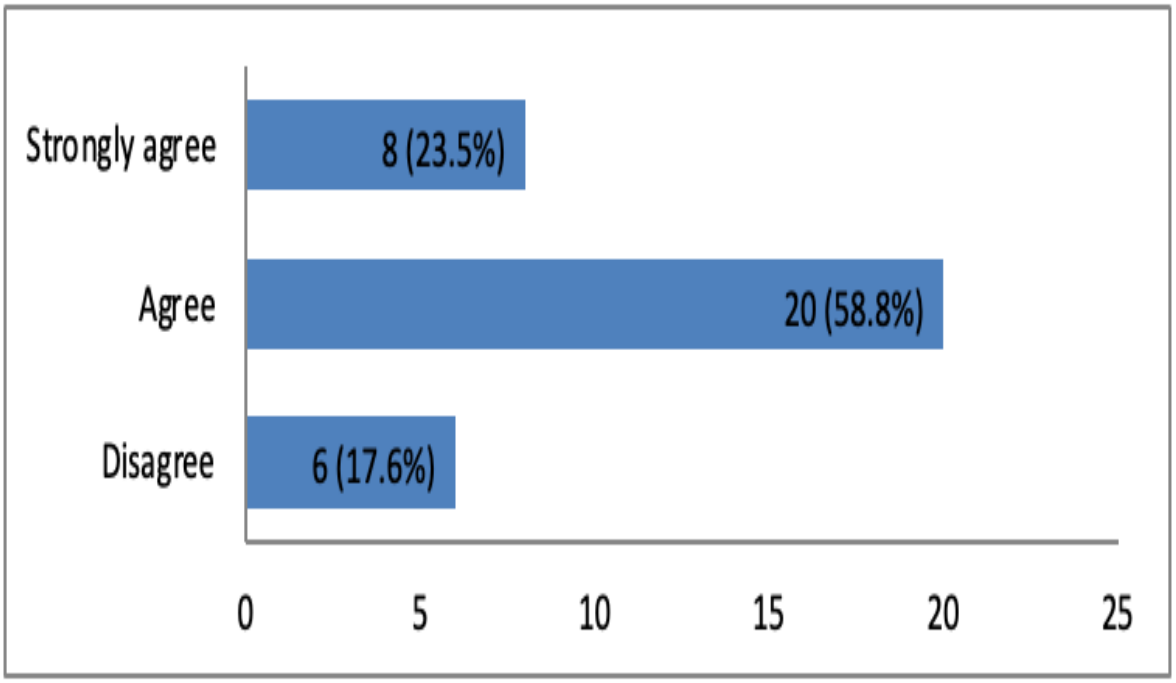

Figure 1. Breakout Rooms on Zoom are helpful for Learning

The research results on student responses to the statement "Breakout Rooms on Zoom are easy to use" can be seen in the graph in Figure 2. Based on the graph, 17.6% of students disagree, 67.6% agree, and 14.7% strongly agree with this statement. This means that Breakout Rooms in Zoom Meetings are easy to use.

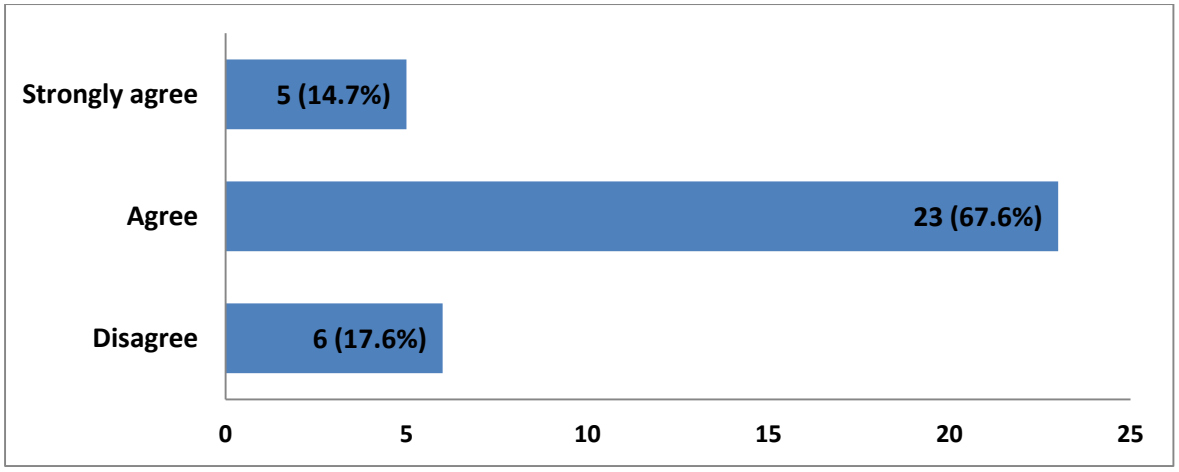

Figure 2. Breakout Rooms on Zoom are easy to use

The research results on student responses to the statement "Using Breakout Rooms on Zoom for group discussions makes learning fun" can be seen in the graph in Figure 3. Based on the graph, 14.7% of students disagree, 50% agree, and 35.3% strongly agree with this statement. Breakout Rooms in Zoom Meetings for group discussions make learning fun.

