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Bekerja sama dengan
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Exploring Genius Hour: A literature study on concepts, benefits, and their application at every level of education in various countries

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ABSTRACT

Genius Hour in this article will be studied in the literature, focusing on the concept and benefits of Genius Hour in the context of Education, as well as how Genius Hour is implemented in various countries at different levels of Education. It is hoped that the results of this study can provide further knowledge about Genius Hour and an overview for students who wish to apply to Genius Hour. Genius Hour is an approach to learning by setting aside time in class so students can learn about topics that match their interests or passions, developing essential questions, researching their topics, and creating a final project to be shared at the end of learning. The literature review in this study uses Prisma flow diagrams to assist in the process of determining the literature to be studied.

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INTRODUCTION

Almost three years of Indonesian education has been running normally again after the pandemic, but education in Indonesia has not made significant progress. This can be seen from the data taken by the Ministry of Education and Culture and Research and Technology in 2021, which shows that before the pandemic, learning progress for one year (1st grade) was 129 points for literacy and 78 points for mathematics. After the pandemic, learning progress in grade 1 decreased drastically (learning loss) (Rachmawati et al., 2022). For literacy, learning progress is only around 77 points, or it can be said that there is a learning loss equivalent to 6 months of learning, while for numeracy, it is at 34 points, or there is a learning loss equivalent to 5 months (Zainudin et al., 2022). Learning loss is a phenomenon in which children's academic skills and knowledge decline (Cerelia et al., 2021). In another view, learning loss can be interpreted as a loss of interest in learning students due to a lack of interaction with learners during the learning process (Hadi, 2021). Several signs can be observed when a child experiences learning loss, including decreased intellectual ability and skills, decreased achievement and interest in learning, disturbed child

development, psychological and psychosocial pressure experienced by children, and gaps in access to learning (Budi et al., 2021).

In order to reduce the impact of learning loss, the Ministry of Education and Culture provides the freedom to use several curricula that can be selected according to the needs of each school. The curriculum includes entirely using the 2013 curriculum, using the emergency curriculum, and choosing an independent curriculum simplification (Maulida, 2022). Even though the government has provided policies to overcome problems, in some cases in the field, obstacles still occur (Jojor & Sihotang, 2022). As stated by Rofiq Arifin in their research, it was explained that the implementation of the emergency curriculum had not gone as expected; this was due to the lack of available supporting facilities and the lack of understanding of IT from both students and students (Rofiq & Arifin, 2021). Another case example is research conducted by Supriatna, which explains that the emergency curriculum implemented in primary schools is still far from standard, which impacts the effectiveness of online learning (Supriatna, 2021).

Based on the less-than-optimal results from the previous policy, the government, through the Ministry of Education and Culture, tried to study and create a new curriculum called the Independent Curriculum. What can be said to be an independent curriculum results from an evaluation of the implementation of the 2013 and emergency curricula during the pandemic (Sadewa, 2022). The independent curriculum has several main characteristics; among others, learning activities are focused on using a project-based learning model, which aims to develop the profile character of Pancasila students. Then, one of the essential basic competencies is the development of literacy and numeracy. Furthermore, students can design lessons according to their abilities, which are also relevant to the context and local content (Sadieda et al., 2022).

In this study, the researchers wanted to focus on one of the main characteristics of the independent curriculum, namely learning focused using a project-based learning model. Rati explained that project-based learning allows students to manage learning by involving project work (Rati et al., 2019). Project-based learning can potentially create exciting and rewarding learning experiences for students (Culclasure et al., 2019). Furthermore, Sani explained that with project-based learning, students will go through a process of investigating problems that occur in the real world, and based on that, students are expected to be able to create works or products that can be useful for solving these problems (Sani, 2014).

From the explanation above, it can be concluded that project-based learning can provide new learning experiences for students and, at the same time, can help solve problems that occur in society by producing valuable products. Even so, students still need to provide variations or innovations in project-based learning so that students continue to feel enthusiastic about participating in learning (Rahardjanto et al., 2019). One way to create learning that can make students enthusiastic and increase motivation is to apply learning that supports students' interests or passions because supporting this is proven to increase enthusiasm, motivation, and student involvement in learning (Serin, 2017). One project-based learning that can support students' interests and passions is implementing Genius Hour (Horrigan, 2018). Genius Hour can be an effective solution to overcome low student motivation and engagement. Genius Hour allows students to take control of their learning, follow their interests and passions, and explore topics that interest them (Reid, 2019). In Genius Hour, students can choose creative projects they want to realize, which can increase their ownership and responsibility for learning. Genius Hour can increase students' intrinsic motivation by enabling them to explore their interests and talents. When students feel in control of their learning, they feel more engaged and motivated to complete their chosen projects (Zvi & Krebs, 2015).

In addition, Genius Hour is also proven to increase student creativity (Ginsberg & Coke, 2019). Because in Genius Hour, students must use creative, innovative, and problem-solving thinking skills when they choose and implement their projects. This can help them develop the creative skills they need to tackle future challenges. With Genius Hour and a more inspiring learning environment, students will have more opportunities to develop and increase their creativity. This can directly have a positive impact on students' literacy and numeracy. Thinking creatively enables students to approach challenges and concepts innovatively, encouraging them to

become better readers, more effective writers, and more skilled math problem solvers (Brookhouser, 2015).

Unfortunately, the implementation of Genius Hour itself is still sporadic in Indonesia and the world. As revealed by Townsend, less than one percent of students worldwide have had the opportunity to take part in Genius Hour learning; this could be due to a lack of knowledge by students or resources regarding Genius Hour itself (Townsend, 2018). The low number of related sources regarding Genius Hour can be an obstacle for students who want to learn and apply this concept in an educational context. Because Genius Hour is in the context of education, Genius Hour can be said to be relatively new and still in the development stage. However, the scientific literature that specifically addresses this topic is still minimal. In addition to the low levels of support, McNair explains that Genius Hour can often appear messy, as students have difficulty finding clear directions when implementing it. In implementing Genius Hour, students often face difficulties determining the appropriate parameters, objectives, and assessments for the Genius Hour project. Students also experience difficulties in supporting students in developing projects that suit their interests and achieve significant results (McNair, 2022).

Based on the explanation above, the researcher wants to review the literature regarding Genius Hour and how it is applied at different levels of education in various countries. This research will explain the concept and benefits of Genius Hour in the educational context, as well as how Genius Hour is implemented in various countries at different levels of education. It is hoped that the results of this study can provide further knowledge about Genius Hour and an overview for students who wish to apply to Genius Hour.

This research contributes to educators' understanding of Genius Hour. Implementation of Genius Hour as a learning approach by providing free time in class so that students can study topics that suit their interests or hobbies, develop important questions, research topics, and create final assignments to be distributed at the end of the lesson.

METHOD

This type of research is a literature review. This research is a way to solve problems by tracing sources of writing that has been written before. In other words, the term literature study is also very familiar with the term library study. Literature review research is conducted by collecting and synthesizing previous research (Snyder, 2019). The researcher will collect literature from previous studies regarding Genius Hour in this study. The literature in this study was obtained from several sources, such as Google Scholar, Crossref, and Semantic Scholar. The literature search will use only one terminology: "Genius Hour." Apart from that, in this research, the researcher applies specific criteria in selecting the literature that has been obtained, with criteria including research that includes qualitative and quantitative methodologies, then, in the form of journals, articles, and theses/dissertations written by academics and or professional organizations that are known nationally and internationally, then, literature published internationally and nationally, literature published in the last ten years and most recently published in Indonesian/English.

The results of the literature search will be sorted by Prisma flow diagram to help visualize the process to be carried out, with three stages, namely, identification, screening, and inclusion (Page et al., 2021). At the level of identification, results from the exact search (duplicate) will be removed. After that, on-stage screening is the stage of separating the literature that will be examined and not. Paying attention to the title and abstract, the availability of literature with full access, and finally, whether it meets the predetermined criteria. Then, on stage, it includes the results of the literature that will be reviewed.

The amount of literature that has been obtained above will then be reviewed in three phases. The first is data collection information about the problem study, objective study, findings study proposition key and conclusions from any literature obtained. Then, group results from the first phase, define the theme, identify similarities in each, and group him. Phase third: Identify the primary research and determine the leading research (Meity et al., 2017). More detailed steps can be seen in Figure 1.

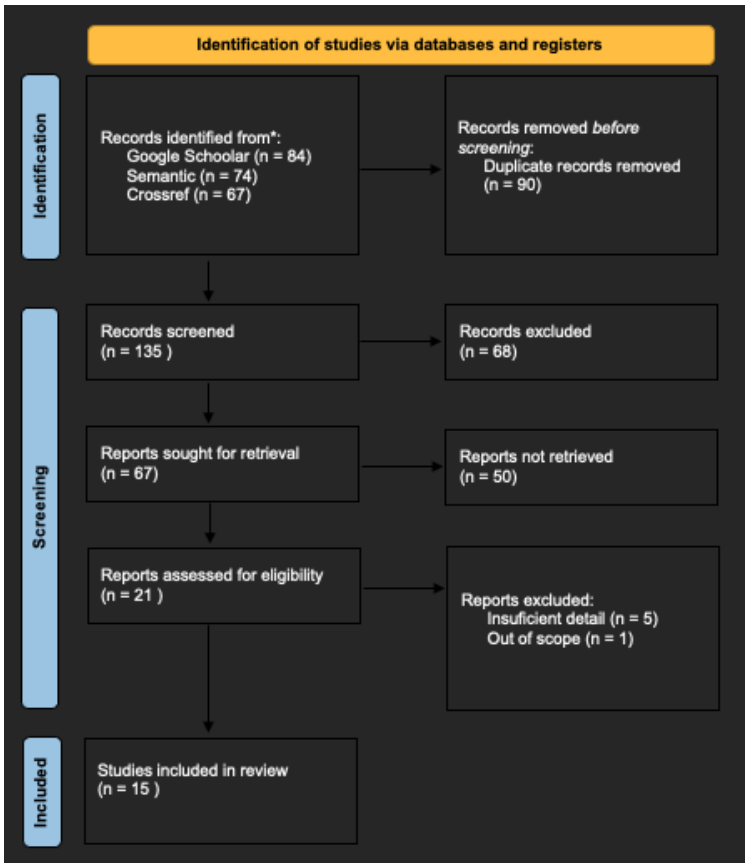

Figure 1. Prisma Flow Diagram

RESULTS DAN DISCUSSION

Results

Based on the search results that have been carried out using the prisma flow diagram method and the search criteria presented in the research methods section, 15 kinds of literature have been obtained, which can be seen in Table 1. The publication years of the 15 articles found were 2016, 2017, 2018, 2019, 2020 and 2021 from various educational levels among them Kindergarten, Elementary School, Junior High School, Senior High School and College. Spread across several countries including America, Brazil, Australia, Canada, Saudi Arabia, South Africa and Indonesia. Summary of selected paper shown in Appendix A.

Table 1. List of Literature

No.	Literature of Kinds	Amount
1	Journal	6
2	Article	1
3	Thesis	6
4	Dissertation	2
Total		**15**

Discussion

Genius Hour, or 20% Time, is a learning concept that gives students time to explore their interests and passion in a project they choose. Technology company Google first introduced this concept in the early 2000s. Although there is no single inventor of Genius Hour, this practice became well known through Google's corporate policy of allowing employees to spend 20% of their work time exploring personal projects or their creative interests (B. Machado et al., 2021). In the context of Education, Genius Hour is a learning approach that gives students structured time to

explore their interests and projects. Genius Hour enables students to become active agents in learning, developing critical thinking skills, creativity, and independence. In addition, Genius Hour is proven to increase students' intrinsic motivation, strengthen collaboration skills, develop digital literacy, and help students discover their interests and talents. Genius Hour can provide opportunities for students to experience freedom and responsibility in learning, expand their understanding of the world, and prepare them to face future challenges (LeGeros et al., 2022). In implementing Genius Hour, it is necessary to pay attention to the following principles (Townsend, 2018), shown in Figure 2.

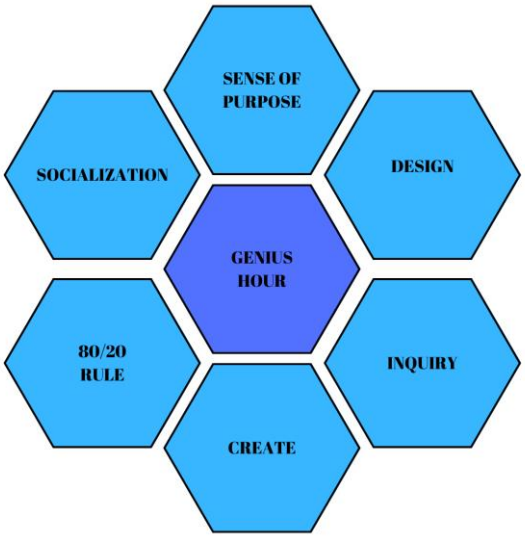

Figure 2. Genius Hour Principles

Sense of Purpose

In learning, a "sense of purpose" will differ based on the goals to be achieved (Lin & Wei, 2021). Inside Genius Hour encourages students to discover creativity, innovation, and critical thinking by allowing them to do what they love and take responsibility for their learning.

Design

Learners are free to design their learning, such as choosing tactics, methods, sources, and freedom about what they want to learn. Learning design will significantly influence the success of their projects (Fan et al., 2021).

Inquiry

Inquiry is a series of learning activities that focus on developing critical and analytical thinking skills to teach students to seek and find their answers to a problem posed. Besides that, it is also deep (Abdi, 2014). Explaining that inquiry learning will attract students' interest in science, provide opportunities for students to use appropriate research techniques to collect evidence, require students to solve problems using logic and evidence, then encourage students to carry out further studies to develop more complex explanations, and emphasize the importance of writing scientific explanations based on evidence.

Create

In Genius Hour, students do not just create a project or product, but there is a problem that bothers them, and they want to solve.

80/20 Rule

The 80/20 rule is to give students at least 20% time to work on what they are most curious about in an educational context. The remaining 80% will be in the form of traditional educational methods. Students can also choose the time for Genius Hour, whether to give 10 minutes per

lesson, 1 hour per day, or maybe one day per week. Each student is allowed to choose a plan that suits their class.

Socialization

Social interaction occurs not only between students and students but also with friends even with experts regarding the topic they will be working on.

Application of Genius Hour in Kindergarten

At the kindergarten level, there is one article that discusses Genius Hour. In this article, Genius Hour refers to a learning approach that allows students to explore their interests in their chosen projects. The implementation of Genius Hour in this article is carried out for one hour per session for five weeks. Breaking down about 10-15 minutes for mini-lessons, then continues, with the remaining 45-50 minutes spent supporting individual children and small groups as they work on Genius Hour activities. The application of Genius Hour in this study began with helping students develop ideas for the Genius Hour project. The way to do this was by using a graphic *organizer* with four statements: "I wonder…," "I wish…," "I know a lot about…," and "I think you should know…." Then, from the results, the learner chooses what idea to use. After the idea has been determined, students begin to develop projects from these ideas, assisted by students and related sources, and there are also some students whom experts directly assist. In the last step, students provide several options for choosing presentation models. Students can choose one of these models or methods and then present the results of the Genius Hour project in front of the whole class (West & Roberts, 2016). Implementing Genius Hour in kindergarten allows children to develop curiosity, creativity, and critical thinking skills. Through Genius Hour, students can choose topics they are interested in and work on projects relevant to them. They are given a set time to complete the project while the learner is a facilitator and mentor. In the context of kindergarten, Genius Hour encourages children to explore their interests in areas such as art, science, math, or physical activity. They can engage in activities such as painting, building, role-playing, simple experiments, or creating works of art. Thus, Genius Hour at the kindergarten level provides a fun, interactive, and relevant learning experience for children at an early age (West & Roberts, 2016).

Implementation of Genius Hour in Elementary Schools

At the elementary school level, several articles specifically discuss how to implement Genius Hour in elementary schools. First, Genius Hour is implemented for children aged ten years or 5th grade in Brazil. The implementation of Genius Hour in this article is carried out from the first-week students enter school, with each meeting taking approximately 1 hour. The implementation of Genius Hour in this article is divided into seven steps:

1. Sensitization: showing a motivational video about creativity, innovation, the importance of sharing ideas, persistence ("never give up"), and using passion to create a solution.
2. Reflection: The reflection process begins with the question, "How can I use passion to answer my problems or questions"? In this step, students try to find topics of interest.
3. "Shark Tank Pitches". Students prepare a 3 to 5-minute presentation that demonstrates their conception of the idea in terms of four points: what, why, how, and indication of success. Classmates and students actively participate in this moment, providing suggestions, criticizing, and evaluating the project's feasibility.
4. Planning: Students prepare steps and schedules at this stage. Students develop procedures to achieve their goals by making time schedules for each activity, such as literature research, material procurement, prototype development and refinement, presentation exercises, and final presentations.
5. Project Design: Students start working on their projects at this stage. At this stage, students or parents also need to supervise and provide guidance so that students stay on the right track.
6. Presentation Preparation: Students prepare a presentation of the results of the project that has been done. Students prepare their final presentation. They explained what, why, and how within five minutes.

7. Sharing Results: In this step, students present the results of the projects they have worked on in the Genius Hour project.

The Genius Hour project in this study is divided into three categories based on the difficulty level. The first level is easy (learners can develop their products and may not need to receive help from adults), the second level is Medium (students may need help from adults on several occasions), and the last is the problematic level (students need adult help). This study shows that the majority of students choose the project level that is easy to complete with the theme of the project being worked on by students is a project about "Toys/Games" (N = 59), then "Robotics" (N = 14), "Scale Model" (N = 10), "Video Production" (N = 10) and many more. The benefit of Genius Hour in this research is the development of essential characteristics to become a successful entrepreneur, such as self-motivation, discipline, self-confidence, determination, and creativity. Besides that, creating a learner-centered learning environment, developing critical thinking, creating social learning and opportunities to increase individual strengths, connecting students to the real world, and getting them involved in solving problems using their "passion" (B. Machado et al., 2021).

Furthermore, research was conducted in South *Sydney Church of England Grammar School* on a 6-year-old boy. This project was designed to take advantage of highly motivational learning situations as a means for children to learn more about how to work collaboratively and to demonstrate understanding of their interactions with peers during learning sessions. During the exercise, children research, experiment, and practice making multiple decisions and working collaboratively in small groups. The results of this study indicate that applying Genius Hour to students aged six years can provide motivation, flexibility, and freedom. In addition, this research also shows that Genius Hour can foster the ability to collaborate in students aged six years. This is indicated by the emergence of the nature of being responsible for the group, respecting all views and listening to others, and the emergence of students' self-confidence in contributing to groups (Harrington, 2016).

The following research is about designing a Genius Hour "Handbook." There are several things in the handbook: First, the design schedule for Genius Hour is implemented every week for 30-60 minutes and is reviewed from the students' daily academic schedule. Then, it presents aspects of teaching Genius Hour and examples of projects students have successfully carried out. *The handbook's* function is to facilitate the implementation of Genius Hour, but the role of the learner is vital; do not get too caught up in what is in the handbook. Because students still need to instill trust, honesty, and openness between students. Also, providing a comfortable learning environment will increase learner engagement and prevent disruptive behavior later (Reid, 2019).

Furthermore, there is research conducted in Indonesia by Aida. The background in this research is because of looking at the learning process, which often only focuses on fulfilling the exam requirements without providing space to get to know and explore students' interests. With Genius Hour, it is hoped that learning that occurs can provide meaningful experiences for all students, as well as inspire students to learn passion. The combination of Genius Hour and Tokkatsu differentiates this research from others. This merger aims to increase student collaboration skills while helping students develop their interests and potential for the topics they are interested in (Fandilah, 2020). Tokkatsu is an activity carried out in the learning process but not tied to a particular subject. Tokkatsu activities are a strategic step in maintaining the balance of the overall development of students, who have good cognitive skills and are supported by balanced emotional maturity, social skills, and communication skills (Miharja et al., 2020). The result is that the combination of Genius Hour and tokkatsu is suitable for implementing teaching and learning activities. Tokkatsu acts as a tool to create learning situations, while Genius Hour is a learning activity. By combining the two, it can reduce possible obstacles that may arise (Fandilah, 2020).

Implementation of Genius Hour in Junior High Schools

Two articles specifically discuss implementing Genius Hour at the junior high school level. The first is research conducted by Opsahl, which aims to explore the impact of Genius Hour, which focuses on environmental issues and students' attitudes toward the environment. This study will analyze whether participation in Genius Hour, which leads to environmental projects, can

change students' attitudes towards environmental issues, such as awareness, concern, and environmental responsibility. Genius Hour is implemented for one hour every week, lasting five weeks. Students can develop projects related to the natural environment or other environmental issues in this research. In this project, students will use their time to explore and carry out projects that contribute to their understanding of environmental issues and provide creative solutions. Through this Genius Hour, which focuses on the environment, it is hoped that students will experience positive attitudes toward the environment, including increasing awareness, concern, and responsibility for environmental issues. The results of this study indicate that the Genius Hour centered on the environment mainly influences students' attitudes towards the environment. At the start of the study, most students were interested in choosing their environmental topic, but the proportion decreased at the end. Through Genius Hour, students learn to undertake step-by-step projects driven by student interests (Opsahl, 2018).

Subsequent research was conducted by (LeGeros et al., 2022). This study provided an understanding of the implementation of personalized learning for junior high school students through Genius Hour, which is applied to all schools. This study aims to provide insight into how Genius Hour can support and strengthen a personalized learning approach to students. Here are some potential steps to implement personalized learning in middle classes through school-wide Genius Hour:

1. Develop a clear understanding of personalized learning: Learning and school stakeholders need a shared understanding of how it can benefit students. This can be achieved through professional development, reading research articles, and attending conferences (Olofson et al., 2018).
2. Introducing the Genius Hour concept: Learners can introduce it to students and explain how it aligns with personalized learning. They may also provide examples of successful projects from the previous year.
3. Set aside a specific time for Genius Hour: Schools must designate a specific time each week or month. This time must be protected and not used for other activities.
4. Provide resources: Students should provide students with the resources they need to complete their projects, such as access to technology, materials, and support experts.
5. Monitoring progress: Students should monitor student progress during Genius Hour and provide feedback and support as needed. They can also use this time to evaluate students' understanding of essential concepts and skills.
6. Evaluate effectiveness: Schools should evaluate the effectiveness of their personalized learning initiatives, including school-wide Genius Hours. This can be done through surveys, focus groups, and other data collection forms (DeMink-Carthew et al., 2017).