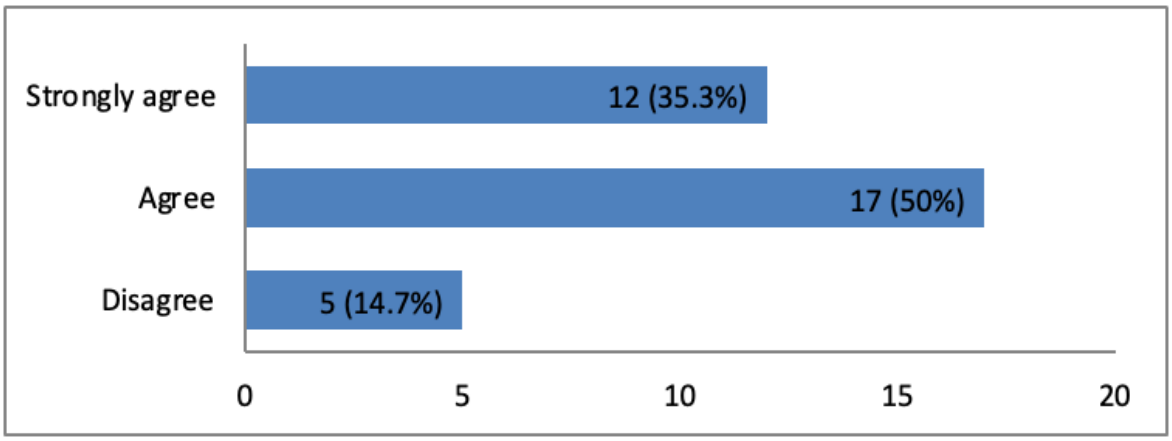

Figure 3. Using Breakout Rooms on Zoom for Group Discussions makes Learning fun

The research results on student responses to the statement "Using Breakout Rooms on Zoom can increase productivity in group discussions" can be seen in graphic figure 4. Based on the graphic, 8.8% of students disagree, 52.9% agree, and 38.2% strongly agree with this statement. This means that Breakout Rooms in Zoom Meetings can increase productivity in group discussions.

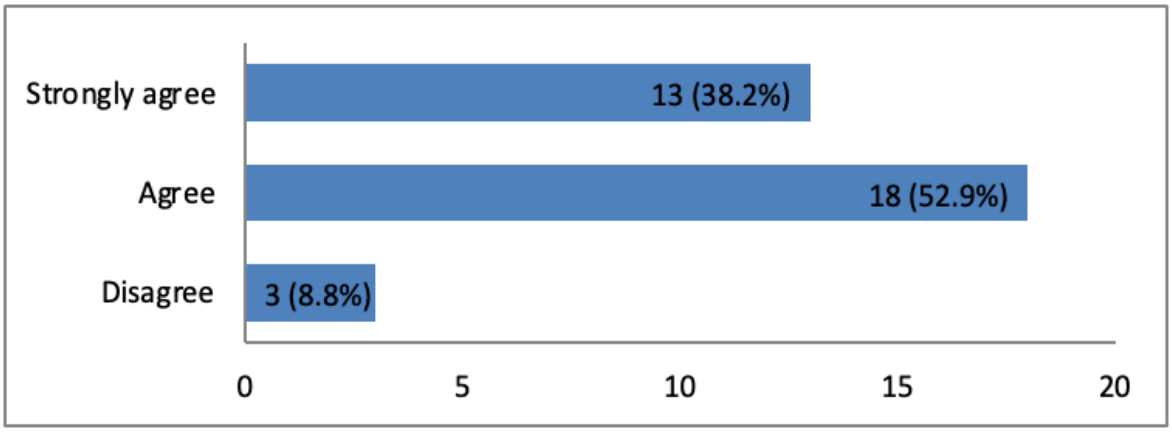

Figure 4. Using Breakout Rooms on Zoom can increase Productivity in Group Discussions

The research results on student responses to the statement "Using Breakout Rooms on Zoom makes discussions more focused without being distracted by other groups" can be seen in the graph in Figure 5. Based on the graph, 17.6% of students disagree, 44.1% agree, and 38.2% % of students strongly agree with this statement. This means that Breakout Rooms in Zoom Meetings make discussions more focused without being distracted by other groups.

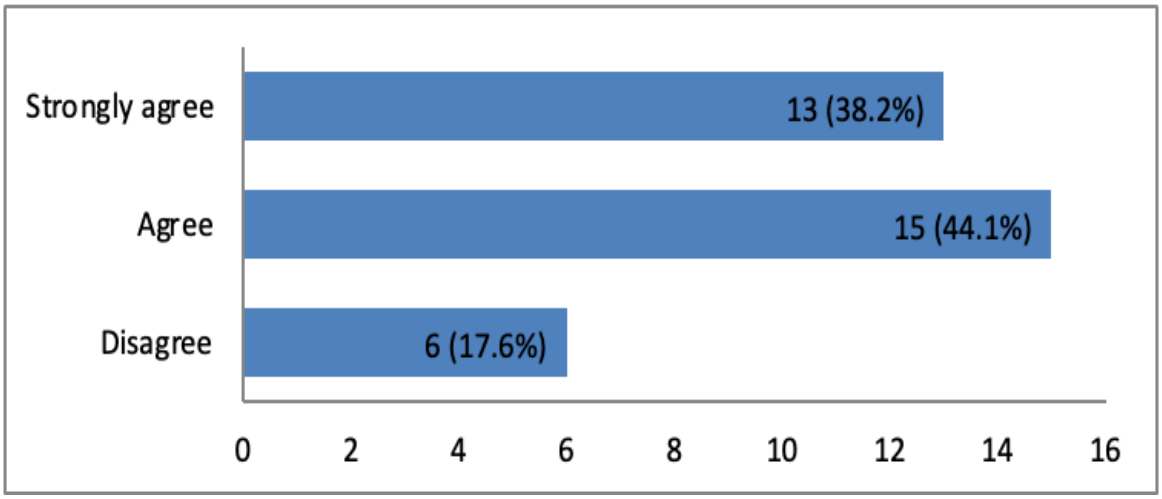

Figure 5. Using Breakout Rooms on Zoom makes Discussions more Focused without being Distracted by other Groups

Discussion

The first statement, "Breakout Rooms on Zoom are useful in learning," received a positive response from students. Zoom meetings help learn when learning must be online, such as during the COVID-19 pandemic and the haze disaster. Zoom meetings bring together lecturers and students live and can interact directly as if they were meeting in the real world via video conference. This follows the opinion of Putri (2020), who stated that the Zoom meeting application is a video conference application whose name became popular during the pandemic and was often chosen as a substitute for face-to-face facilities, including lecturers conducting lectures.

Implementing online learning using Zoom Meetings does not rule out the possibility of carrying out small group discussions. Breakout rooms and Zoom meetings help facilitate this. Small group discussions are an essential activity in learning because group discussions make students actively provide ideas and opinions on the topic being studied. This follows Hayun (2019) opinion of those who discuss training the courage to express opinions, ask questions, answer questions, conclude, and provide suggestions on the material studied and train communication and cooperation. Learning through the small group discussion method can also increase enthusiasm and activeness in the learning process (Ratnadi, 2018; Rusmiati, 2022). During learning, students are divided into five groups, which are divided into five Breakout Rooms. Students hold discussions with their respective groups in Breakout Rooms. Afterward, they returned to the main Zoom meeting room to present the group discussion results to all students.