This study resulted in 3 main findings. First, how do students perceive Genius Hour to affect student engagement in learning? From these questions, it was found that the implementation of Genius Hour had a positive impact on student engagement and students' *development of self-direction skills*. The second research question is: How do students describe their experiences implementing Genius Hour? From these questions, it was found that Genius Hour can improve communication between learners and also encourage collaboration. Finally, how does the application of Genius Hour affect the pedagogy of each learner? Moreover, the result is that there are various changes in the pedagogy of each learner (LeGeros et al., 2022).

Application of Genius Hour in Senior High School

Several articles specifically discuss the Senior High School level. The first is Alqahtani's research, which explains the context in this study is how to apply Genius Hour to mathematics so students can have skills such as creativity, self-confidence, and a sense of self-reliance to obtain information and train them to become influential researchers. In this study, students worked with two classes as the treatment group involved in Genius Hour and two classes as the control group. The results of this study will compare the achievements between the treatment group and the control group. As a result, Alqahtani revealed that Genius Hour is an effective differentiation strategy that students can use to meet the needs of individual students. Alqahtani also stated that

Genius Hour allows students to learn new things, experiment with ideas, and develop many needed skills (Alqahtani, 2021).

Subsequent research by Reuer explained that Genius Hour is a project-based instructional technique that encourages learning autonomy and has received much student support. However, despite the widespread enthusiasm for Genius Hour in K-12 grades, there has not been sufficient empirical evidence regarding the effectiveness of this approach. To fill a gap in this research, a long-term exploratory case study was conducted better to understand Genius Hour practices in high school STEM environments. One of the exciting things in this research is the effect of Genius Hour on the identity and self-efficacy of students, especially in science, and confidence in science. The quantitative results show that the Genius Hour instructional technique increases students' confidence in their scientific abilities based on pre-and post-survey data, although the effect is relatively small. In addition, students experience significant improvement in Science and Engineering Practices (Next et al. Practices) in asking questions, defining problems, and analyzing and interpreting data. Although the quantitative analysis did not produce significant results showing the effect of Genius Hour on student identity, substantial qualitative results show that participation in Genius Hour develops student identity, especially identity in science (Reuer, 2017).

Furthermore, Aldehbashi explains that his research aims to investigate and explore the use of Genius Hour and Makerspace in the context of education for students. Makerspace is a space or area dedicated to creative activities, exploration, and product creation. Typically, Makerspace come with various tools and materials that allow students or other users to design, build, and design with different projects and ideas. Makerspace can include tools such as 3D printers, computer programming, electronics, handyperson tools, and many types of creative software. The research aims to assess the effectiveness of Genius Hour and Makerspace in increasing student engagement, creativity, and skills. In addition, the research also aims to understand the impact of using Genius Hour and Makerspace on student learning, including increasing conceptual understanding, applying practical skills, and developing interest and motivation to learn (Macaraeg et al., 2021). The result of implementing Genius Hour at Makerspace provides an open learning environment that encourages critical thinking, collaboration, creativity, and problem-solving. In addition, it makes it easier for students or users to develop practical skills, understanding concepts, and interests in fields such as science, technology, engineering, art, and mathematics. Makerspace also encourages independence and self-exploration, where individuals can follow their interests and ideas to produce unique and innovative projects (Aldehbashi, 2021).

Next, research contains plans for Genius Hour units for senior high school students, including instructional guides, handouts, and a rubric that can be used immediately in a Genius Hour project. The Genius Hour activities designed in this study use a research-based pedagogy and will be used as a guide for learners who are trying to apply Genius Hour for the first time. Genius Hour has the potential as a strategy to increase student interest in the STEM field. When students interview experts in their area of interest, they will better understand the possible career paths they can choose. In addition, this also gives them learning experiences that are relevant to the real world (Horrigan, 2018).

Implementation of Genius Hour in Higher Education

There is an article discussing the implementation of Genius Hour at the higher education level conducted by Downes & Figg, where the research aims to describe the results of an investigation on how learning that focuses on the use of inquiry and problem-based learning, especially learning with Genius Hour can provide 21st-century competencies to students of educational programs at the University of Ontario. In this study, Genius Hour was applied to the "technology methods" course, designed to create a learning environment that makes it easier for students to understand the learning material provided. Then the Genius Hour design will also encourage students to think critically, ask challenging questions, and find answers to current and future world problems. In addition, this design also aims to provide a learning experience that is more related to personalization, especially in topics that interest students. Also, in this design, researchers will apply three simple principles from Genius Hour (Juliani, 2014). First, projects must be driven by high-level questions that stimulate critical and innovative thinking. Second,

these questions must be explored through traditional or direct experience research. Third, the projects' results must be shared with others so that students can contribute and share their knowledge with the community (Downes & Figg, 2019).

This research was conducted using a qualitative method with 35 research subjects, students of the Education program at the University of Ontario. The result of this study is that students show a positive perception of learning with Genius Hour. Then, the results of the data analysis reveal that there are three main themes. First, factors contributing to positive perceptions of learning with Genius Hour are found. These factors include increased involvement, autonomy, and opportunities to explore personal interests. Second, participation in Genius Hour has encouraged creativity and mental well-being among students. Engaging in independent learning and pursuing personal interests can increase creativity and provide a sense of fulfillment, positively impacting mental well-being. Finally, this research shows that participation in Genius Hour helps students gain a better understanding of teaching with technology. Students can utilize various existing technological tools and resources through involvement in this project, enhancing their knowledge and skills in integrating technology into future teaching practice. Overall, this research implies that the Genius Hour project had several positive outcomes for students, including fostering positive perceptions of learning, encouraging students' creativity and mental health, and increasing students' understanding of the use of technology in Education (Downes & Figg, 2019).

From the results of the analysis above, it can be seen a comparison of the implementation of Genius Hour at each level of education Table 2. below this:

Table 2. Genius Hour at Every Level of Education

Educational Level	Implementation of Genius Hour	Benefit	Project Example
Kindergarten	Provide creative time for students to explore their interests, such as painting, building, or role-playing.	Encourage children's creativity and imagination. Helps develop social and sharing skills. Strengthen understanding of basic concepts.	Draw landscapes, build mini-cities, and play roles in fairy tales.
Elementary School	Provide time for students to develop interest-based projects, such as science experiments or art projects.	Increase student interest and motivation to learn. Bring up research and inquiry skills. Promote creativity and innovation.	Research animals, create artwork based on favorite themes, and create simple games.
Secondary School	Allows students to explore their interests with more in-depth student learning projects, such as creating apps or social research.	Encourage problemsolving and critical thinking skills. Broaden knowledge and understanding in the area of interest of students. Train skills and communication	They make mobile apps, research social media's impact, and make documentaries.
College	Provide time for students to carry out research projects, academic explorations, or innovations in their field of study.	Reveals high research and problem-solving abilities. Encouraging innovation and creativity in the field of study. Deepen understanding and mastery of academic concepts.	Conduct scientific research, create new technological projects, and develop contemporary works of art.

Next, several studies are not specific to a certain level. First, Quinn's research discusses from a learner's perspective, where this study is based on how learners can design exciting and meaningful learning experiences for adolescents and prepare them to use technology to help them become lifelong learners. From these questions, the researcher felt that Genius Hour was an appropriate approach. This is also supported by many students and students who have shared their experiences through various digital media regarding the positive impact when they run Genius

Hour. However, no formal research has been conducted to describe this phenomenon's implementation or the experience of running Genius Hour. So, from the explanation above, the researcher will qualitatively examine the implementation of the Genius Hour process, which students in public schools have carried out at the junior high school level. This study also describes how students perceive the challenges, planning benefits, and benefits for students when implementing Genius Hour. As a result, students adopted the same structure for Genius Hour, but the format and emphasis varied by class. Later, students observed they were actively engaged during Genius Hour but sometimes noticed them procrastinating on project work and losing interest in their chosen topics. Finally, each school has a systemic dimension that may hinder the Genius Hour process. These systemic factors include stakeholder reactions to the idea and implementation of Genius Hour. In addition, students' perceptions of what is considered important work and expectations of school work (Quinn, 2021).

The following research is about creating a Genius Hour framework. The main objective of this research is to create an instructional framework to implement Genius Hour in the classroom. In addition, this research also examines and analyzes how the concept of Genius Hour is applied in education worldwide to synthesize information into a collective Genius Hour framework. The results of this study show that Genius Hour benefits higher-order thinking skills. The applied Genius Hour framework contains interest, passion, autonomy, and inquiry. In addition, this research also reveals that a framework is needed to help implement Genius Hour in the classroom. However, the role of the learner himself is equally vital in Genius Hour (Townsend, 2018).

Subsequent research regarding implementing Genius Hour in the BC or "British Columbia" curriculum. This curriculum emphasizes intellectual, social, emotional, and physical development and promotes deep understanding, practical application, and critical thinking (Sinnema et al., 2020). The British Columbia curriculum allows schools and students to customize learning according to local needs and student interests. Jane conducted this research to create a guidebook for elementary to high school. Hopefully, this book will support and guide the implementation of Genius Hour in the classroom using the BC curriculum principles. This handbook will provide a framework for effectively implementing Genius Hour to empower learners' choices and increase engagement. In addition, this book will also provide resources for students to implement Genius Hour projects. The primary purpose of this guidebook is to create a guide that can be used to guide the use of Genius Hour in class and also to help other students who will implement it in their class for the first time (Jane, 2021).

The results of this study stated that the handbook developed could maximize the learner's role as a facilitator. With the handbook created, students will be more prepared to study independently when researching and creating their projects. This allows the learner to gradually assume the role of facilitator in the classroom by only assisting individual students when needed. Jane strongly encourages students to try Genius Hour, especially if motivation and engagement concern the students in your class. Also, keep in mind that the lessons and ideas in the handbook that have been created are only a medium to help how Genius Hour can be implemented. Learners can make adjustments as needed to meet the needs of their respective students (Jane, 2021).

CONCLUSION

This literature study explores the concept, benefits, and application of Genius Hour in education. Genius Hour is an approach in education that provides time and space for students to explore their interests in learning. This concept encourages freedom, creativity, and student initiative in determining the project or topic they want to research. Genius Hour has various benefits for students. Literature studies show that Genius Hour can increase student motivation and involvement in learning. It can also develop critical skills, creativity, problem-solving, collaboration, and independent initiative. Genius Hour can also help connect learning to students' interests, increase learning ownership, and develop self-confidence. Genius Hour can be applied at various levels of education, from kindergarten to tertiary level. However, there may be variations in the implementation. The basic concept of Genius Hour is to provide time for students to explore their interests, where the concept will be relevant at all levels. Learners can adapt this approach

according to the needs and context of learning at each level. Differences in Implementation of Genius Hour in Various Countries: Although Genius Hour is implemented globally, there are differences in its implementation in various countries. Curriculum, education policies, school culture, and resources can influence how Genius Hour is adopted and integrated into each country's education system. These conclusions show that Genius Hour is an approach that has the potential to provide significant benefits to students at all levels of education. However, more research and further exploration are needed to understand the concept, benefits, and application of Genius Hour in various countries' education contexts.

Appendix A. Summary of selected papers

No.	Authors	Country	Kinds of Literature	Type of Research	Level of Education
1	(West & Roberts, 2016)	America	Journal	Qualitative	Kindergarten
2	(B. Machado et al., 2021)	Brazil	Journal	Qualitative	Elementary School
3	(Harrington, 2016)	Australia	Article	Qualitative	Elementary School
4	(Reid, 2019)	America	Thesis	Mixed Method	Elementary School
5	(LeGeros et al., 2022)	America	Journal	Qualitative	Junior High School
6	(Horrigan, 2018)	America	Thesis	Qualitative	Senior High School
7	(Downes & Figg, 2019)	Canada	Journal	Qualitative	College
8	(Opsahl, 2018)	America	Thesis	Mixed Method	Junior High School
9	(Reuer, 2017)	Canada	Dissertation	Mixed Method	Senior High School
10	(Aldehbashi, 2021)	Saudi Arabia	Journal	Qualitative	Senior High School
11	(Quinn, 2021)	America	Dissertation	Qualitative	Junior High School-Senior High School
12	(Townsend, 2018)	South Africa	Thesis	Mixed Method	Elementary School-Senior High School
13	(Fandilah, 2020)	Indonesia	Thesis	Mixed Method	Elementary School
14	(Alqahtani, 2021)	Saudi Arabia	Journal	Qualitative	Senior High School
15	(Jane, 2021)	Canada	Thesis	Mixed Method	Elementary School-Senior High School

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The effect of group investigation model assisted by interactive media Lectora Inspire on high school students' critical thinking skills

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ABSTRACT

Geography learning teaches students to be able to think critically. Critical thinking is one of the thinking skills that students must have in 21st-century learning. However, the critical thinking skills of high school students in Indonesia are proven to be lacking. The study aimed to determine the effect of the Group Investigation (GI) model assisted by interactive media Lectora Inspire on high school students' geography critical thinking skills. The research design used a quasi-experimental design with a posttest-only control group design. The location of the research was carried out at the Laboratory Senior High School Universitas Negeri Malang. The research subjects were XI IPS 3 students as the experimental group and XI IPS 1 as the control group. Data on students' critical thinking skills were obtained from six essay test questions arranged according to indicators of critical thinking skills. Data analysis techniques for critical thinking skills using the Mann-Whitney test show that the GI model assisted by interactive media Lector Inspire affects high school students' critical thinking skills. Comparison of the post-test scores of the experimental group is much better than the control group. The steps of the GI model and interactive media Lectora Inspire during learning to make students productive in critical thinking.

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INTRODUCTION

In learning geography, students are confronted with geosphere phenomena in their surroundings, which encourages them to think critically. Every student must have critical thinking in the 21st century. The ability to think critically is the process of rational thinking when studying a problem and conducting an investigation (Mellita & Rosita, 2019). Students will learn to be responsible for their opinions, be rational, and have the best alternative available through this way of thinking (Firdaus et al., 2019). Students understand a real-life problem given by the teacher and think critically to find solutions to these problems.

However, several studies have shown that the critical thinking of high school students in Indonesia is still lacking. Inappropriate teacher strategies are a factor causing high school students' lack of critical thinking (Suwarna et al., 2022). In addition, students have not been accustomed to dealing with questions with cognitive ability levels evaluated to create (Wayudi et al., 2020). The lack of students' critical thinking was also seen by researchers when teaching through the Teaching

Assistance program at Laboratory Senior High School Universitas Negeri Malang. Students tend not to be enthusiastic when allowed to give arguments, answer, or ask questions. Therefore, appropriate learning models and media are needed to improve the quality of learning by encouraging students to engage in critical thinking activities (Herlina et al., 2019; Wulandari et al., 2023). One of these learning models and media is the Group Investigation (GI) model assisted by interactive media Lectora Inspire.

The GI model is a cooperative model involving students collaborating to investigate a problem (Sharan, 2017). The advantages obtained from using the GI model are that students are more intensive in solving a problem, developing students' skills in obtaining information to solve problems, developing a leadership spirit, the teacher pays much attention to student learning needs, students learn more easily cooperatively, and develop mutual respect among students. Students (Slavin, 2015; Sumarmi, 2012). In addition, students will like learning by discussing and conveying their ideas because the GI model makes students more confident and increases social interaction between students. Students will encourage and help each other complete group topics (Halimah, 2017). Students also become wise individuals in living community life, such as collaborating on various activities and planning activities to be carried out (Artini et al., 2015). Some of these advantages can be seen that the GI model can positively influence students during the learning process.

In addition, the GI model also has a weakness: the sitting position between one group and another adjacent group allows for a disturbing classroom atmosphere (Sumarmi, 2012; Widyanto, 2017). The "free rider" effect, or the act of piggybacking students, can be triggered by the GI model (Slavin, 2015). This effect means that only a few students in one group do their work. Another drawback is that students cannot use the GI model properly if they do not understand the material (Shoimin, 2014). The disadvantages of the GI model indicate that there is a need for media to minimize the deficiencies of the GI model, such as the interactive media Lectora Inspire.

Lectora Inspire is software for creating interactive learning media developed by Trivantis Corporation to provide an exciting learning experience (Wibawa, 2017). Lectora was Inspired to be an AICC-certified authoring system. This achievement has provided the credibility needed to gain acceptance in the e-learning industry. Learning media developed through Lectora Inspire can be published so students can learn independently (Shalikhah, 2016; Shalikhah et al., 2017). Teachers can also apply Lectora Inspire to help students learn online and offline material. The material in the Lectora Inspire media can be presented in writing, pictures, or videos so that learning is interactive. The GI model assisted by interactive media Lectora Inspire is a suitable combination because the attractive display of interactive media Lectora Inspire has the potential to arouse student enthusiasm for learning, seriously answer teacher questions, and increase understanding of the material (Dewi et al., 2020; Rahmadani, 2019). This potential makes it easy for students to apply the GI model assisted by interactive media Lectora Inspire in geography learning, especially when facing a problem so that students' critical thinking processes will emerge.

The GI model assisted by interactive media Lectora Inspire is suitable for use in geography material. The selection of geographic material that can be used indicates essential competencies 3.5 competency achievement, namely analyzing problems caused by environmental population dynamics. The reason for using this material is because there are still many population problems in Indonesia. Using media-assisted models will encourage students' thinking processes and their awareness and concern for population issues, so it is hoped that this will become their provision in the future.

The explanation of the background above shows that the researcher found a suitable combination of models and learning media that needed to be tested for its effect on critical thinking, namely the combination of the GI model with interactive media Lectora Inspire. The novelty of the research is the use of instructional media, teaching materials, and research subjects. Thus, the study aimed to determine the effect of the GI model assisted by interactive media Lectora on high school students' critical thinking skills. The Group Investigation model, assisted by Lectora Inspire media, improves high school students' critical thinking skills.

METHOD

Research design, namely the strategy chosen by researchers to thoroughly integrate research components logically and systematically to discuss and analyze the research's focus. The research design used a quasi-experimental design with a posttest-only control group design. This quasi-experimental research design, posttest only control design, emphasizes the comparison of treatment between the two groups, namely the control group and the experimental group, where the experimental group is the group that was given special treatment and carried out on January 31 - February 10, 2023. The research sample was selected based on the geographic average end-of-semester assessment scores. The following is the average value for class XI IPS at Laboratory Senior High School Universitas Negeri Malang in 2022/2023.

Table 1. Average End of Semester Assessment Geography

No.	Class	Average
1	XI IPS 1	81
2	XI IPS 2	80
3	XI IPS 3	81.5

Based on Table 1, the study population was obtained: students XI IPS 1 with an average of 81 and XI IPS 3 with an average of 81.5. The experimental and control groups were selected through a random sampling technique with a lottery type. The lottery results showed that XI IPS 3 was the experimental group, and XI IPS 1 was the control group. The experimental group was given the treatment of the GI model assisted by interactive media Lectora Inspire. Media use is used to minimize the shortcomings of the GI model. It is used to deepen the material students study before carrying out investigative activities. At the same time, the control group uses conventional learning. The mean of this conventional learning is usually carried out by Laboratory Senior High School Universitas Negeri Malang, which uses a scientific approach. The research design (Sugiyono, 2022) is shown in Table 2.

Table 2. Research Design

No.	Group	Treatment	Post Test
1	Experimental Group	X	O
2	Control Group	-	O

Information:
X: Learning with the GI Model assisted by interactive media Lectora Inspire
O: Post Test in the group after being given treatment

The data collection technique is the posttest with instruments in the form of six essay questions based on indicators of critical thinking according to Ennis (Bustami et al., 2016), including 1) formulating problems, 2) giving arguments, 3) deduction, 4) induction, 5) evaluation, and 6) decide and implement. The question is used to obtain a score of students' critical thinking skills. The questions were first given to XII IPS 3 before being distributed to the experimental and control groups and then tested for validity and reliability. The basis for deciding on the validity test includes: 1) the item is declared valid if the significance is $0.00 < 0.05$, and 2) the questions are declared invalid if the significance is $0.00 > 0.05$. Meanwhile, the basis for making decisions on the reliability test includes: 1) the item is declared reliable if the significance is $0.00 > 0.60$, and 2) the item is not declared reliable if the significance is $0.00 < 0.60$.

Data analysis techniques assisted by SPSS 22 for Windows, namely the normality test, homogeneity test, and hypothesis testing with a significance level of 5%. The provisions of the Kolmogorov-Smirnov normality test are that if the significance is $0.00 > 0.05$, the data is usually distributed. The homogeneity test uses the condition that if the significance is $0.00 > 0.05$, then the data is homogeneous. Testing the hypothesis with the Mann-Whitney Test, which has the following conditions: 1) if the significance is $0.00 > 0.05$, then H_0 is accepted, and H_1 is rejected; 2) if the significance is $0.00 < 0.05$, then H_0 is rejected; and H_1 is accepted.

RESULTS AND DISCUSSION

Results

The initial implementation step was conducting instrument trials on XII IPS 3 students who had previously studied essential competencies 3.5. The second step was treating the GI model assisted by interactive media Lectora Inspired by the experimental group. At the last meeting, the posttest was given to both the experimental and control groups. The posttest results received are data on critical thinking skills. The data is presented and divided into five classifications, as shown in Diagram 1.