The second statement, "Breakout Rooms in Zoom Meetings are easy to use," also received a positive response. Many people choose Zoom Meeting because it is easy to use and provides various features that can support learning. One of the features is the Breakout Room. Breakout Rooms in Zoom Meetings are easy to use. Students click Join on the available Breakout Rooms according to their assigned groups. Only 14.7% of students thought Breakout Rooms were not easy to use because the research subjects used the Breakout Rooms facility on Zoom for the first time. They are used to using Zoom Meetings, especially when the COVID pandemic hit, but have never been facilitated to use Breakout Rooms. To overcome this, the lecturer, as host of the Zoom meeting, can also directly enter students into each breakout room according to the groups that have been distributed.

Figure 6. Students began to enter Breakout Rooms according to their Groups

The third statement, "Using Breakout Rooms for group discussions makes learning fun," also received a positive response. Students feel happy because they are more accessible in group discussions without any intervention from lecturers or other groups. This is because the participants who enter the Breakout Rooms are only members of their respective groups, so students have more freedom to express opinions regarding the assignments given by the lecturer. Lecturers can visit the Breakout Room one by one to see the progress of the discussions carried out by each group. The lecturer only acts as a facilitator who controls the debate so that the discussion is in line with the learning objectives.

The fourth statement, "Using Breakout Rooms on Zoom increases productivity in group discussions," also received a positive response. This is because they can discuss while preparing presentation materials during discussions with other groups. Students can discuss things that will be presented and write directly on Microsoft PowerPoint. Presentation materials in the form of Microsoft PowerPoint can be instantly displayed on the Breakout Rooms screen for each group via the Share Screen feature. Microsoft PowerPoint can help you understand the material, increase interest, motivate, and focus on learning.

The fifth statement, "Using Breakout Rooms in online learning discussions makes discussions more focused without being distracted by other groups," also received a positive response. Students join Breakout Rooms, which consist of their groups. They can focus on discussing the topic that is their assignment. The voices of friends from other groups will only be heard if their discussion rooms are separated through the Breakout Rooms facility. This is, of course, different from group discussions in class. Between one group and another, the sound of each group's discussion will be heard, often making the debate less conducive. A conducive atmosphere can increase concentration, especially in understanding lesson material (Tambunan et al., 2020). A conducive learning environment is also related to the quality of learning, which will provide motivation and resilience in learning (Jumrawarsi & Suhaili, 2020).

CONCLUSION

Based on the research results, it can be concluded that students' responses to the use of Breakout Rooms Zoom Meetings for small group discussions received positive responses for all aspects asked in the questionnaire. Students gave positive feedback that Breakout Rooms were easy to use, helpful in supporting the learning process, made learning fun, and made discussions more focused and productive. Recommendations for further research are to see the effectiveness of using Breakout Rooms on student learning outcomes.

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Teachers' belief and implementation of ICT in early childhood education classroom

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ABSTRACT

Technology has a vital role in every aspect of life. Early childhood education also requires technology in its learning. This study aims to analyze teacher beliefs and explain the application of ICT in Early Childhood Education (ECE) classes. This research uses mixed methods, questionnaires, and interviews as data collection tools. Questionnaires were used to obtain data related to ICT used in ECE and teacher beliefs, while interviews were used to obtain data on the implementation of ICT in ECE classrooms. The sample was 132 ECE teachers in Magelang, Central Java, and Yogyakarta. The sampling technique used is a simple random sampling technique. Regression analysis is used in this study's data analysis technique. The results obtained include 1) 40% of teachers use laptops in class, 2) 26.67% of teachers never involve children in using ICT, and 3) there is a relationship between educational background and ICT implementation beliefs in class. Implication This study aims to hold workshops for ECE teachers to apply ICT in learning activities involving children in their use.

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INTRODUCTION

In today's era, they are quickly taking advantage of modern technology to meet the needs of human life. Every aspect of human life will be increasingly diverse in technology used in education. This dramatically affects the learning process conducted by schools during the COVID-19 pandemic. The learning process is carried out at home, so teachers must develop strategies so that learning can occur even if they do not interact face-to-face with their children. Therefore, the education ministry's policy in Indonesia recommends using technology as a bridge so that the learning process can proceed well. Schools welcomed the policy to be able to conduct learning activities through video conferencing, Zoom, educational shows on TV, and WhatsApp Group/WAG features (Aprianti & Sugito, 2022). Until the end of the COVID-19 pandemic, which has decreased and started to

normalize, technology in learning became a variation in teaching activities between teachers and students. The learning process is becoming more exciting and varied. In addition, the application of technology in learning will provide teachers with the challenges of providing children with the skills and knowledge needed to develop today and in the future (Fox-Turnbull, 2019).

All levels of education must be involved and take advantage of technological advances (Hatzigianni, 2018). This is because education is a lifelong process with no definite beginning or end, and new technology penetrates everything we do in 21st-century life. ICT utilization is also included in early childhood education levels. Information and Communication Technology (ICT) is widely used in education, policy, and practice research. In recent years, the communication dimension of ICT has been considered equally important. ICT can be defined as anything that allows us to get information, communicate with each other, or influence the environment through electronic or digital equipment.

The term ICT may include a type of hardware and software, including television, video, digital camera, radio tape recorder, smartphone, computer, internet, interactive blackboard, projector (Kamaruddin et al., 2017), digital gameplay (CD), laptop computer (Hu & Yelland, 2017) and augmented reality and electronic book (Sulistyaningtyas et al., 2023). These technologies can be applied to early childhood learning activities. Based on literature studies conducted by Undheim (2022), technology can be incorporated into mathematics learning activities using computers or interactive blackboards to teach children numeracy and addition and literacy learning activities using iPads and digital picture book applications. This reading activity allows children to communicate, collaborate, explore, and create meaningful products. It also includes exploration activities using tablets, digital microscopes, and trace cameras to encourage children to observe and discover objects in the neighborhood.

The use of ICT in early childhood education is still a pros and cons. Based on the results of a study conducted by Romero-Tena (2020), the use of ICT in Early Childhood Education still needs to be improved. Many factors affecting ICT use in Early Childhood Education include age, gender, teacher confidence in ICT use, ICT accessibility, and ICT training (Hasbi et al., 2020). The research conducted by Susanti (2020) aims to describe the use of technology for early childhood both in the family and school environments. Involving 20 parents who have 3-6-year-olds, the result is that children use their cell phones more often at home, and many parents still need to give control over their use.

Such practices make parents and teachers feel that early childhood does not need to be introduced to technology from an early age. Some literature suggests at least three reasons for the importance of ICT in early childhood education: 1) ICT has influenced people and the environment around children's learning, 2) it offers new opportunities to strengthen many aspects since early childhood education practice, and 3) there has been supporting and interest throughout education integrates sectors for ICT development and integration into educational policies, curriculums, and practices (Hasbi et al., 2020). In addition, technology emphasizes products, processes, competencies, and institutions, and children are encouraged to consider environmental and political issues when involving technology (Hatzigianni, 2018). However, the use of technology in learning at the early childhood education level has yet to be discussed.

The use of technology in the classroom depends on the role of the teacher. With its pedagogical capabilities, entry into the digital age is not an allergy. Educational competencies are included in the competence called "Teacher of the 21st Century" (Ghavifekr et al., 2016). Of course, teachers have more complex technology-related abilities. This media is expected to be innovative and support children's development from various life, social, and cultural aspects. Some research literature and disciplines state that digital technology can be used as a means of critical thinking to document children's learning and that all levels of education must be involved and utilize these technological advances. ICT is important in early childhood education because of the opportunities and potential offered in this sector. It includes opportunities to 1) support and enhance children's learning and playing experiences; 2) support and strengthen the learning and development of practitioners' professionals; 3) support and strengthen relationships and communication between children, parents, and others connected to early childhood education (Yang & Hong, 2022).

Confidence and equality of teacher satisfaction influence their practice of combining ICT in their teaching process with traditional pedagogy and, consequently, the child development process. Since preschool teachers make several decisions in early education settings, it is essential to emphasize teachers' approaches and views. An important factor in integrating ICT into learning depends on the teacher's skills and attitudes toward ICT (Kerckaert et al., 2015). Teachers' positive approach to new technologies in early education can accelerate ICT integration. Teachers who believe that the value of ICT education can lead children to technology-related activities and integrate these activities into the preschool curriculum.

A study conducted by Konca & Erden (2021) related to the use of digital technology by preschool teachers in the classroom involving 167 preschool teachers in the central region of Turkey found that although teachers have sufficient technology resources and positive attitudes towards using these devices in classroom activities, their use of technology is limited to several types of activities. Unfortunately, the study did not explain teachers' beliefs in the use of technology in early childhood. At the same time, teacher beliefs are one of the factors for implementing technology in the classroom. The following study conducted by Hoareau et al., (2021) involving 214 kindergarten teachers in Northern France found that teachers needed more confidence in using technology in the classroom. The use of applications in the school for the learning process is also low. The study describes teachers' beliefs in using technology and applications in early childhood learning. However, more in-depth data is needed to strengthen the results of the questionnaire that has been obtained. So, teacher confidence in technology, both hardware and software and its implementation need to be studied further to get more in-depth results on using technology in learning in ECE classrooms.

Teachers' beliefs in the use of technology are one factor in implementing technology in classroom activities. This shows the importance of studying teacher beliefs and using technology as a data source to improve or change teacher beliefs to be positive. Technology will be used effectively and efficiently depending on teachers' beliefs as facilitators of children in the classroom. Unfortunately, studies on teacher beliefs in technology use in early childhood classrooms are still minimal. Therefore, the study aimed to determine teachers' beliefs in using technology in ECE classrooms during learning. This research also explores the implementation of technology in learning in ECE, hoping to contribute positively to developing more effective and efficient technology usage strategies in early childhood education.

METHOD

The type of research used is a mixed method by combining quantitative research with qualitative. The population in this study is teachers who teach at Early Childhood Education (ECE) institutions, among them kindergarten, playgroup/preschool, and Daycare in Magelang and Yogyakarta. The research sample is 132 teachers. The sampling technique used is a simple random sampling technique.

The data collection techniques used are questionnaires and interview sheets. The demographic data from respondents' identities include respondents' initials, age, educational background, length of teaching, and type of institution to teach. The data collection related to the application of technology used by teachers adopted a questionnaire (Zaki, 2013). Aspects of the questionnaire related to ECE teachers' beliefs regarding implementing technology in learning included preschool teachers' beliefs, comfort with ICT, and current use of digital technologies. The teacher's confidence level in applying technology in learning was adopted (Nikolopoulou, 2015).

Analysis of this research data uses descriptive statistical analysis by calculating the mean, percentage, and amount. Data was obtained from the descriptive statistical analysis results by presenting respondents' demographic data, ICT utilization questionnaire data, and teacher perception. It was also analyzed using regression analysis.

Furthermore, qualitative data analysis using thematic analysis by presenting data descriptively from interviews with teachers and data obtained from descriptive statistics on teacher utilization and perception in implementing ICT in ECE learning.