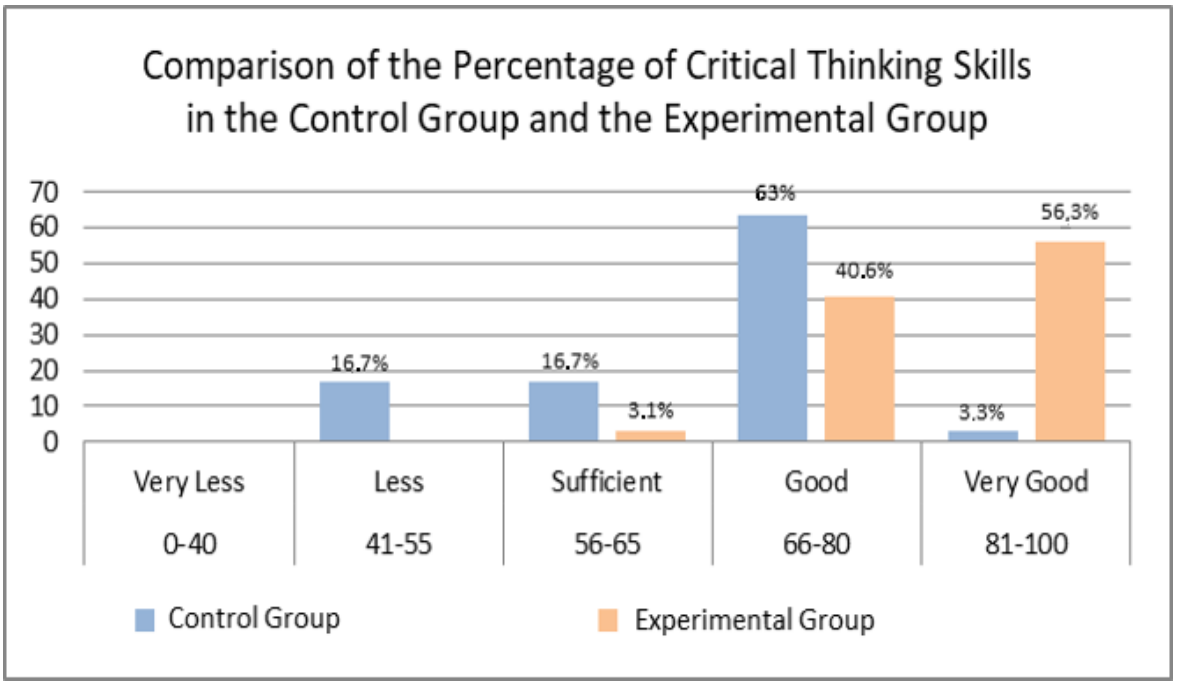

Diagram 1. Comparison of the Percentage of Critical Thinking Skills in the Control Group and the Experimental Group

Diagram 1 shows the percentage of students' critical thinking in the control group who are classified as less and sufficient at 16.7%. 63% of students have a good classification, and only 3.3% have a perfect classification in critical thinking. Meanwhile, in the experimental group, 3.1% of students had a sufficient classification. 40.6% of students are classified as good, and 56.3% are classified as good. From the results obtained, it is said that fewer students in the control group have excellent critical thinking skills. This is because the control group was not given the GI model assisted by the interactive media Lectora Inspire during learning. In addition, the teacher determined the problems that the control group students must solve. Meanwhile, the experimental group used the GI model with the help of interactive media based on Lectora Inspire, and students determined their problems.

Table 3. The Average Value of Critical Thinking Ability for Each Indicator

No.	Indicator	Average Value		Difference
		Control	Experimental	
1	Formulating Problems	3.0	4.4	1.4
2	Giving Arguments	3.6	4.3	0.7
3	Deduction	3.4	3.8	0.4
4	Induction	3.3	4.1	0.8
5	Evaluation	3.0	3.9	0.9
6	Decide and implement	3.9	4.2	0.3

Table 3 proves that indicators of critical thinking skills, namely formulating problems, have the most significant difference with a difference of 1.4. The reason is that the experimental group students are taught to find and formulate problems. The ability to formulate the main issues and explain answers to the questions given, students can learn to think critically to become one of critical activities (Budiarsih & Supeni, 2019; Hidayati & Indriana, 2022).

The decide and implement indicator has a difference of 0.3 and is an indicator of critical thinking with the lowest average difference. This is because the experimental and control groups have a similar learning process assigned to find solutions to existing problems. In addition, students are already accustomed to providing solutions to problems that arise around them, so there is little difference in average between them. The experience that a person has experienced exceptionally influences his ability to think because he has previously experienced and done it (Sudrajat et al., 2021; Sutriyanti & Mulyadi, 2019).

Data analysis on critical thinking skills used prerequisite tests, namely the homogeneity test and the Kolmogorov-Smirnov normality test. Meanwhile, the Mann-Whitney Test is used for hypothesis testing. The following are the provisions for deciding the research hypothesis.

H_0: The GI model assisted by interactive media Lectora Inspire does not affect the geography critical thinking skills of high school students

H_1: The GI model assisted by interactive media Lectora Inspire affects the geography critical thinking skills of high school students

Table 4. Results of Data Analysis

Prerequisite Test	**Significance**	**Information**
Kolmogorov-Smirnov Normality Test		
Experimental Group	0.000	Not Normal Distributed
Control Group	0.016	Not Normal Distributed
Homogeneity Test	0.450	Homogeneous
Hypothesis Test	Significance	Information
Mann Whitney test	0.000	H_0 is rejected, and H_1 is accepted

The normality test results in Table 4 show that the experimental group has a significance of 0.000 < 0.05, while the control group has a significance of 0.016 < 0.05, which shows that both data are not normally distributed. Meanwhile, the homogeneity test produces a significance of 0.450 > 0.05, meaning the data is homogeneous. Nonparametric statistical tests are used to test the hypothesis because the prerequisite test results do not meet the parametric statistical test analysis requirements.

The use of nonparametric statistical tests in research, namely the Mann-Whitney Test. The test results show a significance of 0.000 < 0.05, so H0 is rejected, and H1 is accepted. That way, it can be said that the GI model, assisted by the interactive media Lectora Inspire, influences the critical thinking skills of high school students.

The GI model assisted by the interactive media Lectora Inspire used in the experimental group is a learning that allows students to study independently in groups, starting from identifying topics to presenting project results. Therefore, the GI model assisted by the interactive media Lectora Inspire is based on a student-centered approach. The role of the teacher during the learning process is as a facilitator, assisting in learning experiences, assisting with environmental changes, and assisting in a learning process that is in harmony with needs and desires and helping groups when experiencing difficulties or offering assistance to each group (Sharan, 2017).

The material arranged in interactive media Lectora Inspire is the material students will learn about population problems. The media provides several cases of population problems in Indonesia, both open and dark, so the lessons learned are more concrete and contextual. The material is made in text, images, and videos to make it easier for students to learn and understand it from a visual and audio-visual perspective. To attract more visual attention but also concentration. The appearance of the material in interactive media Lectora Inspire is shown in the following Figure 1 and Figure 2.

Figure 1. Display of Visual Aspect Material

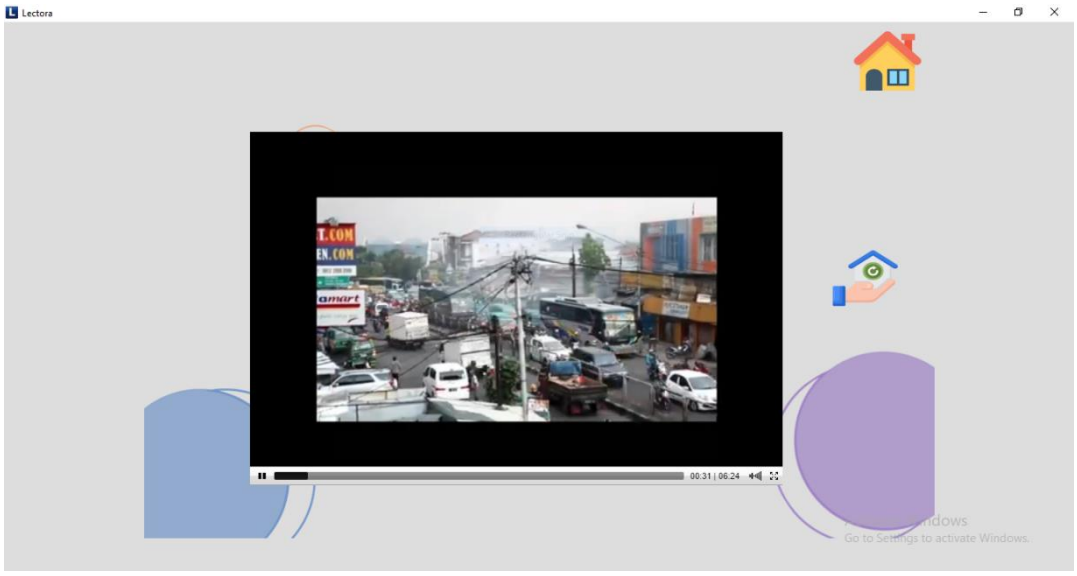

Figure 2. Display of Audio-Visual Aspect Material

The explanation of material in interactive media Lectora Inspire is carried out with the aim that students can understand the material first before carrying out investigative activities. This is also related to the shortcomings of the GI model. Namely, students cannot do the GI model learning correctly if they cannot understand the material. Next, we will discuss further the influence of the GI model, assisted by interactive media Lectora, on critical thinking skills.

Discussion

There are findings in this study, namely that students have been able to identify and provide solutions to problems that are still unclear regarding the population in Indonesia with the GI model assisted by the interactive media Lectora Inspire. These findings arise because, during the learning process, students are given an overview of population problems that are still relatively dark, and students in groups can determine other dark problems and analyze these problems. Therefore, it can be said that the stages of the GI model assisted by interactive media Lectora Inspire are the cause of the findings of this study. Further explanation regarding the research findings is described as follows.

Interactive media assist the GI model Lectora Inspire learning to make students active in facing a problem. The steps of the GI model assisted by the Lectora Inspire media in learning are 1) identifying topics and forming students into groups, 2) planning investigations, 3) investigations, 4) analyzing data and preparing final reports, 5) presenting reports, and 6) evaluating (Slavin, 2015). Media Lectora Inspire in learning is used in the first and second steps. The step of the GI model assisted by Lectora Inspire media can influence students' critical thinking, which consists of six indicators: formulating problems, giving arguments, deduction, induction, evaluation, and deciding and implementing (Bustami et al., 2016).

The first step is identifying the topic and forming students into groups. Students are presented with text, pictures, and videos of several open-ended population problems in Indonesia in the Lectora Inspire media, as shown in Figure 1 and Figure 2. The residents' problems in this video are slum settlements, crime, and poverty caused by population movements. The purpose of this presentation is so that students can know examples of open population problems in advance. Then, students are presented with pictures of examples of dark population problems through interactive media Lectora Inspire. In this activity, students are asked to compare open and dark problems. Topic problems that later need to be investigated by students are dark so that students can feel challenged (Sharan, 2017). Dark problem topics displayed in the media encourage students' desire to respond and provide appropriate solutions (Gaol & Darmana, 2022; Suwarna et al., 2022). The first stage shows that students can answer the teacher's questions so that it can be interpreted that students have recognized the problems displayed. Students' ability to recognize a problem is a characteristic of critical thinking skills (Nisa, 2022; Tumanggor, 2021). Students were formed into five heterogeneous groups using a paper lottery at this step. Groups formed heterogeneously influence high-ability students to help students under them during the project (Amin, 2019; Widyanto, 2017). Each group received an investigation sheet as a tool to make it easier to investigate the problem. Students in groups discuss determining the topic of population problems that are still unclear and explaining the reasons for choosing the problem. Each group has a different problem topic, so they can share the information they find. Achievement of critical thinking skills indicators in the first step, namely formulating problems, because students can define problems before formulating questions.

The second step is the planning of the investigation. In investigation planning, students plan activities, create strategies, and divide tasks to deal with problems (Sudiasih & Margunayasa, 2020). At this step, the teacher explains the procedure for planning the investigation properly through the interactive media Lectora Inspire. The procedures described are formulating problems, determining objectives, data, location and time, data collection techniques, and instruments. Students are also shown videos of conducting investigations on the media so they can understand the process of carrying out investigations that will be carried out. After that, students discuss determining their investigative plan by formulating the investigation's problem and purpose. The determination of the location and time between groups is the same, namely in the area around Laboratory Senior High School Universitas Negeri Malang on Thursday, February 2, 2023.

In addition, each group also determines the data along with the method of collection and the instruments written on the investigation sheet. The purpose of this investigative planning process is so that the data collection process carried out by students becomes more structured and directed (Mushoddik et al., 2016). The group that had prepared its investigation plan was asked to make an instrument in the form of an interview sheet. The questions made cover 5W1H. The group was also asked to assign tasks to each member, such as the interview section and documentation, and to record respondents' answers so as not to trigger a "free rider" effect. However, the division of tasks must be adjusted to students' abilities (Rokayah, 2014). Group discussions are seen at this step because students need to be active and think critically in planning their investigations to prevent future mistakes. Thus, the planning step becomes one of the success of a group's project. Critical thinking indicators at this stage are formulating problems and giving arguments.

The third step is the implementation of the investigation. This step is the core of the group investigation model assisted by interactive media Lectora Inspire. Before carrying out the investigation, each group was asked to collect literature reviews according to the topic of the problem. They can find this literature review through textbooks and sources from the internet. The

literature review will later be written in the investigation report. After collecting the literature review, each group can investigate the classroom. The investigation was carried out during study hours with limited time, and the location was not far from the school, so the sources obtained by each group did not vary. This is due to the limitations of the school. At the investigative step, students gain new learning experiences by collecting data through interviews with specified sources. Collecting data or information about this problem is a stage of critical thinking (Lismaya, 2019; Saloom, 2022). The data they found was then written on the investigation sheet. The process of achieving indicators of critical thinking skills at the investigative stage is induction because students can collect problem data through interviews.

The fourth step is analyzing the data and preparing an investigative report. This step is a follow-up activity from the implementation of the investigation. Each group reviews the interview data they get. Then, they discussed analyzing the data with the 5W1H aspects to obtain answers from the formulated problems. Through this data analysis, each group has developed problem information that is still unclear, starting from the factors that influence the problem and the impact of the problem. Therefore, data analysis activities allow students to think critically (Lismaya, 2019; Nuraini et al., 2020). Groups are also asked to determine and evaluate appropriate problem solutions to increase student development in solving problems. Students' insight increases by studying the problems around them (Marlina et al., 2017; Taher et al., 2019). The indicators seen in the learning model of GI assisted by the Lectora Inspire media in the fourth stage include deduction, induction, evaluation, and deciding and implementing. In the fourth step, each group prepares an investigative report. The investigation report is in the form of a paper and is prepared by the writing systematics listed on the investigation sheet.

The fifth step is the presentation of the investigation report. Each group presented their investigative report in front of the class. At the time of the presentation, the presenter group seemed confident in conveying their findings. The group that is the audience is allowed to ask questions or respond to the results of the investigation of the group presenting. Questions to the group of presenters are limited to 1-2 questions due to time constraints. This process raises group discussions, making students' courage to express their arguments visible. Expressing arguments plays an essential role in developing critical thinking (Roviati & Widodo, 2019). Therefore, implementing this stage raises critical thinking indicators, namely, giving arguments.

The sixth step is evaluation. The evaluation step is a question-and-answer activity between the teacher and students about the learning process that has been carried out (Aulia et al., 2020). Representatives of students were asked to express their opinions on the learning process using the GI model assisted by the interactive media Lectora Inspire and what they got during the lesson. Students revealed that implementing learning by investigating a problem became a new learning experience and felt more enjoyable because the investigation was implemented outside the classroom. In addition, students also stated that learning with the GI model assisted by interactive media Lectora Inspire had helped them understand population problems in Indonesia, how to investigate problems correctly and train them to think. At this step, students bring up students to think critically because they dare to express their opinions (Sukmawati & Putra, 2019).

One example of a dark problem topic taken by Group 1 is the Impact of the Perception of Women Not Allowing Higher Education on the Level of Education—implementing investigations or activities to collect data from Group 1, namely interviews with informants. The results of the investigation show that 1) the emergence of the notion that women should not have higher education is due to the thinking of the people who do not understand education, 2) the impact of this assumption can encourage women not to pursue higher education and can reduce education for women and the next generation, and 3) problems can be overcome by providing outreach to the community about the importance of education or by using social media to create content on the importance of education for women. The investigation carried out by group 1 shows that group members have found an answer to one of the dark problems regarding population and its solution.

The step of the GI model assisted by interactive media Lectora Inspires during learning, showing that using models and media influences students' critical thinking. However, the stages of the GI model have a more significant influence on encouraging students to think critically. This is because all stages of the GI model include critical thinking activities according to the indicators. The

first step of the six majorly influencing students' critical thinking is identifying topics. This stage provides experience for students because students in groups are required to think and discuss to determine and decide on dark population problems. Therefore, students become aware that there are still many population problems whose causes and impacts have not been answered. Thus, identifying topics makes students think actively and productive (Mushoddik et al., 2016).

During the learning process, the experimental group differs from the control group. The control group only uses the steps of the scientific approach. In observing, the teacher presents news on population problems through infographic media. The role of students at this stage is to observe the problems that occur in the news. At the questioning step, the teacher divides students into groups and asks each to compose questions related to news on population problems through the student worksheets. At the try and reason step, each group discussed looking for information to answer questions through books or internet sources. The information they find is written on the student worksheets. At the last stage, each group presented the results of their discussion. The activities were almost the same as those of the experimental group, but the actions taken differed—this difference in action resulted in different critical thinking.

The use of the GI learning model assisted by the interactive media Lectora Inspire went well. It was proven to encourage students to think critically, but researchers also faced problems. Problems are encountered when students in groups prepare investigative reports. Some students tend to be more engrossed in chatting, which can affect the concentration of students from other groups because the sitting positions between groups are too close. This is caused by the condition of the experimental group class is not so broad when compared to the control group class. In addition, this problem corresponds to one of the weaknesses of the GI model; namely, the sitting position between one group and another adjacent group allows for a disturbing classroom atmosphere. Thus, the action taken by the teacher is to condition the student to focus on working in the group.

CONCLUSION

The findings in this study are that students have been able to identify and provide solutions to problems that are still unclear regarding the population in Indonesia with the GI model assisted by the interactive media Lectora Inspire. This influence arises because students can recognize the phenomenon of population problems presented in the media, and students in groups can seek information through interviews and analyze population problems that are still relatively dark. The activities carried out during learning make students experience an increase in critical thinking. The comparison of the posttest scores of the experimental group students was also better than that of the control group students. In other words, the GI model assisted by interactive media Lectora Inspire is perfect for use in geography learning to influence students' critical thinking. As an implication, teachers can use this research as a reference for learning using the GI model assisted by interactive media Lectora Inspire to improve critical thinking skills. For future researchers, it can be used as a reference for researching the GI model assisted by interactive media Lectora Inspire with different dependent variables. In addition, the researcher recommends that investigative activities with interviews be carried out with various sources. This makes students gain more diverse insights or knowledge, and the results of investigative analysis become more leveraged.

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Sundanese ethnoastronomy-based Astronomy bulletin as an alternative to Astronomy learning: A feasibility test

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Astronomy; Bulletin; Ethnoastronomy; Sundanese

ABSTRACT

This study aims to determine the feasibility of independently developing a Sundanese ethnoastronomy-based astronomy bulletin as an alternative astronomical learning media. This research uses the ADDIE method, which consists of five stages, namely (1) Analysis, (2) Design, (3) Development, (4) Implementation, (5) Evaluation. However, this research only reached the determination of the feasibility of the bulletin, so the *implementation* and *evaluation* stages still needed to be carried out. The subjects of this study were one physics education lecturer and one physics teacher. The results of the feasibility test on the three indicators include (1) content validation tests obtained an average value of 81.25%, (2) language validation tests obtained an average value of 81.25%, and (3) presentation validation tests obtained a value of 80%, and the overall indicators showed reliable results. Therefore, the bulletin learning media developed is feasible and can be used as an alternative learning media for Sundanese ethnoastronomy-based astronomy.

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INTRODUCTION

Astronomy is one of the branches of the National Student Competition, where interest increases yearly. According to kalderanews.com by Britto (2022), the 2022 District-level National Student Competition in Astronomy with 19,612 participants increased compared to the 2021 District-level National Student Competition with 12,880 participants. However, education in astronomy in Indonesia still needs to be improved to channel the interests and talents of students. This is seen when we examine the astronomical content in the School Curriculum. This school's curriculum has no special lessons in Astronomy (Paramitasari et al., 2023). In addition, more astronomical facilities and mentors are needed for equitable distribution of astronomical knowledge and skills (Elzulfiah et al., 2015). This resulted in the need for special attention related to Astronomy material in schools.

The presence of astronomy, which has a vital role in natural knowledge, cannot be separated from the life part of a culture. Indonesia, which consists of several cultures, is undoubtedly familiar with natural sciences, including science related to the astronomy of a culture, such as the sky and

stars. Astronomy in culture is associated with the material of the astronomical Olympiad in schools. Some of the things discussed by ethnoastronomy related to the fabric of the Astronomical Olympiad in schools include cosmology, the concept of time and calendar, the movement of the moon, the direction of the sun, and the motion of stars (Suherman, 2017). However, along with the times, ethnoastronomy is less widely known by modern society, especially students. Previous research conducted by Suherman (2017) stated that of the 72 respondents in the West Bandung area, 13.9% answered knowing Sundanese ethnoastronomy, and 86.1% responded not knowing Sundanese ethnoastronomy. This shows that students' trust in ethnoastronomy is still low.

According to the main news of UAD, according to Putri (2019), the Indonesian state's wealth and local wisdom have a unique potential. This unique potential was able to give hope for the popularization of astronomy. However, there needs to be more in-depth research on knowledge about astronomy in the wisdom and richness of the local culture of the archipelago. Then, as reported by news. Permana (2021), Dr. Hakim said that in this era of modern science, local wisdom about astronomy has an excellent opportunity to be developed, one of which is through learning at the education level. Dr. Hakim and his team developed a program based on IAU-Network for Astronomy School Education (NASE) guidelines such as workshops, classroom learning, and excursions related to Astronomy (Pratiwi, 2021). Therefore, it is necessary to develop an alternative learning media related to Astronomy in ethnoastronomy-based high schools, especially for participants in the Astronomy Olympiad.