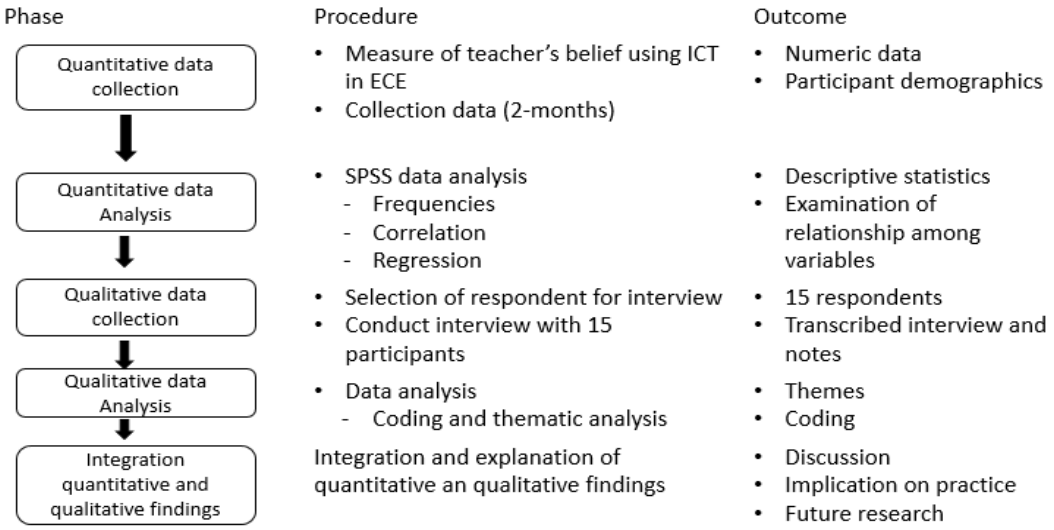

Figure 1. Design Mixed Methods

RESULTS AND DISCUSSION

Results

This study aims to explain the implementation of Information and Communication Technology (ICT) in early childhood learning. Data collection methods are questionnaires and interviews with instruments used by questionnaires and interview sheets. Questionnaires were randomly given to early childhood teachers aged 0-6 years. Next, the interview is done online. Techniques spread lift and interview using Survey Monkey. Demographic Data obtained from the questionnaire distribution can be seen in Table 1.

Table 1. Data Demographic

No.	Aspect	Description	Percentage	Aspect	Description	Percentage
1	Gender	Male	3.13	Teaching to Children Aged	2-3 years	6.25
		Female	96.87		3-4 years	46.88
					4-6 years	46.88
2	Age	<20	3.13	Number of Class Students	1-5	16.67
		21 – 25	15.63		10-15	30
		26 – 30	31.25		16-20	23.33
		31 – 35	21.88		21-25	20
		35 – 40	9.38		>26	10
		41 – 50	15.63			
		>51	3.13			
3	Teacher's Role in the Classroom	Class Teacher	84.38	Teachers' Years of Teaching Experience	<3	18.75
		Assistant Teacher	15.63		4-8	25
					9-13	37.5
					14-18	18.75
4	Teachers' Years of Working in Current Workplace	<3	25	Teachers' Educational Level	Master	3,13
		4 – 8	37.5		Bachelor	65.63
		9 – 13	25		Diploma	3.13
		14 – 18	12.5		High School	28.13
5	Number of computers in the classroom	none (0)	60	Number of computers in the school	None (0)	6.67
		1	33.33		1-2	60
		2	6.67		3-4	13.33
					5-6	13.33
					>6	6.67

Based on The answers given by the respondents in Table 1, 96.87% of the teachers who filled in were female. The age range is 26-30 years, with a percentage of 31.25%. The highest educational background at the bachelor level is 65.63%. The role of teachers in the classroom is mostly class teachers, with a percentage of 84.38%. The number of computers owned by the school mostly ranges between 1 and 2, with a rate of 60%. Furthermore, the number of computers in the classroom is mainly answered no with a percentage of 60%.

Frequency of ICT Used in Class Early Childhood Education

The questionnaire results from the respondents showed the frequency of various technologies in the classroom. In addition to the technology used in the school, the frequency of using technology in software is also presented in this study. In addition, data related to technology implementation in the classroom was obtained from respondents, both technology activities carried out by teachers and children, between teachers and children, and between children and children.

Table 2. Technology Used in the Classroom

No.	ICT	Percentage (%)
1	Desktop computer	16.67
2	Laptop	40
3	Netbook	3.33
4	Tablet (iPad)	3.33
5	TV	33.33
6	Interactive Whiteboard	0
7	LCD	26.67
8	DVD	13.33

Table 2 shows that the most used technology in the classroom is laptops (40%), followed by televisions (33.33%) and LCD (26.67%). The least used technology was netbooks and tablets (3.33%), and the least used technology was interactive whiteboards (0%).

Table 3. Frequency of the use of ICT in the Classroom (n=132)

No.	Indicator	Every day (%)	All day (%)	Several days once (%)	Not every week (%)	Never (%)	Do not have in the Classroom (%)
1	Playing Educational Games (Online Educational Websites)	5	0	20	35	15	25
2	Searching the Web for Teachers	50	5	25	10	0	10
3	Searching the Web by Child	5	0	10	25	35	25
4	Master typing by using a Program (such as Microsoft Word or WPS)	50	0	30	10	0	10
5	Child Typing using a Program (such as Microsoft Word or WPS)	0	0	10	5	55	30
6	Drawing by utilizing a Program Conducted by the Teacher	0	5	20	25	30	20
7	Drawing by utilizing a Program Conducted by the Child	5	5	10	20	45	15
8	Other Programs	0	5.56	16.67	27.78	33.33	16.67
Average		**14.38**	**2.57**	**17.7**	**19.73**	**26.67**	**18.95**

Table 3 shows the frequency of the activities done by the teacher and the child using technology in software. All activities using ICT that children do are rarely done in school. It can be seen that the percentage of the item t has the highest value. In contrast to the use of ICT by teachers, almost all items have a high-frequency rate every day, and every few days, search activities are done

through the web and typing using programs (such as Microsoft Word or WPS). However, using a teacher program, the highest frequency percentage is never done in the drawing activity (30%).

The interview results related to the activities carried out using ICT obtained various responses. There are 4 out of 15 who use ICT involving children. One of the opinions of educators:

"When showing children about erupting volcanoes, they look more excited" (Yu, W 5, 2023)

Another opinion:

"Looking for answers to questions given by children so that children can get concrete answers with children's images" (Bu, W 5, 2023)

Next, 10 teachers out of 15 use ICT for administrative purposes. One of the teacher's opinion:

"Using ICT is very helpful when we have to present and process learning activities. As our reference material when less able to make props and soon."(Is, W 5, 2023)

Another opinion:

"Using ICT to search for ideas for teaching materials" (Ti, W 5, 2023)

Table 4. Teacher's Report about the Frequency of the Practice of ICT in the Classroom (n=132)