NASE programs in the form of classroom learning can be implemented with the help of alternative learning media that are independent and interesting. Bulletin is one of the exciting learning media that can be used in the learning process independently in class and outside the classroom (Wahyuni, 2019). Previous research on newsletter learning media has been conducted by Utami et al., (2022), with the results of research validation of material experts by 97% and media experts by 95.2% with excellent qualifications so that the bulletins developed can be categorized as feasible and tested in the learning process. Then, research conducted by Mikraj et al., (2019) regarding the physics bulletin in the form of a pocketbook shows that there is a significant influence on improving student learning outcomes when using bulletin learning media. This indicates that magazines influence the learning process, so they are suitable for use in a learning activity at school.

Based on previous problems and research, this article aims to develop an alternative learning media in the form of a bulletin related to Astronomy material in Sundanese ethnoastronomy-based high schools so that students can learn independently. This alternative is an astronomical magazine, which contains ethnoastronomy in Sundanese culture and explanations according to astronomy. The preparation of alternative learning media in the form of this bulletin can produce something new as reading material for students independently. Also, more attractive packaging and light language will increase students' confidence in ethnoastronomy. This research contributes to developing bulletin-based learning media with local wisdom, especially Sundanese, regarding astronomy so that it is easily understood by students who often use Sundanese.

METHOD

The method used in this study is ADDIE. ADDIE is an acronym for Analyze, Design, Develop, Implement and Evaluate. Model ADDIE is an instructional development design centered on individual learning, has immediate and long-term phases, is systematic, and uses a systems approach to human knowledge and understanding. The ADDIE model concept is applied to build essential performance in education, namely developing a learning product design. However, in this research article, there is no Implementation and Evaluation stage because the research in this article only aims to test the feasibility of newsletter products. The results of the feasibility test of this bulletin can later be used for further testing so that it can be used for alternative learning media.

Analysis Phase

At this stage, an analysis of problems related to the topic is taken through literature studies or relevant previous research. The search for the best solutions related to the issues that have been

analyzed is carried out. Apart from that, pre-planning is thinking or deciding about the subjects or courses that will be given.

Design Phase

Design is a systematic process that starts from setting learning objectives, designing teaching and learning activities, designing learning tools, and designing learning materials and tools for evaluating learning outcomes. Efforts to design the learning process to become a compelling and exciting activity: At this stage, it is carried out by designing products to be developed that contain astronomical material based on Sundanese ethnoastronomy. Alternative astronomy learning media in the form of a bulletin is designed to support the independent learning process by students who are attractively designed using a combination of colors, layouts, letters, and images by the material. The stages carried out in designing alternative astronomical learning media in the form of this bulletin are (1) determining the theme to be published in the bulletin, (2) determining the content to be poured in the bulletin, (3) collecting information and content from each content in the bulletin, and (4) making alternative designs of astronomy learning media in the form of bulletins.

Development Phase

In this last stage, a product feasibility test was carried out to determine the feasibility of alternative learning media developed as an astronomical bulletin. One physics education lecturer and one high school physics teacher conducted the feasibility test. Due diligence data was taken using Microsoft Word documents for feasibility test assessment with a Likert scale of 1-4, which contained three indicators: content indicators containing four statements, language indicators having two ideas, and presentation indicators containing five words. The weight of value one on the indicator of content, language, and presentation indicates a significantly lower value, the importance of value two on the indicator of content, speech, and expression suggests a value of less, the importance of value three on the indicator of content, address, and expression offers a good deal. The importance of value four on the content, address, and presentation indicator shows an excellent value.

To determine the level of feasibility of the developed newsletter, two stages are carried out, namely by analyzing validity and reliability using the Likert Scale. The validity analysis of the designed newsletter is used with the Formula 1 Sugiyono (2013):

$$P = \frac{f}{n} \times 100\% \quad (1)$$

P is Percentage earned, f is Score obtained, and n is Ideal maximum score. Score 4 for excellent, score 3 for good, 2 for enough, and 1 for very lacking (Sugiyono, 2017).

Table 1. Qualify for Validity Level Based on Average Percentage

No.	Achievement Level	Qualification
1	80% - 100%	Highly Valid
2	60% - 79.9%	Valid
3	50% - 59.9%	Less Valid
4	0% - 49.99%	Invalid

Source: (Latifah, 2016)

Furthermore, for the analysis of the reliability of learning media. Reliability indicates the extent to which the tool's measurement results can be trusted. The percentage of agreement (PA) method is Formula 2 (Arsanty & Wiyatmo, 2017).

$$PA = \left(1 - \frac{A-B}{A+B}\right) \times 100\% \quad (2)$$

A is a greater validator score. B for more miniature validator score. Learning media is said to be reliable if the percentage of agreement (PA) value is produced significantly $\geq 75\%$.

RESULTS AND DISCUSSION

Results

Based on the direction of the research method used, the research results obtained include media suitability from media experts, content validity, language, and appearance.

Figure 1. Sundanese Ethnoastronomy-Based Astronomy Bulletin Design

The results of the feasibility test assessment for the development of learning media in this study have been carried out by one physics teacher and one physics education lecturer at the development stage. Then, the results of the feasibility test assessment in the form of validation have been analyzed by referring to the validation test Sugiyono (2013) so that the results of the validation test for the development of learning media related to the national Astronomy student competition material at Sundanese ethnoastronomy-based high schools were obtained as follows:

Table 2. Qualification Test Validation of Sundanese Ethnoastronomy-Based Astronomy Bulletin on each Indicator

No.	Indicators	Average Indicators	Qualification
1	Fill	81.25%	Highly Valid
2	Language	81.25%	Highly Valid
3	Serving	80%	Highly Valid

Based on the results of the analysis listed in Table 2, the average assessment of indicators shows that the qualifications are very valid for all hands. The qualification results in the table show that the Sundanese ethnoastronomy-based astronomy bulletin as an alternative learning media to improve students' trust attitudes is very feasible/worthy of development. In more clarity, the following is presented for each statement on the indicator tested in the test of content, language, and presentation validity.

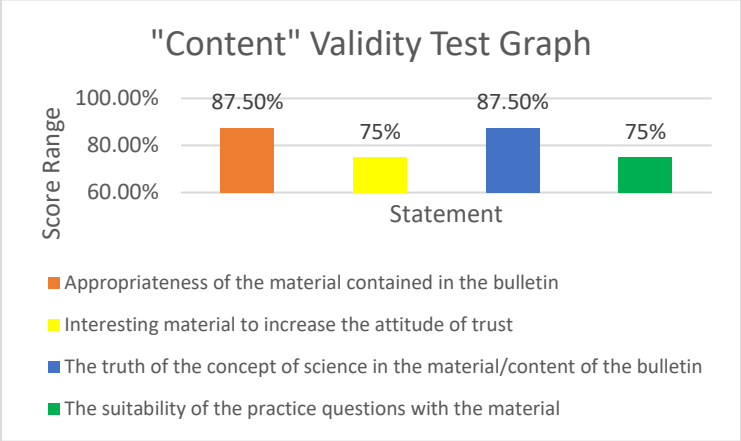

Figure 2. Validity of the Content Indicator

Based on the results of the analysis in Figure 2, if reviewed thoroughly against the content indicators of each statement regarding the newsletter that has been developed, shows very valid results with an average hand of 81.25%, so the newsletter learning media that has been designed can be tested in the field. The statement of conformity of the material contained in the bulletin and the correctness of the concept of science in the publication's content obtained a value of 87.5%, which indicates very valid results. Assessment is the process of collecting data/information used to measure the achievement of a goal. Assessment shows that the material presented is based on the truth of concept science, which influences students' confidence in Sundanese ethnoastronomy. This is in line with Firman (2018), which states that facts accepted by the scientific community are based on empirical proof, thus producing a belief. The statement of exciting material and the suitability of the practice questions with the material obtained a value of 75%, which shows valid results. The assessment indicates that exciting material can increase participants' interest in learning about it (Wijayanti et al., 2018). Coupled with practice questions on the material, students can learn independently. This is in line with Wahyuningsih (2011) and Budiarti (2022), which state that improving learning outcomes occurs because it begins with the interest of students who can increase student interest and activity in learning the material.

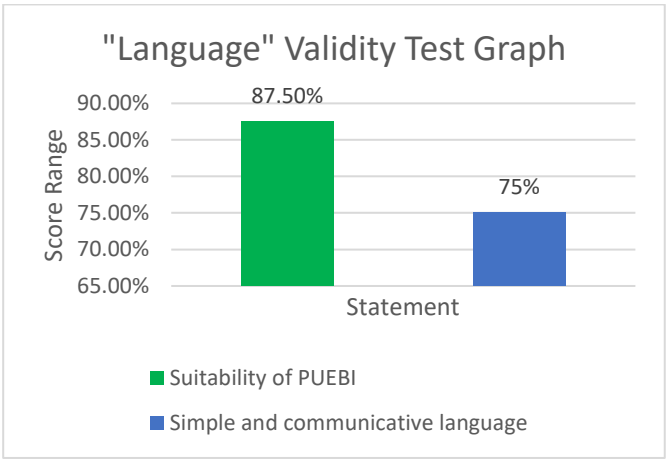

Figure 3. Validity of Language Indicators

Based on the analysis results in Figure 3, when reviewed thoroughly, the linguistic indicators of each statement in the developed bulletin show very valid results with an average hand of 81.25%, so the learning media of the developed bulletin can be tested in the field. The PUEBI (General Spelling Guidelines Indonesian) conformity statement yielded an 87.5% assessment, which showed valid results. The evaluation suggests that the use of language clarity is based on PUEBI. Using language based on PUEBI can make it easy for students to understand the material transferred by the teacher during learning activities (Putri, 2019; Wiguno et al., 2021). Then, a 75% assessment showed valid results for simple and communicative language statements. The evaluation indicates that Indonesian and Sundanese language use is simple and communicative, making it easy for students to understand the material in the developed bulletin (Wulandari, 2020).

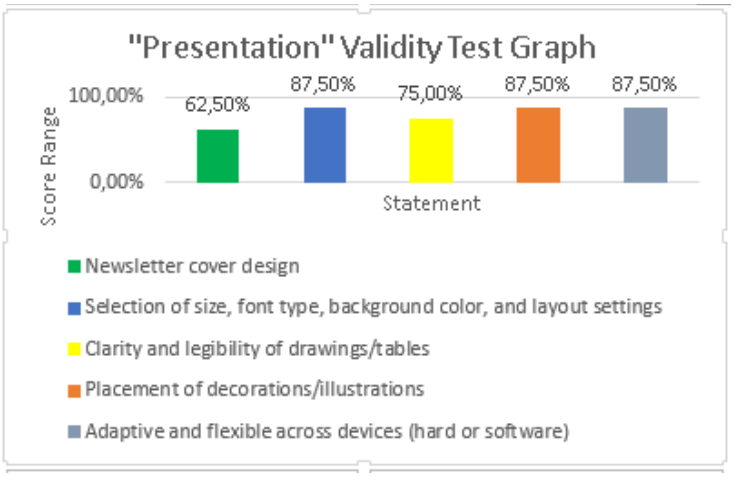

Figure 4. Validity of the Presentation Indicator

Based on the analysis results in Figure 4, when reviewed thoroughly, the presentation indicators of each statement on the bulletin learning media show very valid results with an average hand of 80%, so the newsletter learning media developed can be tested in the field. Choosing the size, font type, background color, layout settings, decoration placement, and adaptive and flexible on various devices obtained a rating of 87.5%, which showed very valid results. These results show that the alignment of the presentation and illustration arrangement used by researchers is by Sundanese ethnoastronomy-based astronomy material so that it can attract students' attention during learning

activities (Listianingsih et al., 2022). Students' attention during this learning process is included in one of the indicators of student learning interest (Istiqomah & Trilaksana, 2022).

On the statement, the newsletter cover design and decoration placement obtained 62.5% and 75%, respectively, which showed valid results. Both validators stated that the surface of the newsletter should include the name of the material to be discussed in the developed newsletter. Both validators also said that more HD images are highly recommended to support the readers' clarity of the designed newsletter.

Furthermore, the feasibility test assessment results in the form of reliability have been analyzed (Arsanty & Wiyatmo, 2017) so that the results of the reliability test of learning media development related to the national Astronomy student competition material at Sundanese ethnoastronomy-based high schools were obtained in Table 3.

Table 3. Learning Media Reliability

No.	Indicators	Percentage of Agreement (PA)	Information
1	Fill	84.62%	Reliable
2	Language	92.30%	Reliable
3	Serving	88%	Reliable

The analysis results in Table 3, Percentage of Agreement on all indicators, show reliable results. From the results of these qualifications, it can be shown that there is a match in the assessment results between the two validators in the Sundanese ethnoastronomy-based astronomy bulletin as an alternative learning media that aims to improve students' trust attitudes.

Based on the description above with the results of analysis related to the problem, a solution was found in the form of the development of an astronomical bulletin based on Sundanese ethnoastronomy, which further obtained an assessment that the development of an astronomical magazine based on Sundanese ethnoastronomy received very valid and valid qualifications in each indicator test, as well as in the whole Indicators show reliable results. These results are from research conducted by Utami et al., (2022), which states that the presentation of the newsletter is very well-qualified and is worthy of being used as an alternative learning media that can be tested in the learning process. The involvement of the development of the Sundanese ethnoastronomy-based astronomical bulletin can be continued to the next stage, namely the limited trial stage to determine the validity of the magazine, then the effectiveness test, which can later decide whether the developed magazine can be continued to trials in learning activities in schools.

Discussion

Education in Indonesia astronomy still needs to be improved to channel the interests and talents of students, even though the interest in the national astronomy student competition every year always increases. This is due to limited astronomical facilities and guidance, which results in an uneven distribution of astronomical knowledge and skills. The presence of astronomy, which has a vital role in natural ability, cannot be separated from the living part of a culture (Putri et al., 2015). There are many dimensions of cultural existence in ethnoastronomy and astronomy in Indonesia (Venia, 2020). However, in modern times, many learners need to learn astronomy from a cultural perspective (Hikmatiar et al., 2023). Therefore, it is necessary to develop an alternative learning media related to the national Astronomy student competition material in Sundanese ethnoastronomy-based high schools.

Limited astronomical facilities and supervisors that result in uneven distribution of astronomical knowledge and skills can be overcome with interestingly arranged independent learning media. Bulletin is one of the exciting learning media that can be used in the learning process independently in class and outside the classroom (Wahyuni, 2019). The bulletin in this study was chosen because the magazine is easy to read in the delivery of content and packaging with an attractive appearance so that students can learn independently (Afifah et al., 2022). This beautiful

display makes newsletter media not fixed just like that, and learners learn independently and better understand the content, increasing enthusiasm for reading newsletter media (Asyhari & Silvia, 2016; Putri et al., 2015).

The design of an alternative learning media related to the national Astronomy student competition material at the Sundanese ethnoastronomy-based high school consists of several stages. The first stage is to determine the theme to be published in the bulletin about astronomical material in Sundanese culture. These materials include cosmology, calendar, and constellations from the Sundanese culture's perspective and their analysis in astronomical reviews. The material for the Astronomy national student competition was chosen because the material has a relationship with the view of the Sundanese people, so students learn astronomy through the material and from a cultural perspective. This is in line with research conducted by Cotte (2016), which presents the situation on the Astronomical and Archaeoastronomical heritage related to the World Heritage Convention over the past few years to date, which states that astronomy represents a rich and significant cultural and natural indicator of world heritage. Fahrozy et al., (2022) Also believe that local culture associated with learning can shape students' character and understanding of the excellence and wisdom of local culture in their area. This can undoubtedly increase students' attitudes and beliefs towards culture.

The second stage of the design, which is to determine what content will be published in the bulletin, namely the content of astronomical material in Sundanese culture, then continued with the material content in the astronomical review so that it can be seen the relationship between astronomy from the perspective of Sundanese culture and its astronomical theory which can increase the confidence attitude of students. Then, content challenges aim to review understanding and train student skills. The last stage is to compile an astronomical bulletin design based on Sundanese ethnoastronomy. The bulletin is designed with a contemporary and colorful design and exciting letters. This aims to make interesting literature so that it can attract the attention of students to learn astronomy independently so that there are students' attitudes and beliefs in the local culture. Thus, an astronomical bulletin based on Sundanese ethnoastronomy was formed with material on cosmology, calendars, and constellations.

CONCLUSION

The Sundanese ethnoastronomy-based astronomy bulletin can be used as an alternative learning media for students who aim to increase their trust attitudes towards Sundanese ethnoastronomy. This Sundanese ethnoastronomy-based astronomical bulletin was declared feasible after feasibility tests were carried out on three indicators. The three indicators are content hands, which produce an average score of 81.25%, including very valid qualifications; which has an average score of 81.25%, including excellent capabilities; and presentation, which produces an average score of 80%, including fantastic stuff, and overall indicators show reliable results. In addition to the Sundanese ethnoastronomy-based astronomical bulletin that is already feasible, the magazine developed also needs improvement. These improvements can be in the form of adding images with more apparent quality, which, of course, are based on material to improve the quality of the developed newsletter.

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Improving integrated thematic learning outcomes using the numbered head together cooperative mode

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Numbered head together (NHT)

ABSTRACT

This study used a classroom action research method by applying qualitative and quantitative approaches carried out in 2 cycles through the stages of planning, implementation, observation, and reflection. This study aimed to observe the improvement of student learning outcomes in class VB SDN 13 Kuranji by applying the Numbered Head Together (NHT) Model. The research data obtained were analyzed using qualitative and quantitative techniques with the instruments of the Teaching Implementation Plan (RPP) assessment sheet, teacher and learner activity observation sheets, evaluation question sheets, attitude journals, and skill rubrics. Teachers and students became the subjects of this study. According to the results of the study, there was an increase in each cycle. In the lesson plan assessment in Cycle I, the score was 85%, and 95% in Cycle II. Regarding teacher activity, the value reached 84.3% in Cycle I and 93.7% in Cycle II, while the learner aspect in Cycle I was 83% to 94% in Cycle II. In addition, students' learning outcomes increased from 78.4 in Cycle I to 87 in Cycle II. The results showed improved student learning outcomes after applying the Numbered Head Together model. The improvement is also seen in the lesson plan and the implementation of learning regarding teachers and students.

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INTRODUCTION

Curriculum 2013 in primary schools combines several subjects into a theme as the main focus or integrated theme. Integrated thematic learning makes a theme a binding concept for various materials or competencies to integrate knowledge and skills (Artapati & Budiningsih, 2017). The application of integrated thematic learning aims to provide opportunities for students to become the main actors or centers of learning to build concepts that are interconnected with other concepts that are already understood so that they can understand the problems that exist in the surrounding environment and can use the information obtained meaningfully (Tirtoni, 2018). Integrated thematic learning aims to support the achievement of learner-learning outcomes aligned with specific competencies, namely attitude, knowledge, and skills competencies. The success of achieving these

goals can be seen from the results of learning achievements obtained after going through the learning procedures that have been determined (Fauzana & Lena, 2020). Substantially, learning can be defined as changes in individuals who learn from thoughts and behavior regarding attitudes, knowledge, and skills after following a series of learning processes (Dahuri & Desyandri, 2021).

The ideal integrated thematic learning begins with developing a Learning Implementation Plan that follows the correct writing rules and their components. In implementing learning, wherever possible, teachers create good and pleasant learning conditions to attract attention and make students actively involved and able to think critically and creatively to make learning meaningful. Furthermore, in conducting learning assessments, teachers are guided by the Learning Implementation Plan, designed to determine the objectives of the assessment and make grids and assessment instruments (Yuza & Reinita, 2021). Furthermore, the characteristics of integrated thematic learning, among others, are that students become the center of learning, provide authentic experiences, the separation between subjects is not too clear and flexible, the learning process presents concepts from several subjects, adapts to the interests and needs of students (Amelia, 2019).

Based on reality, implementing thematic learning in the field has yet to be maximized. According to the results of observations in class VB SDN 13 Kuranji Padang City on September 23-24, 2022, several obstacles were still found. These obstacles are reviewed from the Learning Implementation Plan, the learning implementation aspect, and the student learning outcomes. 1) In the Learning Implementation Plan, indicators must still follow the guidelines for formulating correct indicators. The Operational Verbs (KKO) formulated by the teacher have decreased the cognitive level. Then, there is also no assessment grid for assessing the knowledge aspect. 2) In the implementation of learning, several obstacles were still found, including a) the teacher is still the center of learning where the teacher dominates the learning, b) when moving the material, the teacher still mentions the identity of the subject so that it seems that there is still a separation between subjects, c) teachers do not develop learning resources and materials or only focus on teacher and student books, d) in high grades teachers still tend to use them and students, d) in high grades teachers still tend to use a scientific approach, e) the Learning Implementation Plan does not thoroughly guide the implementation of learning, f) rarely use learning media due to time constraints.

Some of the above obstacles affect students, such as: 1) quickly feeling bored because of monotonous learning, so they tend to be passive in learning. 2) Students' thinking is still compartmentalized due to the separation of subjects, 3) Most students still do not dare to express their opinions, 4) students are rarely allowed to learn in groups, 5) students are less enthusiastic because of limitations in using learning media, 6) as well as the learning outcomes of students who have not reached the predetermined Minimum Completeness Criteria (KKM). It can be seen from the results of the Midterm Assessment that 1 out of 20 people, only eight or 40%, managed to reach the KKM.

Looking at the problems, it is necessary to make an innovation in carrying out learning, one of which is by applying a model in learning that is innovative and adapted to the characteristics of students. Applying innovative learning models following learning materials indirectly impacts students' understanding and learning achievement. Teachers are required to be good at sorting and choosing learning models that are tailored to the material and characteristics of students, as well as making students the center of learning so that they are motivated to be serious, creative, and enthusiastic in learning (Afriyanti & Hamimah, 2022). However, the learning model used by the teacher is not suitable for the material and characteristics of the learners. In that case, this can hurt the achievement of learning outcomes in line with the predetermined learning objectives (Wulan & Reinita, 2021).

Based on what has been described above, researchers in this study chose the Numbered Head Together (NHT) type cooperative learning model to be applied in the learning process to improve students' learning achievement. The Numbered Head Together model is a learning model that allows collaboration between students in small groups and builds on each other's ideas (Haerullah & Hasan, 2017). In addition, the Numbered Head Together model is also characterized as a learning model that aims to improve students' understanding of the subject matter through intense interaction to learn together in groups with the characteristic of using head numbers (Leonard et al., 2019). The application of the Numbered Head Together model in learning will motivate students to actively

learn, foster an attitude of cooperation, foster a sense of responsibility, be required to have the same understanding when working on their group assignments, and have the courage to convey their ideas to others (Kholis, 2017). In its implementation, this Numbered Head Together model forms students into several small groups. The teacher will call one of the head numbers, and the number called will represent the group at the front of the class without any notification of which head number will be called (Majid, 2022). In its application, the Numbered Head Together model is designed as a pattern of interaction between students and forms students into several small groups as a means of completing tasks that will be thought of together and answer the task according to the head number that each group gets (Septrima & Lena, 2021).

This Numbered Head Together model also has advantages, namely: (a) making it easier for students to understand learning materials, (b) students trained to explore their knowledge, (c) creating interaction between students in completing tasks, (d) creating peer tutor activities where less intelligent students can learn from their clever friends, (e) creating an attitude of cooperation in solving problems (Dadri et al., 2019). The Numbered Head Together model also has the potential to make students play an active role during learning and create a fun atmosphere by learning in groups by involving all students (Petriza & Eliyasni, 2020).

Learning that is carried out using the Numbered Head Together model is expected to improve students' conceptual understanding of the material. The novelty of this research is the use of the Numbered Head Together model in learning that combines the use of PowerPoint technology in learning to make learning less tedious and can focus the attention of students because the subject matter explained through PowerPoint shows will attract the attention of students more than the explanation of material using only words (Humairah, 2022). By combining technology and the Numbered Head Together model, this research can provide a new alternative to improve the quality of learning. This research emphasizes the importance of using a suitable learning model in the learning process to achieve maximum learning outcomes.

The success of the Numbered Head Together (NHT) model in improving learning outcomes is reinforced by research conducted by Desyandri and Adha (2022) that there was an increase in thematic learning outcomes in class VB SDN 18 Koto Hilalang after the application of the Numbered Head Together model in the learning process.

Based on the description presented, this study aims to determine the improvement of integrated thematic learning outcomes in students in class VB SDN 13 Kuranji using the Numbered Head Together model. This objective involves three aspects: learning planning, learning implementation from the perspective of teachers and students, and learning outcomes. This research contributes to educators implementing the Numbered Head Together model to improve student learning outcomes.

METHOD

This research used the Classroom Action Research (CAR) method, which combined qualitative and quantitative approaches. Classroom Action Research is research conducted collaboratively and sustainably to improve learning practices (Asdar, 2018). Classroom Action Research aims to improve the quality and learning outcomes by improving teaching methods (Fauzana & Lena, 2020). The research was carried out based on the Classroom Action Research cycle, which refers to the model developed by Kemmis and MC Taggart where the research procedure begins with the planning stage, secondly implementation, observation, and ends with reflection activities carried out in at least two cycles (Rahayu & Lena, 2021).

The research was conducted in class VB SDN 13 Kuranji Padang City, in the second semester of the 2022/2023 school year, involving 19 students consisting of 9 boys and ten girls. This study involved researchers as practitioners and teachers as observers. The research took place over two cycles. Cycle I was carried out in 2 meetings on Wednesday, January 11, 2023, and Thursday, January 12, 2023. While cycle II consisted of one meeting on Wednesday, January 18, 2023.

The data source in this study was obtained during the learning process, including the Learning Implementation Plan, the implementation of learning in terms of teachers and students, and the assessment of learning outcomes. The research data came from teachers and class VB SD Negeri 13

Kuranji Padang City students, who became the research subject. In the aspect of the Learning Implementation Plan, the document analysis technique was used. The instrument used was a Learning Implementation Plan assessment sheet using indicators adjusted to the Learning Implementation Plan components. Furthermore, in the aspect of learning implementation, using an observation sheet instrument to observe the course of learning in terms of teacher activities and participant activities with indicators tailored to the steps of the Numbered Head Together model in the introduction, core, and closing stages. Based on the observation sheet, the observer directly saw what happened during the learning process while giving a checkmark in the designated column. The observer observed what happened or what appeared and did not appear during learning. Furthermore, the aspect of learning outcomes used an evaluation question sheet consisting of 10 items in multiple-choice questions covering the content of the Indonesian language, social studies, and civics—as well as attitude journals and skill rubrics.

The data analysis technique applied in this research combined qualitative and quantitative techniques. Qualitative data analysis uses analysis techniques referred to as the Miles and Huberman model, where the data obtained is initially reduced, then presented, and finally, conclusions are drawn (Farhana et al., 2019). The data was obtained from the assessment of the Learning Implementation Plan and the results of observations of the implementation of learning from the perspective of students and teachers, as well as the results of the attitude journal. Meanwhile, quantitative analysis was used to measure learning outcomes from knowledge and skills using the calculation formula explained in Formula 1 (Kemdikbud, 2018). The range of success predicates can be observed in Table 1.

$$P = \frac{f}{n} \times 100\% \quad (1)$$

Table 1. Range of Success Predicates

No.	Predicate	Rated
1	A (Very Good)	$93 < A \leq 100$
2	B (Good)	$86 < B \leq 93$
3	C (Enough)	$80 < C \leq 86$
4	D (Needs Guidance)	$D < 80$

RESULTS AND DISCUSSION

Results

This research was conducted for three sessions in 2 cycles. Based on the research, the results can be seen from 3 aspects: the aspects of the Learning Implementation Plan, the aspects of learning implementation in terms of teachers and students, and the aspect of obtaining learning outcomes by applying the Numbered Head Together model. This model consisted of several steps. The first step was to divide the learners into small groups and assign different head numbers within a group. Then, the teacher would give out tasks, and each group would collaborate to complete the task. After that, each group member would discuss and ensure that all group members understood the correct answer. The teacher would call a head number, and the member who had that number would report the results of their group discussion. Next, the members of other groups would comment on the report; then, the teacher would call a different number of heads. Moreover, it ended with a conclusion (Nourhasanah & Aslam, 2022). The research results can be described as follows:

Aspects of the Learning Implementation Plan

A learning Implementation Plan is a guideline containing the teacher's learning steps to achieve predetermined competencies (Juanda, 2019). Before conducting research, researchers designed a Learning Implementation Plan that was adjusted to the learning implemented by applying the Numbered Head Together model. The researcher also gave the Learning Implementation Plan assessment sheet to the observer to find the deficiencies, which would then be reflected or improved in the next cycle to obtain a good Learning Implementation Plan. This lesson plan assessment referred to the components that should be in a lesson plan. The components of the Learning Implementation Plan included 1) identity, 2) essential competencies and indicators, 3) learning objectives, 4)

materials, 5) models and methods, 6) media, 7) learning resources, 8) learning stages, and 9) assessment (Jaya, 2019). According to the observer's assessment of the Learning Implementation Plan devised by the researcher in each cycle, the scores can be seen in Table 2.

Table 2. Assessment Results of Learning Implementation Plan for Each Cycle

No.	Rated Aspect	Cycle I	Cycle II
1	Identity of Lesson Plan	4	4
2	Indicators	3.5	4
3	Learning Objective	4	4
4	Learning Materials	2	3
5	Learning Resources	3	3
6	Learning Media	3	4
7	Learning Model and Method	4	4
8	Learning Activities	3	4
9	Assessment Design	3.5	4
10	Lesson Plan Layout	4	4
	Total	**34**	**38**
	Percentage	**85%**	**95%**
	Qualification	**C**	**A**

The result shows in Table 2 that the Learning Implementation Plan assessment in each Cycle has improved. This Learning Implementation Plan assessment referred to the components that should be in a Learning Implementation Plan. In Cycle I, the Learning Implementation Plan design needed to be improved in Cycle II. Ten aspects were assessed from the lesson plan, each with four descriptors. Cycle I only fulfilled 34 of the 40 descriptors and scored 85% (C). Furthermore, in Cycle II, it could fulfill 38 out of 40 descriptors with a score of 95% (A). It indicated that the researcher had designed the Learning Implementation Plan well after conducting reflection activities with the teacher in the first Cycle. However, there were still shortcomings in selecting materials and learning resources that fulfilled only some of the required descriptors.

Aspects of learning implementation from the teacher's perspective

The learning implementation was based on the Learning Implementation Plan designed based on the steps of the Numbered Head Together model. The researcher provided an observation sheet related to the implementation of learning, starting with the introduction, core, and closing stages. Observers observed the implementation of learning by the researcher as a practitioner teacher. The purpose of this was to observe the suitability between the implementation and the design of the Learning Implementation Plan that had been made and to know what activities were carried out and activities that were not carried out. Observers observed the researcher as a practitioner teacher in implementing learning in each cycle in Table 3.

Table 3. Results of Observation of Learning Implementation of Teacher Aspects of Each Cycle

No.	Rated Aspect	Cycle I	Cycle II
1	Preliminary Activity	3	4
2	Step 1: Students are Divided Into Groups and Assigned Head Numbers	3.5	4
3	Step 2: The teacher gives the task, and each group works on it	2.5	3
4	Step 3: Students discuss and unify opinions and ensure that each group member knows the answer	4	4
5	Step 4: The Teacher Called One Number, and The Number Called Reported The Results of Their Group Discussion	4	4
6	Step 5: Members of Other Groups Give Responses, and The Teacher Calls Out Different Numbers	3.5	4
7	Step 6: Conclusion	3.5	4
8	Closing Activity	3	3
	Total	**27**	**30**
	Percentage	**84.3%**	**93.7%**
	Qualification	**C**	**A**

As presented in Table 3, there was an improvement in the implementation of learning from the teacher's aspect in each cycle. Based on Table 3, in Cycle I, a score of 27 out of 32 descriptors was obtained with a score of 84.3% (C). Then, in Cycle II, a score of 93.7% (A) was obtained, with a score of 30 out of 32 descriptors requested. The improvement was inseparable from the corrective efforts in cycle II, where the learning was adjusted to the learning steps in the Learning Implementation Plan. However, descriptors still had not appeared in the core activities of giving assignments and closing activities.

Aspects of learning implementation from the student's perspective

Aside from the teacher's aspect, the observer also observed the implementation of learning regarding students. The descriptors assessed in this aspect of students used the same descriptors as the observations on the teacher's aspect. Observations of student aspects in Cycle I and Cycle II are presented in Table 4 below.

Table 4. Results of Observations of Learning Implementation of Student Aspects of Each Cycle

No.	Rated Aspect	Cycle I	Cycle II
1	Preliminary Activity	3	4
2	Step 1: Students are Divided Into Groups and Assigned Head Numbers	3.5	4
3	Step 2: The Teacher Gives The Task, and Each Group Works On It	2.5	3
4	Step 3: Students Discuss and Unify Opinions and Ensure That Each Group Member Knows The Answer	4	4
5	Step 4: The Teacher Called One Number, and The Number Called reported The Results of Their Group Discussion	4	4
6	Step 5: Members of Other Groups Give Responses, and The Teacher Calls Out Different Numbers	3	4
7	Step 6: Conclusion	3.5	4
8	Closing Activity	3	3
	Total	26.5	30
	Percentage	82.8%	93.7%
	Qualification	C	A

As presented in Table 4, there was an improvement in the implementation of learning from the learners' aspect for each cycle. In the implementation of learning in Cycle I, there were differences in the scores obtained regarding teachers and students, even though they used the same descriptors. In Cycle I, a score of 26.5 out of 32 descriptors was obtained with a score of 82.8% (C), and the score increased in Cycle II, which was 93.7 (A) with a score of 30 out of 32 descriptors. The improvement in the quality of learning was due to the utilization of the Numbered Head Together model, which can motivate and make students more active and earnest when participating in learning activities (Desvianti et al., 2020).

Aspects of learning outcomes

Learning outcomes are the actual achievements of students in thinking and acting that can be measured and observed (Ananda & Abdillah, 2018). Based on the research, the student's learning outcomes after applying the Numbered Head Together model in the learning process in each cycle can be observed in Table 5.

Table 5. Learning Outcomes for Each Cycle

No.	Cycle	Average	Number of Students Who Completed	Percentage
1	Pre-cycle	73	8	42.1
2	Cycle I	81	12	63.1
3	Cycle II	87	16	84.2

The data recorded in Table 5 shows an improvement in the average score of students in each Cycle. In addition, there was an increase in the number of learners who exceeded the set minimum score limit. In the previous pre-cycle, the average score was still far from what was expected, where it had yet to reach the minimum completeness of 80. Only a small number of students (8 people) succeeded in getting scores exceeding the minimum score because the learning carried out had yet

to apply various models, such as the Numbered Head Together model. However, in Cycle I and Cycle II, there was an improvement in students' learning outcomes, which exceeded the minimum completeness score. Cycle I obtained a score of 81 with a percentage of 63.1%, and Cycle II obtained a score of 87 with a percentage of 84.2%.

Then, the learning outcomes of the skills aspect in Cycle I obtained an average of 78.8, and in Cycle II obtained an average of 86.4 with a percentage of completeness of 94.7%. In addition, there was an improvement in learners' attitudes. It could be seen in each Cycle. There was an improvement in the number of students who showed a positive attitude, and the number of students who showed a hostile attitude decreased. In Cycle I, there were five students whose attitudes stood out, 2 of whom carried out negative attitudes. Whereas in Cycle II, three people had a positive, prominent attitude. The results of the overall improvement can be seen in Figure 1.

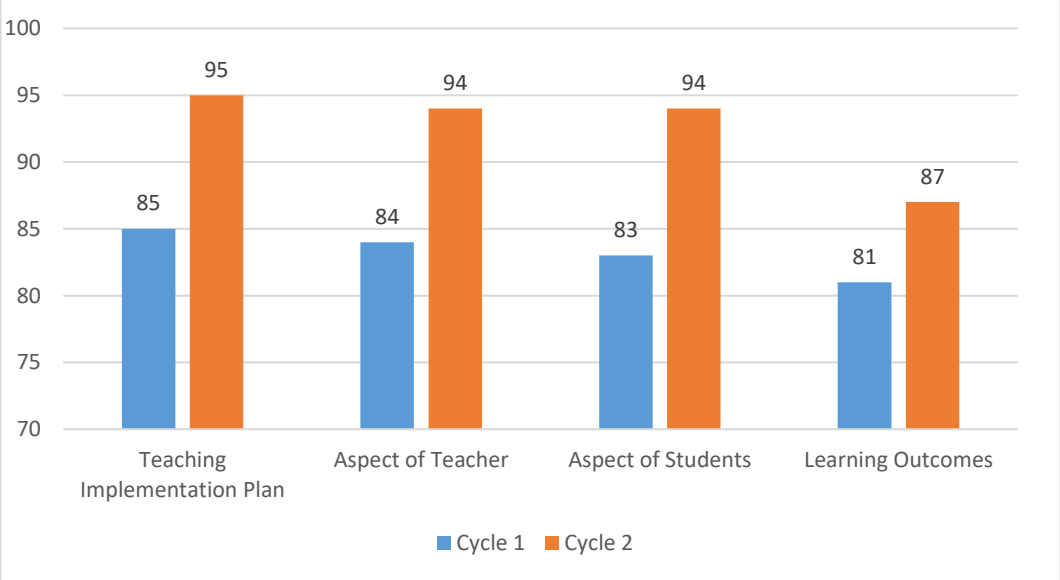

Figure 1. Average Improvement Results of Each Aspect

Figure 1 shows an average improvement in the aspects of the Learning Implementation Plan, teachers, students, and learning outcomes from Cycle I to Cycle II. This improvement indicated that the Numbered Head Together model positively impacted student learning outcomes. It could be seen from the average student score increased and the number of students who had yet to reach the minimum completeness value.

Discussion

Based on the findings of the research results, implementing the Numbered Head Together (NHT) model in the thematic learning process could improve the students' thematic learning outcomes, which could be reviewed from the research results in each cycle. From the research results, three things improved, including aspects of the Learning Implementation Plan, learning implementation in terms of teachers and students, and learning outcomes. This increase was due to reflection activities between researchers and observers after observing the shortcomings in implementing the first cycle. Based on the results of this reflection, improvement efforts had to be made in the next cycle to overcome the obstacles or shortcomings found during the implementation of cycle I. This result was in line with the findings of Hayyi & Indrawati (2021) and Desyandri and Adha (2022), which also show that implementing the Numbered Head Together model can improve students' learning outcomes.

The improvement in each cycle was also caused by applying the Numbered Head Together model that can train and prepare students thoroughly, produce productive discussions, train students to become peer tutors, encourage intense interaction between students, and prevent domination from

certain students (Nurbaiti et al., 2022). The Numbered Head Together model was also helpful in increasing students' involvement in sharing information about learning and working together to solve problems so it could increase a better understanding of the concept of integrated thematic learning (Widyawati et al., 2023). It was especially correct in the learning content of Bahasa Indonesia, IPS, and PPKn n class VB SDN 13 Kuranji on theme six learning "Panas dan Perpindahannya."

The improvement of learning outcomes was also inseparable from improvements in the design of the Learning Implementation Plan. The researcher tried to compile a Learning Implementation Plan adjusted to the components the Ministry of Education and Culture suggested. It could be seen in the Learning Implementation Plan assessment value in Cycle I of 85% (C); in Cycle II, it increased to 95% (A). Because indirectly, a well-designed Learning Implementation Plan could affect students' learning outcomes. Deviana and Kusumaningtyas (2019) mention that preparing a sound, systematic, and complete Learning Implementation Plan bridges teachers to realize excellent and successful learning. It can be proven through increased class average scores at each learning meeting.

Based on the research results, the implementation of learning had also been carried out well, which could be seen from the improvement of grades in each cycle. Regarding teachers, the score obtained in Cycle I was 84.3% (C) and increased to 93.7% (A) in Cycle II. Similarly, regarding students, the value obtained in Cycle I was 83% (C) and increased in Cycle II with a value of 94% (A). The quality and success of learning implementation could be measured by looking at the active participation of students during learning, where ideally, all or most students (80%) could be actively involved physically, mentally, and socially (Hayyi & Indrawati, 2021). To achieve this, as much as possible, the teacher must carry out learning that was adjusted to the steps in the Numbered Head Together model planned in the Learning Implementation Plan so all descriptors could be implemented in learning and get good results.

In the implementation of learning, students' activities were actively monitored using the observation sheet that had been provided so students were more serious about understanding the learning material. In assessing learning outcomes, researchers were guided by assessment sheets such as attitude journals, skill rubrics, and evaluation question sheets at the end of learning. In attitude assessment, it was seen as the most prominent attitude of students, whether it stood out in a positive or negative attitude during the activity using an attitude journal. Meanwhile, the improvement in knowledge and skill scores could be seen from the increase in the classical average, that during Cycle I, the score was 78.4, and during Cycle II, the score was 87.

Despite the improvement in learning outcomes that had been described above, there were still obstacles that occurred in its implementation. These obstacles were mostly found at the first meeting in cycle I. It could be seen from the design of the Learning Implementation Plan that it had yet to be maximized, and the implementation of learning was not entirely following the previously designed activities. It followed the research of Desyandri and Adha (2022), which explains that the first meeting on the Learning Implementation Plan and implementation needs to be improved in several aspects to achieve the expected goals optimally. The research was limited to one class and focused on thematic learning with Bahasa Indonesia, IPS, and PPKn content. Therefore, further research can involve more diverse subjects and research subjects to provide a more in-depth representation of the effectiveness of the Numbered Head Together model to improve learning outcomes.

CONCLUSION

According to the results and discussion previously presented, thematic learning using the Numbered Head Together (NHT) model in class VB SDN 13 Kuranji could improve students' overall learning outcomes. The improvement could be observed in acquiring the average score of students who mostly exceeded the minimum passing standard of 80, where the percentage of classical completeness reached 84.2% from the previous 42.1%. In addition, the improvement could be seen from the increase in the results of the assessment of the aspects of the lesson plan, the implementation aspects in terms of teachers and students at each stage, as well as the improvement of student learning outcomes in each learning cycle, both in the attitudes, knowledge and skills aspects. This improvement was also affected by the active involvement of teachers and students during learning in the classroom.

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Analysis of the needs of teachers of SMAN 3 Sidoardjo in the creation and use of learning media

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ABSTRACT

This study aims to analyze the needs of teachers of SMAN 3 Sidoardjo in the creation and use of learning media in the teaching and learning process. The research method used is descriptive qualitative by taking data through a Google form-based questionnaire filled out online. The subjects of the study were 51 teachers of SMAN 3 Sidoardjo. The results of the survey based on questionnaire data obtained showed that the learning media used by the teachers of SMAN 3 Sidoardjo in the teaching process was made by as much as 72.5% and 27.5% were not made by themselves, so the media was obtained from Youtube, Google, and colleagues. The media created by several teachers has obstacles, namely mastery of IT (editing and programming languages), a long time in the development process, and its use has not adjusted to the characteristics of students and unites several media and materials in one platform such as Learning Management System. Therefore, teachers need training and direct assistance in making intensive and simple learning media without using programming languages, flexible time, and accessible anywhere and anytime. Website-based media to accommodate all the material and learning resources taught so that students can easily use the press and improve their understanding of the material and the quality of learning So that teachers and students can adjust the scope and face problems in the learning process by the demands of the times.