No.	Indicator	Every day (%)	All the day (%)	Some days (%)	Not every week (%)	Not ever (%)
1	A Discussion Directed by the Teacher about how to get Information through the Web	10	0	25	25	40
2	Small Group Discussion Directed by the Teacher about how to get Information through the Web	0	0	20	30	50
3	Taught in Particular the Ability to Search the Web	0	0	15	25	60
4	Children Lead a Demonstration with Classmates about how to use Technology	0	0	5	25	70
5	Children Initiated the Discussion with the Teacher about how to Find Information	5.26	0	10.53	26.32	57.89
6	The Child-Teacher Interacts in Front of a Computer	0	0	30	30	40
7	The Child-Teacher Interacts by doing a Web Search	0	5	15	30	50
8	Children Interact in front of a Computer	0	0	20	35	45
9	Children Interact Together and Perform a Search using the Web	0	0	10	25	65
10	Individual Child in front of a Computer	0	0	10	15	75
11	Individual Children do a Search using the Web	0	0	5	10	85
12	I am combining DiffeRent Sources of Information Search (e.g., Books, Brochures, Internet).	5	10	25	40	20
Average		**2**	**1**	**16**	**26**	**55**

Report to teachers about the frequency of the practice of ICT and the Internet in the classroom. According to Table 4, the results show that a percentage of the most frequent teachers only do some of the activities related to the practice of ICT and the internet with the child in the classroom. However, some teachers report doing it frequently, once every few days or not every week. However, combining various sources of the information search is the highest frequency, although only some weeks (40%). Some never do it. Teachers dominate the activity, so the percentage varies in each frequency.

The results of interviews conducted by early childhood teachers about the perception of teachers related to the application of ICT in early childhood learning have obtained various

responses. Some teachers support the application of ICT in learning, but some teachers need to keep technology in the classroom. There are 11 of the 15 teachers interviewed agreed with the application of ICT in learning. One of the teachers ' opinions in favor of the presence of technology in the classroom:

"Teachers need to introduce ICT in early childhood, to be technologically literate. As an aid to learning media." (En, W 2, 2023)

Another opinion:

"It is easy for teachers to give activities that can be packaged interestingly." (Ros, W 2, 2023)

There are 4 out of 15 teachers disagree with the existence of ICT to be applied in the classroom. One of the opinions of teachers who do not support the existence of technology in learning:

"Using a computer will reduce the interaction of children with each other because children will only focus on the computer screen in front of them." (Is, W 2, 2023)

Another opinion:

"For children of early age, the application of ICT is not so important." (Ar, W 2, 2023)

Another teacher's opinion about the lack of support for Technology:

" ICT for early childhood education is not too important to let children socialize with friends and the environment first" (Lu, W 2, 2023)

Teachers' beliefs about the application of ICT in Early Childhood

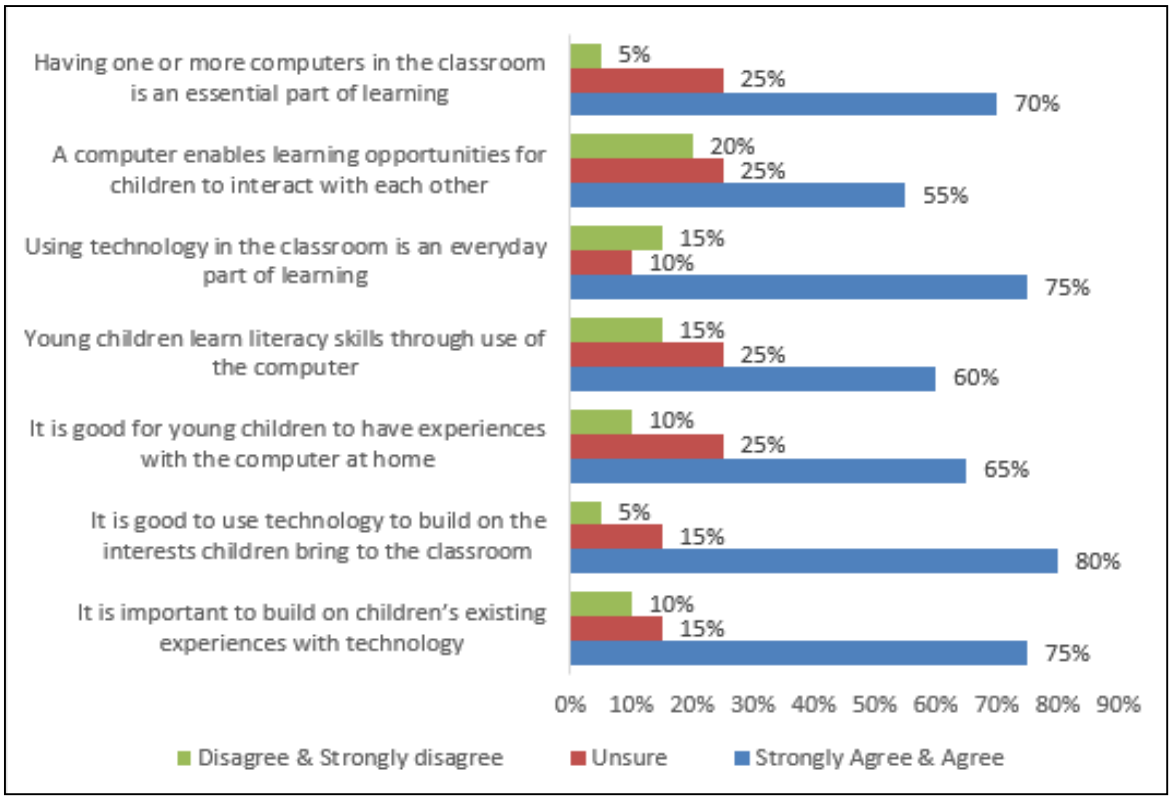

Figure 2. Teachers' Positive Belief in ICT

Based on Figure 2, data related to teachers' positive belief in implementing ICT in classroom learning was obtained. Almost all teachers agree with the implementation of ICT in the classroom. 55% of teachers agree that computers provide learning opportunities for children to interact with each other and that having one or more computers in the school is part of learning (70%). That early childhood can learn literacy through computers (60%). Teachers consider it good when children have computer experience at home (65%). Teachers also respond well to the use of technology in the classroom as part of learning (75%), developing children's interests (80%), and building children's experiences with technology (75%).