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INTRODUCTION

The development of science and technology has resulted in many changes and benefits in the current field of education, especially in the learning process (Azmi et al., 2020). The role of teachers today is to make learning exciting and fun so that they can keep up with developments in information technology and the ever-evolving world of entertainment (Nurseto, 2011). Learning in schools is considered adequate if there is an active interaction between teachers and students. Teachers must try optimally to foster students' learning motivation because it is one of the keys to achieving learning objectives (Rokhim et al., 2022). Many studies inform that various learning innovations such as approaches, models, strategies, assessment instruments, and learning media that have been developed

to be attractive to students are considered more effective in application compared to conventional learning, which tends to focus on the explanations presented by the teacher (Minata et al., 2022). One is by utilizing adequate, relevant, and functional media to be applied in the classroom so that the information conveyed can affect student learning outcomes.

Using learning media for teachers can help make concepts or ideas concrete (Asmara, 2015). For students, the media can help them think critically and encourage them to study independently to achieve student-centered learning (Jamil, 2019). Thus, the media can support the tasks of teachers and students to attain predetermined essential competencies (Abdullah, 2017). In using learning media properly, teachers must understand their learning needs and problems related to the material being taught to students (Sudarisman, 2015). In this context, media must be developed according to students' relevance, basic abilities, material, and characteristics (Fernandes, 2019). Teachers can act as designers, creating and using appropriate, effective, and entertaining media for students. However, when used in class, it must be emphasized that students should use the learning media (Karo-Karo & Rohani, 2018).

Teachers need to have more teachers' understanding of instructional media development or media use during most schools' instruction. Such problems often only make learning flexible and more varied in the learning process. As a result, students feel sleepy, less active, bored, and do not even make the class atmosphere energetic and lively. The current field reality shows that with the help and assistance of learning media, it is straightforward for students to comprehend the teaching of teachers/educators (Syamsussabri et al., 2018). Teachers play an essential role in teaching media, but it does not necessarily mean that some teachers/educators cannot use teaching media in the classroom. Several problems can hinder teachers from developing and using learning media in teaching, such as a lack of understanding of the use of learning media, the cost of producing learning media, the material is relatively tricky and complex, so it is difficult for teachers to plan and make this form of media (Alwi, 2017).

This is in line with research from Putri and Citra (2019) that social studies teachers at Madrasah Ibtidaiyah Darussalam Kota Bengkulu encounter several problems in planning learning media, namely difficulties in determining social studies learning media that are by the material in the curriculum in other words, there are some learning materials whose media are difficult to find and design as well as difficulties in creating IT-based social studies learning media itself. Another problem that is also faced by teachers when using instructional media is their use in learning. Based on the results of interviews and observations, it was found that many teachers need more skills in using educational media and limited facilities and infrastructure owned by schools.

This problem is also experienced by teachers of SMAN 3 Sidoardjo based on an analysis of the situation at school and the learning process, namely the uneven mastery of science and technology among teachers and students, the lack of learning media that supports distance learning activities, the limited interaction between teachers and students, and the allocation learning time causes literacy activities to be hampered and the unavailability of unique digital learning platforms that provide learning resources.

Therefore, from the description above, the researcher intends to analyze the needs of SMAN 3 Sidoardjo teachers in creating and using learning media in the learning process to minimize these problems and increase the renewal of the skills of teachers in the development and application of learning media in schools based on needs in media design to be used. With this, it can be seen the needs of SMAN 3 Sidoardjo teachers to be able to face problems in the learning process so that they can achieve the learning objectives themselves.

METHOD

This research was conducted in July 2022. The subjects in the study were 51 teachers of SMAN 3 Sidoardjo using the sampling technique, namely simple random sampling, where the sample was randomly taken from the population. This is qualitative descriptive research, in which the results are presented in descriptive words and sentences. Data collection techniques through questions related to the research object, namely the need for teachers to create and use instructional media, which are packaged in a questionnaire based on a Google form filled out online. This questionnaire consists of

3 parts: the first part identifies the use of media used by teachers in the learning process, and the second part includes an explanation of the constraints experienced by teachers when creating or preparing learning media. The third part contains teachers' suggestions regarding the needs and how to solve problems in preparing learning media. Data analysis consists of three stages: data reduction, presentation, and conclusion. The method of data analysis is presented in Figure 1. The results of the filled questionnaire were analyzed by data reduction to separate the data included in the classification of the object under study. The presentation of data in this study depends on the subject matter and research objectives. At the end of the research results, conclusions were drawn to analyze the research object (Nenohai et al., 2021).

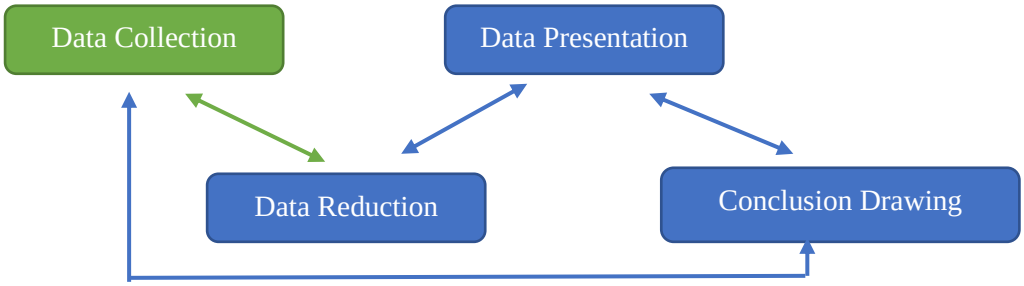

Figure 1. Process of Data Analysis

RESULTS AND DISCUSSION

Results

In this study, filling out the questionnaire consisted of 3 parts: identification, explanation, and suggestions. The identification section determines the creation and use of learning media implemented by SMAN 3 Sidoardjo teachers. This identification section includes the use of media in class, the result of media by the teacher, the type of media, the form of media, and which part of the learning process the press applies to. Based on the results of filling out the questionnaire, it was found that all 51 teachers at SMAN 3 Sidoardjo used instructional media in the learning process, and the press made reached 72.5% of the total. In contrast, 27.5% of the press was not self-made but obtained from YouTube, Google, and colleagues. The type of media used by the teachers of SMAN 3 Sidoarjo is explained in Figure 3. The variety of media that teachers mostly use is audio-visual media, with a percentage of 78.4%, while the form of media most used by teachers is in the form of applications installed on cellphones, laptops, and the like by 76.5%, and animated videos via PowerPoint by 54.9% it presented in Figure 4. In addition, in using this media, SMAN 3 Sidoardjo teachers apply it in the learning process in the core section of teaching materials by 82.4% and the initial part, namely apperception, by 49%, presented in Figure 5.

The data obtained by filling out the questionnaire in the identification section can be seen in the following figures.

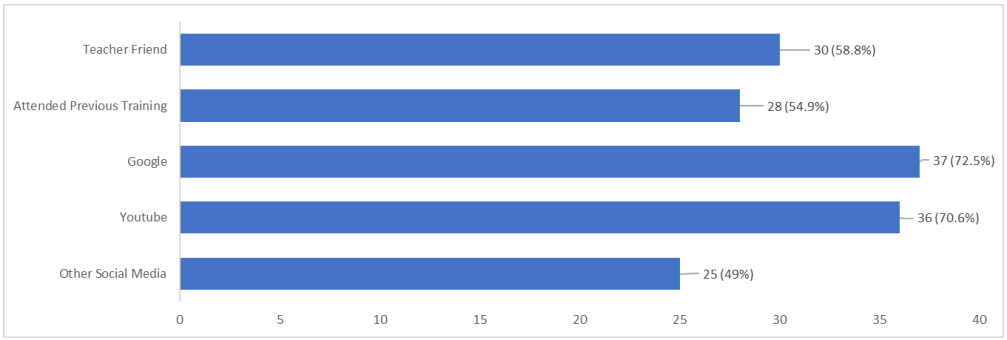

Figure 2. Media Sources Used by Teachers of SMAN 3 Sidoarjo

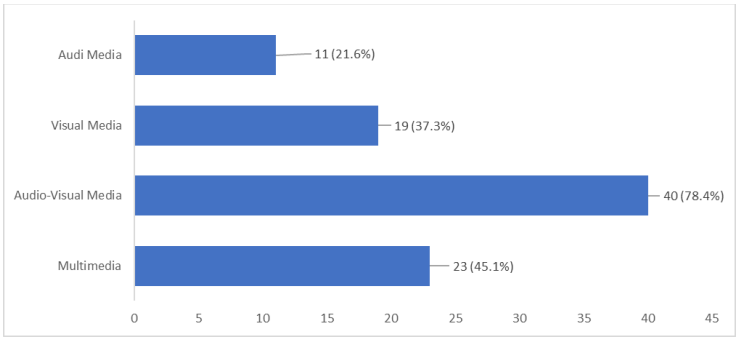

Figure 3. The Type of Media Used by The Teachers of SMAN 3 Sidoarjo

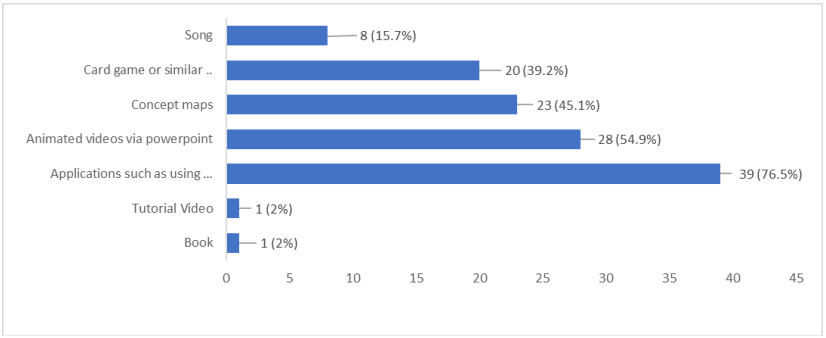

Figure 4. The Form of Media Used by Teachers of SMAN 3 Sidoarjo

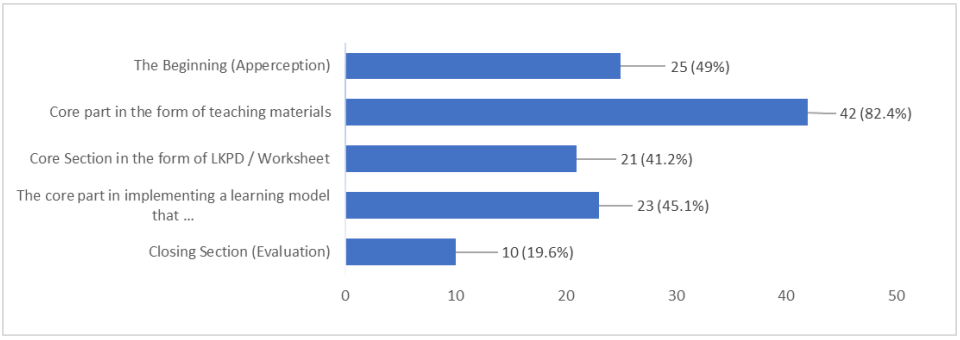

Figure 5. The Application of The Media Used in The Learning Process

The explanation section consists of the constraints of SMAN 3 Sidoardjo teachers in creating or preparing instructional media and the effect of using instructional media on students' understanding based on the teachers' observations. Based on the results of the filled questionnaires, it was found that several teachers had problems, one of which is that in preparing the media, it took quite a long time for the results to be excellent and suitable for use. The results of filling out the questionnaire in the explanation section related to the use of learnifng media on students' understanding based on the observations of teachers that learning media is very influential in the learning process because it can help and direct students in constructing their knowledge of learning material.

The last part of the filled-out questionnaire is suggestions. This section aims to enable the teacher to convey whatever is needed to overcome problems in preparing learning media for the material to be taught. The answers from the teachers of SMAN 3 Sidoardjo varied, one of which is that they often practice using applications that will be developed into learning media and can also take part in workshops/training on creating learning media held by nearby tertiary institutions or those carried out by the government. Other suggestions from the teachers of SMAN 3 Sidoardjo are (1) sharing with fellow teachers from the same cluster and forums for teachers, (2) creating the contextual learning media so that it is easier to understand, for Internet access, it can also be

downloaded beforehand, so that an Internet connection is not required if the media will be used several times, (3) being able to modify existing media and adapting it to class conditions, (4) finding appropriate information in creating and using learning media that is appropriate to learning material, (5) increasing teacher digital competence, through digital skills training activities such as bringing together several media and materials in one platform such as Learning Management System, (6) first determining the cognitive level of students, then designing learning concepts and materials according to the level of each student and (7) always asking colleagues who have more skills in the Information and Technology field.

Discussion

Today's learning media is beneficial for the teacher's task in providing information about the material to be taught to students. Based on the research results related to the analysis of teacher needs in the use of learning media, it was found that in the identification section, teachers at SMAN 3 Sidoardjo used learning media in the teaching and learning process. This indicates that the teachers tried to use media from several sources presented in Figure 2. In the learning process, the teachers need to be competent in using digital learning media, and they must not stutter in technology to provide excellent and clear explanations to students (Khairunnisa & Ilmi, 2020). This is supported by research from Iwantara et al. (2014), which shows that in the learning process using YouTube video media, discussions between students can occur due to watching the videos, thus making the learning atmosphere more interactive.

About 78.4% of SMAN 3 Sidoardjo teachers used the type of media as audio-visual media because it is adapted to the current student learning style and makes it easier for students to understand the material provided by the teacher quickly. This is supported by research by Pradilasari et al. (2019), which shows that audio-visual-based learning media on Colloidal learning material is very suitable for use in the teaching and learning process and can increase student motivation and learning outcomes. Research from Parera et al. (2022) states that the way to make it easier for students to understand the contents of teaching materials is to create media that can combine writing with pictures and is assisted by direct explanations (voice) so that the material becomes more precise and more enjoyable.

In applying this media, most teachers at SMAN 3 Sidoardjo use it in the core part of the learning process. In this section, media is used the most because, in the core section, students usually seek information to solve questions given by the teacher so that learning objectives can be achieved by the data obtained, such as research from Loe et al. (2022) who developed media, namely e-Worksheet, which is helpful for students in accessing information and working on questions on Worksheet using mobile phones and assisting teachers in checking and recording scores automatically. In the apperception section, media is widely used because, at this stage, the teacher provides a stimulus to students to attract students' focus on new material that will be delivered by the teacher and creates an atmosphere for early learning that is effective and encourages students' motivation to be involved in learning. This is evidenced by research from Mariska et al. (2013), whose results show that the learning process that begins with apperception by using media is said to be effective at SMPN 13 Purworejo.

The application of media in the teaching and learning process is beneficial. Still, the teacher needs help creating and developing the press, which requires quite a long time to complete the media so that the results are excellent and suitable. In addition, sometimes, some revisions must be made in its implementation. This can be an improvement in subsequent performance. In addition, they need to be proficient in creating learning videos, and the facilities still need improvement. This is due to the mastery of IT (editing and programming languages), and the teacher states that the obstacles are inevitable because they adjust to students' cognitive levels. In creating the media, it is necessary to match the characteristics and needs of students in receiving material according to the level of understanding of the sub-subjects per subject. This is supported by Lubis and Ikhsan (2015), who state that the media that has been developed, namely those based on Android, must be based on scientific stages and characteristics of students that are by the development of the technological age, namely visualization that is attractive, practical and flexible, and has various evaluation questions

based on the level of questions so that students can learn the material independently without being bound by time and place, and can improve their memory of the material being studied. In addition, teachers must also prepare content in the media, for example, questions in the form of HOTS, to support students in developing skills in the 21st century by directing students to work on HOTS-based questions as a learning evaluation (Minata et al., 2022).

Therefore, teachers must be able to design and develop media according to the needs of the present students because learning media can direct students in constructing their understanding of learning material and help students solve problems through discussions in cooperative learning models. For students who partially understand, learning media can help students to be able to fully understand the material (Turrahmi et al., 2018). Another answer from the teachers is that the use of media is very influential because it increases students' motivation and interest in learning so that they can think and analyze the subject matter provided by the teacher well in pleasant situations, and the material is easily comprehended. This is supported by research by Parera et al. (2021), which states significant differences in learning outcomes between students taught using Android-based digital teaching materials and problem-based learning models on acid-base materials and students trained using printed teaching materials. Besides that, it is also supported by the research of Novitasari et al. (2015), which states that the use of audio-visual media using the Problem-Based Learning model in excretion system material is very effective in increasing student motivation and learning outcomes with 79% knowledge competence and 91% skills competency.

The statement from other teachers is that the use of media. However, it only reaches a portion of 100%. It can at least help the teacher's performance in providing the material and making students feel comfortable in operating the media used, such as using application-based game media like Android in the learning process. This is supported by research by Nenohai et al. (2022), which states that student responses were very positive in using media to study reaction rate material because students also found it fun apart from receiving the material. After all, games were added to attract student learning interest. Research conducted by (Putri et al., 2022) also supports this because the use of digital games is more widely applied in learning due to greater interest in educational technology and having a better evaluation of the subject matter being studied and achieving a deeper understanding. Research conducted by Yunus and Fransisca (2020) proves that 94.1% of students interacted with Smartphones, indicating that Smartphone facilities need to be used, but only 29.4% of teachers used Android-based media. Therefore, teachers must adjust media development based on students' means and learning styles.

Based on the needs and problems faced by teachers of SMAN 3 Sidoardjo in creating learning media, it is expected that teachers and the school parties can cooperate with partners such as higher education and technology experts related to applications so that they can increase new insights in terms of creating learning media and its use for students in the learning process because teachers must be able to carry out a learning innovation and have a very strategic role in the learning process (Sumarni et al., 2020).

CONCLUSION

Based on the results of the research on the needs analysis of SMAN 3 Sidoardjo teachers that have been carried out, it can be concluded that teachers need direct training and assistance in creating intensive and simple learning media without using programming languages, flexible time, media that can be accessed anywhere and anytime such as website-based media so that it can accommodate all the material and learning resources being taught, so that the use of learning media can be maximized, making it easier for students to operate to increase understanding of the material, motivation, interests and activities of students in the learning process. The recommendations based on the needs analysis carried out are that school parties must work together with the Department of Curriculum and Educational Technology to conduct training and create learning media for teachers that are easy for teachers to operate, keep up with the times, and can be performed based on students' learning styles so that teachers and students can adjust the scope and solve problems in the learning process by the demands of the times. In addition, teachers must continue to practice and try to develop media so

that the training provided is not in vain and they will be more proficient in operating or using technology.

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Instrument development to measure the use of hologram-based learning media

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ABSTRACT

Hologram-based learning media is one of the alternative learning media that can be used as educational media, increasing student motivation and interest in learning and optimizing the division of work in groups. This media was developed to avoid abstract thinking, a negative impression that has been allowed to occur since they were young, which, in the end, until adulthood, the negative image is dull and makes students uninterested in things. This research was included as developmental research or RnD. Studies related to developing instruments to measure the use of hologram-based learning media as educational media in elementary schools still need to be completed. The research model used in this study was 4D. The data was collected with an offline questionnaire, and then it was analyzed using quantitative data analysis using the SPSS version 23 for Windows program. The results of this study have proven that: (1) The evaluation instruments construction and development for the use of hologram-based learning media for students in this study were carried out using a theoretical development model to test seven research constructs, namely (a) didactic components, (b) construction of hologram-based learning media, (c) technical hologram-based learning media, (d) ease of use, (e) efficiency of hologram-based learning media, (f) benefits, and (g) interest; (2) The results of construct validity and reliability testing show that the validity of the evaluation instrument has met the valid criteria because the value of r-count > r-table (r-count > 0.254); and (3) The reliability of the evaluation instrument which has been compiled and developed in this study has also met the high category as indicated by the magnitude of the Cronbach alpha reliability coefficient of 0.980. This indicates that the instrument developed meets the requirements for measuring the use of hologram-based learning media for students.

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INTRODUCTION

Learning is a process that occurs in every person from the time he is born until the end of his life. The learning process can happen anytime and anywhere. This can be proven by changes in a

person's behavior at the knowledge, skill, or attitude level. The learning process so far takes place in schools, especially elementary schools, which is more often carried out passively, meaning that the teacher explains the material. The students listen even though the active learning approach was seriously pioneered by the Ministry of National Education Research and Development Agency in 1979 with a project known as the Supervision Project and ASLM (Active et al. Method) (Suhartoyo et al., 2020).

In improving students' knowledge and skills, it requires to have a creative teacher (Kuswanto & Radiansah, 2018). There are various ways to be a creative teacher in the learning process, one of which is by utilizing learning media in the learning process. Learning media is inseparable and integrates the learning methods (Kuswanto & Radiansah, 2018).

Apart from being factored in by the teacher's weaknesses, the low ability of students is also influenced by the teaching materials used, such as books that are not colored and give rise to abstract values (Nengsi et al., 2021). Besides not maximizing learning media, as stated by Fadillah & Ninawati (2020), teachers can also involve the surrounding environment in the teaching and learning process. They are monotonous (Agnesti & Amelia, 2020). Moreover, teachers do not involve students' experiences with the material presented (Andriana et al., 2020). The problems above are contemporary and must be addressed, and solutions must be sought immediately.

Research conducted by Taufiq (2020) found that the low understanding of science, especially the solar system, is due to the teaching system being carried out monotonously, disinterested, and unmotivated because the material is passive and does not pay attention to student modalities. As a result of students' low understanding of the solar system, the scores obtained also decreased (Taufiq, 2020). One of the reasons is that teachers are considered to be lacking in variations in learning methods (Indragani et al., 2021). Also, there is a lack of student independence in finding reading material in their learning process (Hidayati & Listyani, 2010).

One of the learning media that teachers can use is alternative learning media in the form of holograms. Hologram technology, also known as holography, is the refraction of light reflected on the screen to form a recording object that is the same as the recorded object. The hologram is operated by making images or visuals in the form of a background and can be seen from various sides of dimensional objects, such as 2D or 3D views. The holographic display is monotonous, like images in general, and can be communicative according to the audio-visual recordings.

Information in the form of a hologram with visuals as if 3D is supposed to help construct information so that it is efficient and interactive in processing information, which will later be realized and developed (Saada et al., 2020). This hologram-based learning media can make the learning process more interactive and keep students interested in participating in both offline and online learning (Hazin, 2021). It is assumed that the presentation of technology-based learning media (in digital form) significantly influences students' attractiveness to learn the material being taught (Lukman et al., 2020). Through online learning, students can determine their study time freely and can study anywhere (Afandi et al., 2021).

This study attempted to develop hologram-based learning media validation instruments. This is due to the limited instruments used to validate the media. The research instrument is a tool used to measure observed natural and social phenomena. Specifically, all of these phenomena are called research variables (Sugiyono, 2017). Research instruments are used to measure variables in the natural sciences that are widely available and have been tested for their validity and reliability. The urgency of developing instruments for assessing learning media, as expressed by Ruskala (2021), is to evaluate how effective the new learning media is in the learning process.

Recognizing the developments and benefits of this hologram-based learning media, an assessment instrument is needed to see the feasibility of hologram learning media in education. However, very few publications address the issue of developing holographic media assessment instruments. Therefore, researchers intend to create an instrument useful for assessing whether hologram-based learning media is appropriate for the learning process to increase students' interest and motivation in learning, optimize the distribution of work in groups, and avoid abstract thinking. This study is contributed to answer questions about the references used to assess the feasibility of hologram-based learning media.

METHOD

The Research and Development (R&D) research design was used for this particular study. R&D stands for "research and development," which represents a research method used to produce certain items and test the efficacy of those products (Brigenta et al., 2017). Development research in the media and technology sub-domain aimed to improve the instructional design, development, and evaluation process based on specific problem-solving situations and generalized inquiry procedures (Silalahi, 2018). The research model used in this study was 4D. The development of the four D models includes four stages of development, namely define, design, develop, and disseminate.

However, this study only performed three stages of development, namely define, design, and develop—the intended development aimed at developing media validation instruments. The designed validation instrument was developed in the form of a questionnaire. The main objectives of the questionnaire are: (1) represent information that is relevant to the survey objectives, (2) provide a logical sequence of questions that are directed to the subject matter to respondents, (3) provide a standard format for recording facts, opinions, and attitudes, and (4) facilitate data processing (Arikunto, 2013).

Then, the instrument was assessed using a Likert scale. The Likert scale is commonly used as a standard psychometric scale for measuring response. This measurement scale has procedures that facilitate survey construction and administration, as well as data coding and analysis (Li, 2013). Each aspect was translated into an indicator, which will be used as a construction starting point for the instrument. Commonly, the Likert scale has a size expressed in the form of words, such as Very less, less, enough, reasonable, and very good (Sugiyono, 2013).

For quantitative analysis, the answers were given a number or value. The explanation is as follows: less = 1, enough = 2, good = 3, and very good = 4 and would be processed using the SPSS application version 26. Using this SPSS application would make it easier to process data obtained in the field (Kusumah, 2018).

RESULTS AND DISCUSSION

Result

Define

Learning media in the learning process has an important role. The learning process will feel more fun and make it easier for the teacher to convey learning material to students. Recognizing this importance requires an effective and efficient learning media in this learning process. A learning media can be considered effective and efficient if an assessment and measurement of the learning media has been carried out. For this reason, an assessment instrument is needed to assess whether this media is suitable for use or not.

Moreover, learning media that are still new to hearing, such as hologram-based learning media, require instrument construction to assess the validity of this media. To the researchers' knowledge, no one has researched the development of assessment instruments, specifically in examining the validity of hologram-based learning media. Departing from this needs analysis, this study is needed to develop the hologram-based learning media assessment instrument.

Design

The construction and method of developing evaluation instruments for hologram-based learning media in this study were carried out using a theoretical development model. This study began with a theoretical study to formulate an evaluation construct for hologram-based learning media. Based on a study of various theories regarding the evaluation of the use of hologram-based learning media, seven constructs were developed to evaluate the use of hologram-based learning media for students, namely: (a) didactic component, (b) construction of hologram-based learning media, (c) technical hologram-based learning media, (d) ease of use, (e) efficiency of hologram-

based learning media, (f) benefits, and (g) interest. Table 1 is a grid of instruments evaluating students' use of hologram-based learning media.

Table 1. Grid of Training Evaluation Instruments for Teachers

No.	Construct	Item Number
1	Didactic Component	1, 2, 3, 4, 5
2	Construction of hologram-based learning media	6, 7, 8, 9, 10
3	Technical hologram-based learning media	11, 12, 13, 14, 15
4	Ease of use	16, 17, 18, 19, 20
5	Efficiency of hologram-based learning media	21, 22, 23, 24, 25
6	Benefits	26, 27, 28, 29, 30
7	Interest	31, 32, 33, 34

Table 1 shows that the number of statement items is 34, spread into seven constructs after the researchers arranged the instrument grids for each construct.

Develop

Validation of non-test instruments and developed questionnaires

In the next stage, the researcher compiled the statement items using a Likert scale. After the instrument was compiled, a process called expert judgment was carried out, which was consulted by an evaluation expert. The expert judgment resulted in the improvement of several inaccurate statement items with the construct. After correcting the statements, the researchers conducted trials on 60 students at SD Muhammadiyah Penyasawan. Based on the test results data, the next step was to analyze to determine the validity and reliability of the training evaluation instruments for teachers that have been developed.

Construct validity is a measuring tool that shows results by the theory (Ihsan, 2015). Emory stated that construct validity is one of the methods that can be used in making measurements, namely considering the correlation between research data and existing measurement methods, convergent discriminant techniques, factor analysis, and multi-method analysis (Fahruna & Fahmi, 2017). Question items in an instrument are considered to be valid if the calculated person coefficient value (r-count) is greater than the Pearson table coefficient value (r-table) (Triana & Oktavianto, 2013). From the analysis carried out, the results of the instrument validity test from the research data are shown in Table 2.

Table 2. Instrument Validity Using Item Correlation Values with Corrected Item-Total Correlation for Each Study Construct

Construct	Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Didactic Component	1	.698	.981
	2	.664	.981
	3	.676	.981
	4	.719	.981
	5	.709	.981
Construction of hologram-based learning media	6	.697	.981
	7	.759	.981
	8	.834	.980
	9	.810	.980
	10	.864	.980
Technical hologram-based learning media	11	.788	.980
	12	.795	.980
	13	.869	.980
	14	.817	.980
	15	.729	.981
Ease of use	16	.736	.981

Construct	Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
	17	.808	.980
	18	.790	.980
	19	.828	.980
	20	.767	.981
Efficiency of hologram-	21	.704	.981
based learning media	22	.721	.981
	23	.756	.981
	24	.791	.980
	25	.743	.981
Benefits	26	.787	.980
	27	.830	.980
	28	.843	.980
	29	.859	.980
	30	.842	.980
Interest	31	.823	.980
	32	.780	.980
	33	.679	.981
	34	.694	.981

Based on Table 2, it can be seen that the r-table value is 0.254, which is obtained from a table with a degree of freedom (df) of 58 of the 34 questionnaires distributed as a trial. From the calculation, all items are declared valid because the value of r-count> r-table so that all question items can be used to evaluate the use of hologram-based learning media for students.

Reliability of Non-Test Instruments and Developed Questionnaires

Each item was assessed for internal consistency in developing an evaluation instrument for using hologram-based learning media for students. It measures the degree to which an item on a scale measures the same construct as other items on the same scale. Table 3 describes the reliability scale using Cronbach's alpha coefficient for a set of questionnaires based on the evaluation instrument for using hologram-based learning media for students.

Table 3. Cronbach Alpha Reliability Index for Each Study Construct

Construct (N = 60)	Overall Cronbach's Alpha Score
Didactic Component	0.981
Construction of hologram-based learning media	0.980
Technical hologram-based learning media	0.980
Ease of use	0.980
Efficiency of hologram-based learning media	0.981
Benefits	0.980
Interest	0.980

Based on Table 3, the Cronbach Alpha Reliability Index values were obtained for each study construct and the overall alpha values obtained: (a) inactive components, (b) construction of hologram-based learning media, (c) technical-based learning media holograms, (d) ease of use, (e) efficiency of hologram-based learning media, (f) benefits, and (g) interest respectively were 0.981; 0.980; 0.980; 0.980; 0.981; 0.980; and 0.980. This showed that the reliability value (α) is more significant than 0.60 for each construct studied. This result is reinforced by the opinion of Basuki and Hariyanto (2014) that instruments that have a high or reliable correlation are in the range of 0.6 < X < 1 (Arifin, 2017). Thus, the seven research constructs have fulfilled the reliable requirements to be used for further research needs.

Discussion

Based on the results of the validity and reliability test of the evaluation questionnaire on the use of hologram-based learning media, a valid and reliable instrument was obtained. These results confirm the findings of a previous study, which stated that an assessment instrument that can be used is an instrument that meets valid criteria (Nurfillaili et al., 2016). Apart from meeting valid criteria, the instrument must also fulfill highly valid criteria (Efendi & Widodo, 2019; Wales et al., 2017).

Furthermore, the findings explained that the instrument is considered suitable for use in research if it meets the four test requirements: validity, reliability, item difficulty level, and discriminatory power (Aji & Winarno, 2016; Adams & Wieman, 2011). Ihsan (2015) also reported that validity is defined as the ability of the instrument to measure the attributes of the construct under study. These opinions strengthen the results of this study so that the assessment instrument evaluating the use of hologram-based learning media for students is declared valid and suitable for further research needs on the same topic.

According to the analysis, the questionnaire developed concerning the evaluation instrument for using hologram-based learning media for students has good construct validity and high reliability, so it can be used in research, particularly in hologram-based learning media development. Thus, the research instrument that measures the evaluation of the use of hologram-based learning media for students who have been tested is considered feasible and trusted to be used in similar studies. This is reinforced by research, which states that to ensure the quality of research results, the instruments used should be derived from a selection of valid and reliable tools (Souza et al., 2017; Suratno, 2016).

Furthermore, the use of evaluation instruments must meet valid and appropriate criteria for use (Pinilih et al., 2013). Assessment instruments related to hologram-based learning media for students can prevent speculative actions from students in making assessments, especially in determining the final grade after researching evaluation achievement, the topic mentioned earlier. Even so, this instrument did not involve enough respondents from students of SD Muhammadiyah Penyasawan. Of course, it was not necessarily suitable for use as a research instrument in other schools.

The researchers expect that further research can be carried out to determine the validity and reliability of respondents on other campuses and with a larger sample of respondents. This is intended to make this research instrument better and the validity and reliability values higher to be used as a better tool for obtaining research data.

CONCLUSION

From the study that has been undertaken, it is possible to conclude that: (1) An evaluation instrument construction and development for the use of hologram-based learning media for students in this study was carried out using a 4D development model to test seven research constructs, namely (a) deductive component, (b) construction of learning-based media holograms, (c) technical hologram-based learning media, (d) ease of use, (e) efficiency of hologram-based learning media, (f) benefits, and (g) interests; (2) The results of testing the construct validity and reliability show that the validity of the evaluation instrument for the use of hologram-based learning media for students has met the valid criteria because the value of r-count> r-table (rcount> 0.254); and (3) The reliability of the evaluation instrument that has been compiled and developed in this study also meets the high category as indicated by the magnitude of the Cronbach alpha reliability coefficient of 0.980.

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The perceptions of high school teachers and students towards digital interest and literacy

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ABSTRACT

The increased application of information and communication technology (ICT) in society promotes its use in education to align instructional content with students' interests and future working lives. To achieve this, the human resources within education institutions must possess the ability to utilize technology and understand the students' capabilities. This descriptive study was conducted to establish the profile of students' and teachers' interests and perceived digital literacy abilities in high schools and their equivalents. An online questionnaire was used to collect data from West Java, West Kalimantan, and Jakarta high schools. The gathered data were processed with a simple quantitative technique. The data analysis collected by the questionnaire indicates that the respondents have a relatively high perception of digital literacy levels (encompassing operational, information, communication, strategic, and creative abilities), with some relatively low aspects, such as expressing opinions and creating things with ICT. Furthermore, it was also found that respondents exhibit a strong interest in using digital devices for learning, with video games, video processing programs, and graphic design software occupying the three least used digital media in schools but most desired by the respondents for integration.

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INTRODUCTION

The use of electronic devices is increasingly prevalent in society. School-age children, especially those residing in urban areas, are accustomed to using gadgets such as smartphones and computers daily. This necessitates the continuous effort of the government and educational institutions to promote the use of Information and Communication Technology (ICT) (Kaware & Sain, 2015; Sarkar, 2012; Setiawan, 2018) in education as learning media and materials for both instructional and research purposes (Budiman, 2017; Dewi & Hilman, 2019; Fu, 2013; Jamun, 2018; Lestari, 2018; Reddy et al., 2020; Tondeur et al., 2018). Technology integration can also align learning materials with students' everyday lives and real-world professional contexts. The majority of students' interests and hobbies are already technology-oriented, so this can help them prepare for

future careers and global competition (Bhattacharjee & Deb, 2016; Fu, 2013; Hermawan et al., 2018; Hernandez, 2017; Juliff, 2005; Kinematsu & Barry, 2016; Lowther et al., 2008).

Several examples of ICT utilization in some schools in Indonesia for instructional purposes include videos shared on platforms like YouTube, electronic books, and teleconferencing software such as Google Classroom and Zoom (Fu, 2013; Lestari, 2018; Nahdi & Jatisunda, 2020; Reddy et al., 2020). While acknowledging the progress achieved in the Indonesian education system through these measures, the integration of ICT not only requires the availability of equipment in the relevant institutions but also demands the adaptation of the learning process to students' abilities and the skills of human resources to effectively employ said equipment (Akarawang et al., 2015; Lim et al., 2015; Rivalina, 2015; Tondeur et al., 2017; Vitanova et al., 2015; Widaryanto & Sulfemi, 2016). Presently, these skills are understood as digital literacy.

The term digital literacy is commonly used to describe an individual's ability to search and comprehend information from digital sources or media, such as the internet through computers or similar devices, and to utilize that information to develop or produce something (American Library Association (ALA), n.d.; Paul & Glister, 1997; Spante et al., 2018). Organizations and researchers like The Association for College and Research Libraries (ACRL), van Deursen, and Hague and Payton have outlined various digital literacy skills categories. These generally include the ability to comprehend the controls of the internet and computers, operate devices, find information using devices, understand information from devices, communicate with others through devices, utilize devices and acquire information for specific purposes, and create content using devices (Hague & Payton, 2010; Iordache et al., 2017; Kurnianingsih et al., 2017; van Deursen et al., 2016; van Deursen & van Dijk, 2014; van Laar et al., 2017). Because the application of ICT in the learning process often encounters issues such as the lack of skills among students and educators (Aka, 2017; Akarawang et al., 2015; Fu, 2013; Rivalina, 2015), these digital literacy skills are essential for both students and educators to utilize digital devices effectively.

Several studies have been conducted in educational institutions in Indonesia regarding digital literacy. For instance, Kurnianingsih et al. (2017) conducted training to enhance digital literacy among school librarians and teachers in Central Jakarta. Hermawan et al. (2018) gathered information on the implementation of ICT in Indonesian education from 2004 to 2017. Khasanah & Herina (2019) analyzed a digital learning program in a junior high school. Asari et al. (2019) conducted media literacy training for students and teachers in a school. Nahdi & Jatisunda (2020) analyzed digital literacy among elementary teacher education students. Lastly, Dinata (2021) analyzed digital literacy among mathematics education students.

This article addresses a research topic similar to some of the studies mentioned above by examining perceived levels of digital literacy among senior high school students and teachers. However, it focuses more on students' and teachers' interests and capabilities. The study aims to analyze the perceptions of teachers and students regarding their aptitude in using digital devices and media and to investigate the types of devices and media most commonly used by students, as well as teachers' familiarity with these tools. This objective is driven by research indicating that students' interest in learning positively impacts academic performance (Cheung, 2018; Harackiewicz et al., 2016; Jamilah & Isnani, 2017; Skinner et al., 2008; Su & Cheng, 2015), which aligns with educational philosophers such as Rousseau, Pestalozzi, and Dewey (Dewey, 2009; Ornstein et al., 2011), who suggest that education should be tailored to students' interests and readiness.

This research makes education and learning more engaging for students and teachers by finding a middle ground between both parties' interests and readiness to utilize digital devices in the learning process. Additionally, this study can serve as a foundation and comparison for conducting direct assessments of digital literacy skills. This research is contributed to teachers and students so they can choose the most appropriate digital literacy to use in learning.

METHOD

This descriptive research is aimed at depicting the profile of digital literacy interests and capabilities among students and teachers in senior high schools and their equivalents (Marshall, 2005; McCombes, 2019; Mishra et al., 2019; Polit & Beck, 2004; Taherdoost, 2016; Yaddanapudi

& Yaddanapudi, 2019). Data were collected through a questionnaire (Lavrakas, 2008; Marshall, 2005; Polit & Beck, 2004; Taherdoost, 2016; Yaddanapudi & Yaddanapudi, 2019) administered via Google Forms and distributed online from December 24 to December 30, 2022. The research subjects were teachers and students who responded to the online questionnaire. A total of 19 students and 29 teachers from senior high schools (*sekolah menengah atas/SMA*) and vocational schools (*sekolah menengah kejuruan/SMK*) located in West Java (Bandung City, Bekasi Regency, Subang Regency, Sumedang Regency, and Tasikmalaya Regency), West Kalimantan (Sambas Regency), and North Jakarta were included in the study. Subsequently, the collected data were analyzed using a simple quantitative technique to provide a descriptive overview of the study's focus on respondents' digital literacy skills and interests.

The questionnaire completed by the research subjects consists of statement items based on domains collected (with modifications) from books and research on types of skills within digital literacy (Eshet (2004); Hague & Payton (2010); Jenkins et al., (2006); Nahdi & Jatisunda, (2020); van Deursen et al., (2016); van Deursen & van Dijk, (2014); van Laar et al., (2017). These types encompass operational skills, information skills, communication skills, strategic skills, and creative skills.

Operational skills depict the respondents' ability to operate digital media, represented in this study by computer/laptop (item 1), smartphone (item 2), internet (item 3), and various types of applications/media/software like text processors, web browsers, and social networking sites (item 4). Information skills pertain to the ability to process information on digital media, represented in this study by the ability to search for desired information or content through the internet (item 5), select valid and valuable information from the internet (item 6), identify false information on the internet (item 7), and analyze information acquired from any digital source (item 8). Communication skills reflect the capability of sending and receiving messages through digital media, represented in this study by the ability to convey an idea to others on the internet (item 9), receive others' opinions on the internet (item 10), and comprehend the ethical aspects of communication with others on the internet (item 11). Strategic skills involve using digital media for specific purposes, indirectly represented in this study by the habitual level of internet and digital device usage in daily life (item 12), using digital devices for hobbies (item 13), and using digital devices for part-time work (item 14). Lastly, creative skills encompass the ability to create content digitally and upload it to digital media, represented in this study by uploading text content on the internet (item 15), creating digital images (item 16), creating and editing videos (item 17), and software development (item 18).

These eighteen main statement items are accompanied by several demographic items (email address, school origin, and status as a student or teacher) and several statement items related to digital media already used in school learning (item 19), students' and teachers' desires for increased or reduced digital media usage (item 20), and the desired digital media for learning (item 21). Respondents answered most statement items by selecting four response options on a Likert scale (Clark & Watson, 2019; Jebb et al., 2021; van Deursen et al., 2016): strongly disagree, disagree, agree, and strongly agree.

After collecting responses through the questionnaire, the data were processed by calculating the average score for each statement item, with the options "strongly disagree" valued at 0 points, "disagree" valued at 1, "agree" valued at 2, and "strongly agree" valued at 3. An exception applies to statement item number 4 (in the "operational skills" category)—Respondents who chose 0–3 media or software received 0 points, those who chose 4–7 received 1 point, those who chose 8–11 received 2 points, and those who chose 12–14 or more received 3 points, which can be counted by using Formula 1. The interpretation of Formula 1 is $\bar{x}$ means average score, $\sum x$ is the total score of all respondents, and n means the number of respondents

$$\bar{x} = \frac{\sum x}{n} \quad (1)$$

The digital literacy skill assessment categorization is divided into three levels based on average scores: high, moderate, and low. The aspects of digital literacy skills represented by statement items with average scores ranging from 0 to 1 ($0 \leq x \leq 1$) are categorized as low, average scores above 1 to 2 ($1 < x \leq 2$) are categorized as moderate, and average scores above 2 to 3 ($2 < x \leq 3$) are

categorized as high. This categorization is a slight modification of the standard Likert scale categorization. Compared to directly calculating the number or percentage of responses for each answer option, reducing the number of categories simplifies the majority of positive (agree and strongly agree) and negative (strongly disagree and disagree) responses while emphasizing statement items with responses that are not significantly different between positive and negative categories as "moderate" (DiStefano et al., 2021). A similar categorization approach was used in the study by Dinata (2021).

RESULTS AND DISCUSSION

Results

Operational Skills

In this chapter, the data from the online questionnaire distributed to the respondents are shown. Students' and teachers' responses to the statement items representing the five primary skills are shown first, followed by the last three statement items from the "School Learning" section.