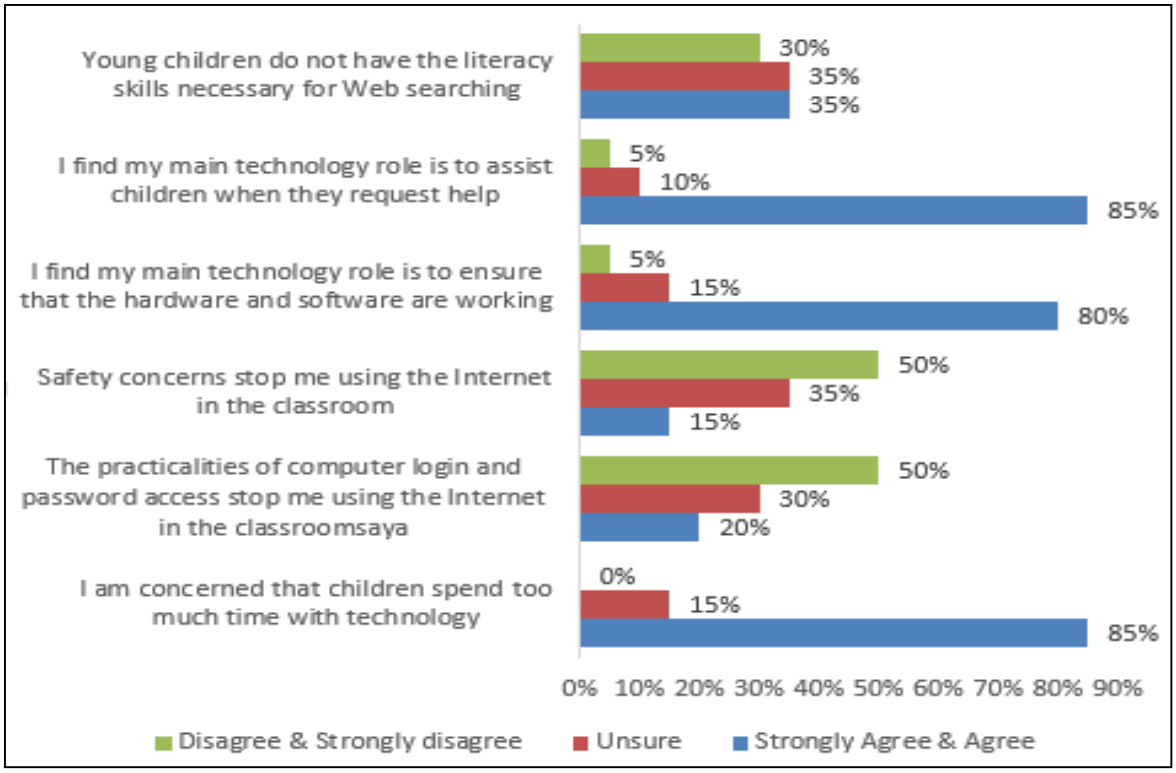

Figure 3. Barriers to the Application of ICT in the Classroom

The results obtained are related to the barriers to the application of ICT in the classroom, which can be seen in Figure 3. The data obtained showed that teachers agreed on their concerns related to children's being able to spend too much time with technology (80%). However, these concerns encourage teachers to be essential in implementing ICT. It can be seen that teachers agree on the role of helping children when asking for help (85%) and ensuring that hardware and software can function (80%). In a statement related to technology problems, as many as 50% of teachers disagree if security problems and the implementation of computer login and password access make teachers stop using the internet in class. However, on the statement that children do not have the literacy skills needed to search the Web, teachers have different opinions namely teachers who disagree as much as 30% are hesitant, and as much as 35%.

Findings from the interview show differences of opinion on questions related to the proper application of ICT in early childhood education. Six teachers out of 15 gave good feedback on using ICT properly in the classroom. One of the statements given:

"Its use for the media when learning introducing something that was not yet brought directly to school."(Yu, W 4, 2023)

Another opinion:

“Technology just for reference or ideas of activities in the classroom to make it fun” (Ti, W 4, 2023)

Nine teachers should have responded excellently to using ICT properly in the classroom. Another opinion that does not agree with the existence of ICT in the classroom

“Children just need to be limited because they do not need to be introduced to ICT” (Lu, W 4, 2023)

Teachers' opinions about the application of ICT in the classroom vary. However, all teachers agreed to give the opinion that the use of ICT in everyday life and at school (preparing learning and teacher administration) impacts ease. One opinion that offers:

“ICT plays an important role in supporting learning activities today to achieve the desired learning goals” (Af, W 5, 2023)

Another opinion that supports:

“It is essential for the work of early childhood learning and administration” (Tr, W 5, 2023)

Table 5. Multiple Regression Analysis Related to Age, Educational Background, Teachers' Years of Teaching Experience, Teachers' Role in the Classroom, and ICT Implementation Beliefs in Class

No.	Indicator	1	2	3	4	5
1	ICT Implementation Beliefs in Class	-				
2	Age	.473				
3	Educational Background	.002	.496			
4	Teachers' Years of Teaching Experience	.391	.005	.081		
5	Teacher's Role in the Classroom	.451	.033	.216	.036	-

Table 5 shows that confidence in ICT implementation in the classroom was influenced by educational background (0.002<0.05). However, age, teaching length, and classroom role did not affect the confidence in ICT implementation.

Discussion

This study aims to analyze the implementation of technology used in early childhood education institutions and teachers' perceptions of utilizing the technology used in schools. The results obtained have given a general idea of the use of ICT by early childhood teachers; the use of ICT in the form of hardware and software is relatively low. Technology in the form of hardware The results of the study obtained the highest is a Laptop (40%), each little technology used is netbooks and tablets (3.33%), and technology that does not exist is an interactive whiteboard (0%). Based on the findings obtained, no one uses an interactive whiteboard in the existing institutions in Magelang and Yogyakarta. According to Baharudin et al. (2020), the use of interactive whiteboards (IWB) can change children's attitudes and ways of learning to be more positive, which can create student-centered learning and provide opportunities for children to be actively involved because children will interact with the equipment itself so that children's confidence and ability to solve problems can increase in a fun environment. Another finding is that IWB supports learning activities both individually and in groups. The interaction between teachers and children and between children and activities with IWB allows children to work together to solve the problems displayed (Bourbour, 2023). The results of experimental research involving children aged 4-5 years by applying IWB in math learning showed that children who used IWB obtained a higher assessment than children who did not use IWB (El et al., 2016). IWB used in learning provides motivation, active involvement, and encouragement to children during learning activities.

Findings in a systematic review research related to the use of technology in learning in Asian countries in 2015-2022 found that the application of technology used includes Augmented Reality, computers, interactive whiteboards / interactive whiteboards (IWB), tablets, cameras, *CD stereo recorders*, and *MP3 players*, while for software used in learning in classes include e-books, and computer games (Sulistyaningtyas et al., 2023). In addition, based on a previous study involving teachers registered with NAEYC, it was found that the technology used included digital cameras, videogame, computers, tablets, iPod/MP3s, internet, light table, iPod touch, smartphone, E-reader, TV/DVD, smart board (Blackwell et al., 2014). The findings obtained by the technology in the form of hardware used include desktop computers, laptops, netbooks, tablets (iPad), television, LCD, and DVD. In contrast, the software technology provides computer programs for typing (*Microsoft Word/WPS*), *computer games*, and computer programs for drawing. However, the use of technology in the classroom still does not involve children, so the use is still widely done by teachers to help prepare learning and administrative activities. This is supported by the results of the average teachers' report on the frequency of ICT and Internet practices in the classroom, which obtained the highest percentage of teachers who mainly never implement ICT by involving children (55%).

The application of ICT in the classroom is closely related to the perception and beliefs of teachers regarding the implementation of ICT in the school. According to Koç (2014), if teachers have a negative attitude, they may inhibit the use of ICT, while a positive attitude increases the effectiveness of the use of ICT. The barriers teachers face in implementing ICT into learning in

PAUD are the lack of practical ICT training and professional development in implementing ICT. (Dong, 2018). The findings obtained in this study show that most teachers have a positive perception of implementing ICT in the classroom. However, some still oppose the use of technology; teachers feel that children need more hands-on experience and opportunities to develop socially and emotionally, which is achieved through interaction with peers while playing. Teachers are particularly concerned about children becoming addicted to technology and the lack of creativity that can develop when technology is given in the classroom. Teachers believe that children already spend much time using technology at home, so there is no need for the use of technology at school anymore. The literature review study conducted by Undheim (2022) states that the implementation of technology in learning is not only children and teachers using existing technology, but children need to know and explore its functions and uses before using it. The use of technology in the classroom is not only playing *games* with computers or *iPads*; teachers can introduce children to writing, drawing, and searching for information with computers or other technology.

Barriers to using technology in the classroom include teachers' limited knowledge and ability to utilize technology (Voogt and Mckenney, 2017). Another opinion states that it is not a lack of pedagogical skills or technology acceptance. However, teachers do not consider technology a tool that can support learning throughout the curriculum in the context of early childhood (Vidal-Hall et al., 2020). The findings obtained by Vidal-Hall et al. are different from those in this study in that many teachers consider technology in the classroom essential and support the existence of ICT in early childhood classes. However, some teachers disagree with the existence of technology in the school for the ability to use less technology not yet needed for early childhood. However, more teachers support technology because the use of technology in the classroom helps teachers concretize abstract material and attract children's attention to singing, dancing, and playing, which can support various aspects of child development. The use of technology in learning activities can help multiple children's abilities. It is proven in Kervin's (2016) research that digital games with carefully selected applications can provide active, practical, engaging, and empowering learning opportunities. Digital games (iPad apps) can support language and literacy learning activities. Children's literacy experiences can be facilitated by reading, writing, listening, and communicating through various scenarios and activities. Another finding is that technology can support children's skills in math, robotics, STEM, and literacy (Dorouka et al., 2020).

Based on the findings obtained, this study is a new thing because, based on previous research findings, there has been no research related to teachers' beliefs and implementation in the use of technology in early childhood learning in Indonesia. In addition, based on the findings in this study, teachers' beliefs about the application of technology in learning are positive. However, the application of technology involving children is almost nonexistent. This finding reveals that classroom practice using hardware and software technology still needs to be improved. This aligns with research conducted by Ogegbo and Aina (2020), who found that teachers understand the benefits of incorporating technology in early childhood education and have a positive mindset about using ICT in the teaching and learning process in early childhood education. However, teachers' acceptance of ICT use appears low due to barriers such as poor parental and school support, lack of technology resources, common teacher knowledge, and lack of practical training on using developmentally appropriate technology. Regarding parental support, different findings were obtained from a study conducted by Gjelaj et al. (2020), which mentioned that most parents suggested that early childhood children be exposed to various digital technologies. Based on the findings obtained, the factor that affects the teacher's confidence in the implementation of ICT in early childhood education is the educational background of teachers. Higher education teachers also believe positively in implementing ICT in early childhood education. This can be attributed to the teacher's experience in using ICT in the classroom during school years while pursuing a bachelor's or Master's degree. The research results by Konca et al. (2016) show that the teacher's educational background also influences ECE teachers' attitudes toward ICT. In addition, educational background is not an entirely important factor; the interview mentioned that teachers with a high educational background also have a less favorable response to the application of ICT in learning. This requires training to support effective learning and professional development programs so teachers can apply a broader range of pedagogical strategies to help young children use ICT (Dong, 2016).

CONCLUSION

The findings presented data on ECE teachers' beliefs about implementing ICT in the classroom. Teachers have positive beliefs about the use of technology. However, this belief is only related to the use of technology in helping teachers complete their work. This is also supported by the results obtained from interviews showing that technology is only used by teachers and without involving children. This shows a gap between the practice in the field and teachers' beliefs. Therefore, the findings obtained can be used as input by policymakers in providing workshops for ECE teachers to apply ICT in learning activities involving children in their use. In addition, the curriculum also needs to support the use of technology in learning.

The implication of this study is to provide training to PAUD teachers related to the use of technology in learning. Each school institution will need assistance from policymakers to support the realization of the use of technology in the classroom. In addition, the use of technology needs to be discussed with parents so that the understanding related to technology implementation in learning can be agreed upon and the practice can run well.

The limitation of this study is that it only uses respondents in certain regions in Indonesia, so it cannot be generalized to other areas. It is also necessary to investigate the use of ICT in teaching literacy, cognitive, social-emotional, and other skills. In addition, using different instruments in addition to the existing findings related to teachers' beliefs related to the use of technology will be more varied. Exploring teachers' knowledge related to integrating technology into learning or TPACK (Technological et al. Knowledge) can be one of the issues for further research.

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