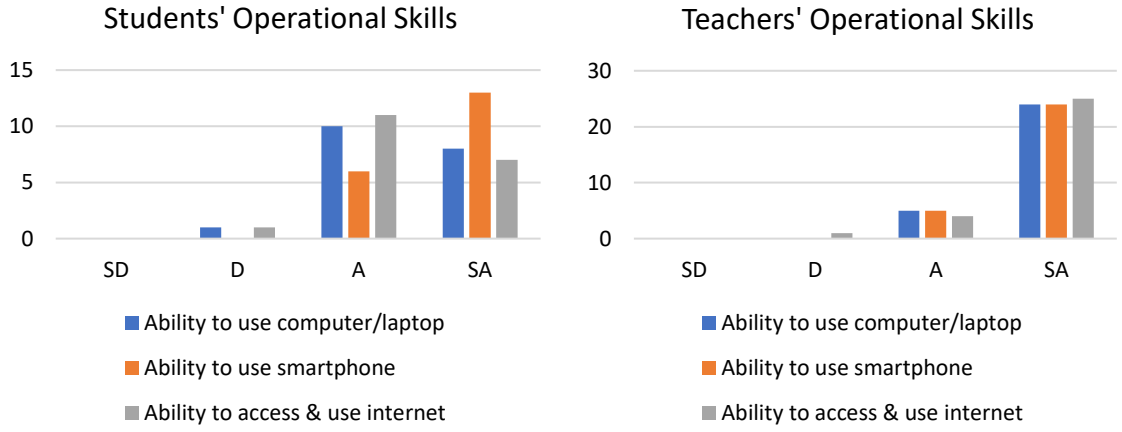

Figure 1. Responses for the Operational Skills Category

In Figure 1, the operational skills category, the respondents' answers indicate that most students feel they have good abilities in using computers/laptops and the internet and excellent abilities in using smartphones. Meanwhile, teachers' responses show that most teachers can use computers/laptops, smartphones, and the Internet. From the responses to the first three statement items, students have an average score of 2.4 for their ability to use computers/laptops, 2.7 for their ability to use smartphones, and 2.3 for their ability to access and use the internet. On the other hand, teachers have average scores of 2.8, 2.8, and 2.9 for these respective abilities, all of which fall within the high digital literacy skill category.

The fourth statement item found that student respondents displayed varying software usage skills. Students had an average score of 1.2 (moderate category), with the majority being able to use only 1 to 2 types of software. In contrast, responses from teachers showed an average number of software types used per person that was higher than that of students, at 1.7, but still within the moderate category, similar to student respondents. It can be shown in Figure 2.

In Figure 2, regarding the most and least mastered types of software, messaging tools (such as email, WhatsApp, and LINE) were the most commonly used type among respondents (17 students (89.5%) and 25 teachers (86.2%)). In contrast, programming software and sites (such as Visual Studio Code, Notepad++, and Github) were the least used type (0 students and five teachers (17.2%)).

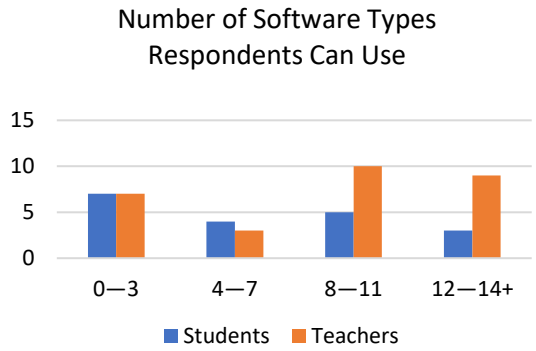

Figure 2. Responses for the Number of Types of Software that the Respondents can Use

Information Skills

In the information skills category, the student respondents' answers indicate that most have good abilities in searching for information or content, selecting valid and valuable information, recognizing false information, and analyzing information from the internet and digital sources, as drawn in Figure 3.

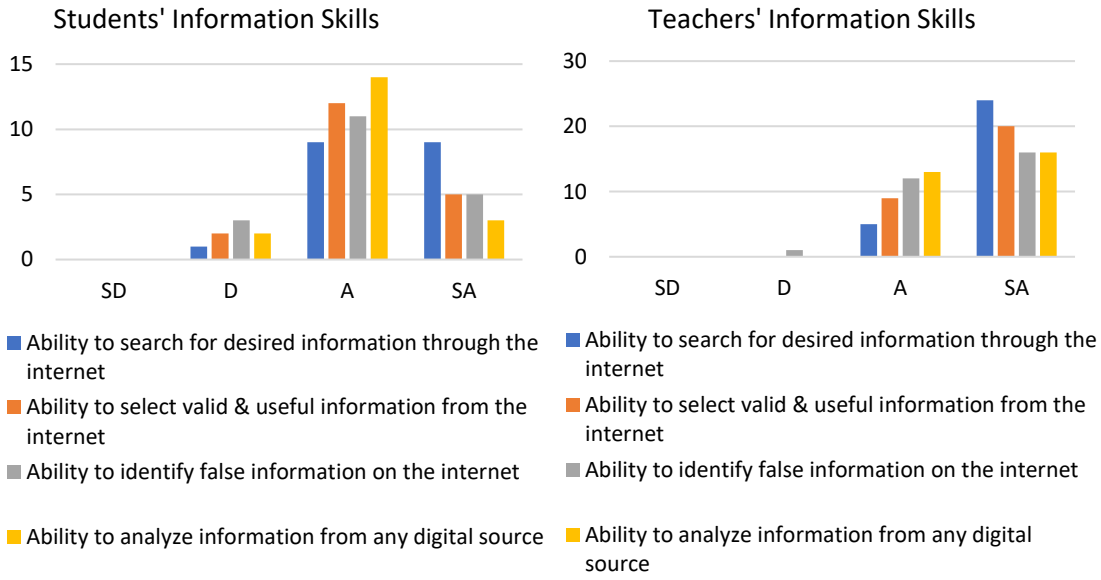

Figure 3. Responses for the Information Skills Category

Meanwhile, looking at Figure 3, teachers' responses show that most teachers feel they have excellent abilities in these four activities. From the responses to the four statement items in the category, students have average scores of 2.4, 2.2, 2.1, and 2.1, respectively. In contrast, the teachers have average scores of 2.8, 2.7, 2.5, and 2.6, all falling within the high category.

Communication Skills

The respondent's answers to the statement items in the communication skills category indicate that most students feel they can convey ideas to others, receive others' opinions, and understand communication ethics on the internet. However, four respondents feel their ability to convey ideas through the Internet is lacking. Meanwhile, teachers' responses show that most teachers have excellent abilities in all three abilities, with only one respondent feeling their ability to convey ideas through the internet is lacking, as shown in Figure 4.

From the responses to the three statement items, students have average scores of 1.9 for the first item in Figure 4, falling within the moderate category, followed by 2.1 and 2.4 for the second

and third items, falling within the high category. As in the previous categories, teachers have higher average scores of 2.6, 2.6, and 2.7, all falling within the high category.

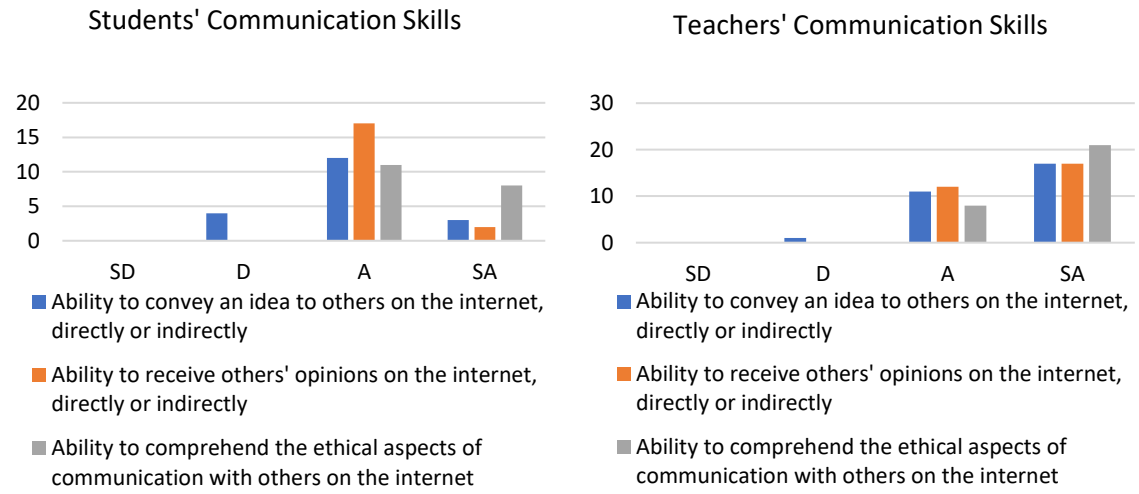

Figure 4. Responses for the Communication Skills Category

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Strategic Skills

In the strategic skills category, most student respondents use the internet and digital devices in their daily lives and for hobbies. However, many respondents do not use digital devices to fulfill their hobbies. Responses from teachers are more varied compared to their responses in previous categories. Most teachers use the internet and digital devices daily and for hobbies. While most teachers also use digital devices for side jobs, the number is still not as high as those who use them daily and for hobbies. The result of strategic skills can be shown in Figure 5.

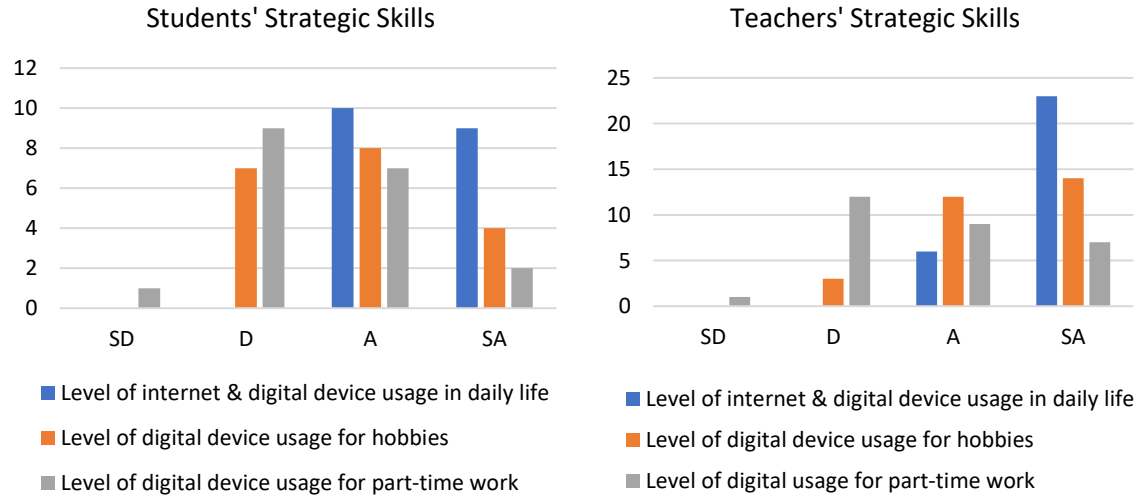

Figure 5. Responses for the Strategic Skills Category

From the responses to the three respective statement items in Figure 5, students have an average score of 2.5, falling within the high category, followed by 1.8 and 1.5, falling within the moderate category. On the other hand, teachers have higher average scores of 2.8 and 2.4, falling within the high category, followed by 1.8, falling within the moderate category.

Creative Skills

In the creative skills category, it was found that the majority of student respondents can create textual content on the internet (such as blogs, fiction, and research articles), create or design digital

image content (such as internet memes, artworks, and posters), and create and edit videos. For the last statement item, respondents are almost evenly divided between students who can develop software and those who cannot. In Figure 6, many respondents still feel they lack the mentioned skills in these statement items. Compared to student respondents, teacher respondents have a larger ratio of individuals who can create textual, image, and video content. However, it was also found from the responses that most teachers feel they cannot create software.

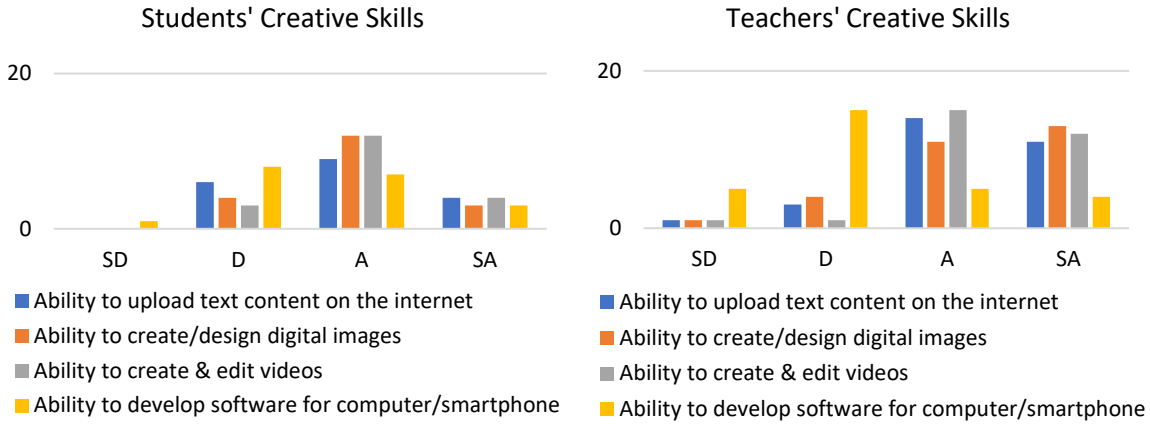

Figure 6. Responses for the Creative Skills Category

From the responses to the four statement items in the creative skills category, students have average scores of 1.9, 1.9, 2.1, and 1.6, respectively, as shown in the order in Figure 6 three of them fall within the moderate category, with only the video creation skill falling within the high category. On the other hand, teachers have average scores of 2.2, 2.2, 2.3, and 1.3, respectively; the first three fall within the high category, while the ability to create software for computers or smartphones falls within the moderate category.

School Learning

In school learning, respondents expressed: (1) Which digital media have been used in their school's learning process; (2) Whether they would like more digital media to be used in their school; and (3) Which specific digital media types they would like to see used in their school. The result can be shown in Figure 7.

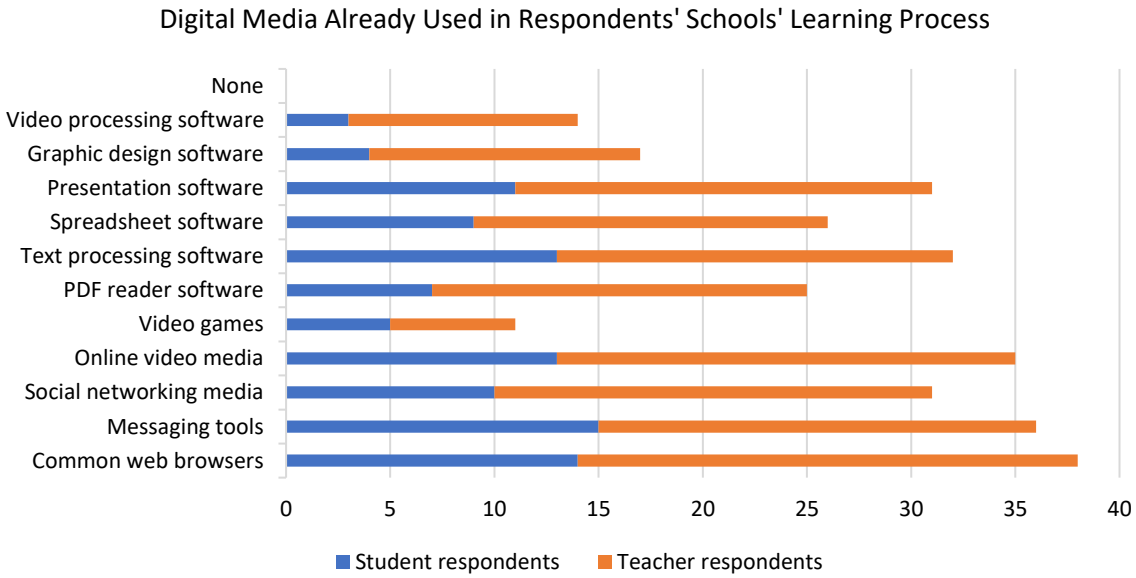

Figure 7. Digital Media Types that Have Been Used in Respondents' Schools' Learning Process

For the first statement item, student and teacher responses: Web browsers such as Chrome and Firefox are the most widely used types of digital media in learning (38 respondents), followed by messaging apps like WhatsApp and LINE (36), then online video platforms like YouTube and TikTok (35). Video games are the least used among the choices of digital media types (11).

Meanwhile, the second statement about the respondents who want more digital media use at school in Figure 8 found that most respondents want digital media to be used more in their school's learning activities (16 students and 28 teachers).

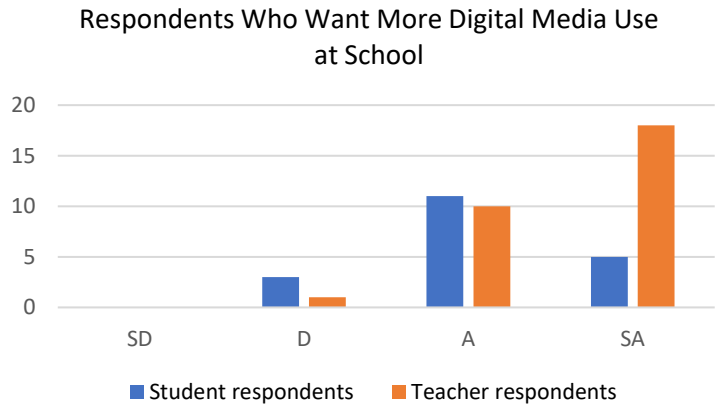

Figure 8. Respondents who want more Digital Media to be used in their Schools' Learning Process

Among all respondents shown in Figure 8, it can take the result that only three students and one teacher indicated disinterest. There is a slight inconsistency with some of the responses in the third statement item, as seen in Figure 9.

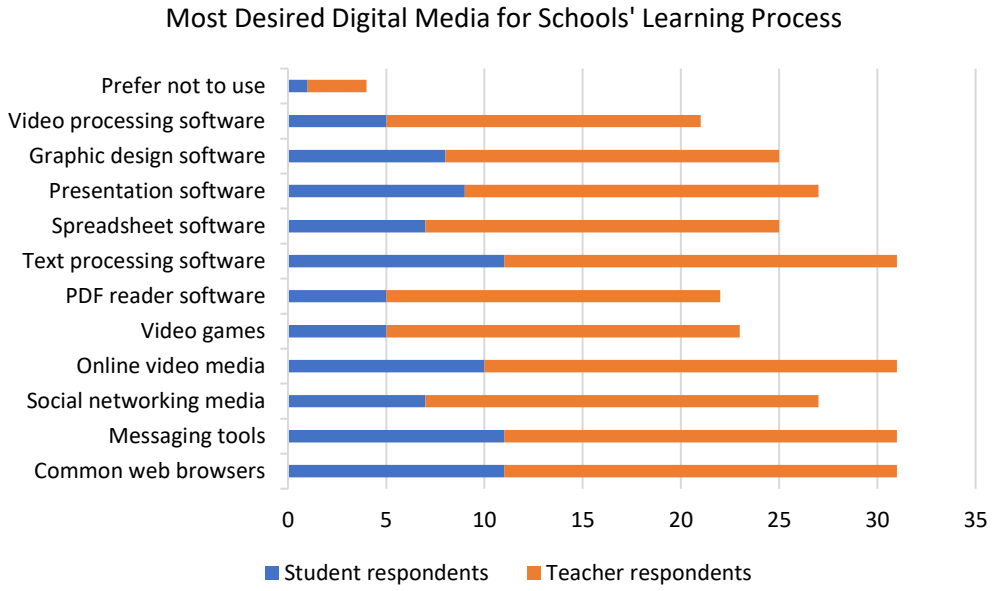

Figure 9. Most Desired, Digital Media Types Respondents would Like to See Used

For the third statement item in Figure 9, it was found that the most desired digital media for learning are not significantly different from the responses in the first statement item. This is evident from the positions of web browsers, messaging apps, online video platforms, and text editors; the top four choices in the first statement item, as mentioned in Figure 7, were also the most commonly selected in this section. Regarding the "Prefer not to use" option, one student and three teachers expressed disinterest in digital media for learning. This differs from the response to the second

statement item, where three students and one teacher indicated that they do not want more digital media to be used.

To determine the most wanted but still unused digital media types by respondents, the researchers calculated the ratio of respondents desiring a particular digital media type to the number of respondents mentioning that the media had been used in their school. The result can be seen in Figure 10.

As a result, in Figure 10, video games are the most desired digital media for both students and teachers to be used in school learning, considering the relatively low number of respondents who have learned using video games. This is followed by video editing software and graphic design tools.

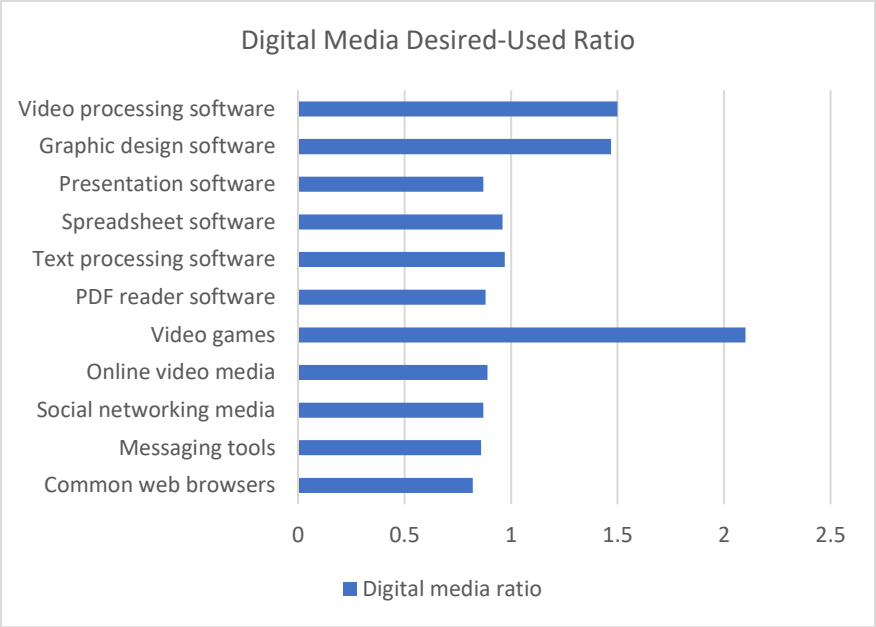

Figure 10. Comparison of Desired Digital Media Types with Those Already Used at School

Discussion

Five Digital Literacy Skill Categories

There are several similarities and differences between the findings of this research and a couple of studies mentioned in the introduction, namely the studies by Dinata (2021) and Nahdi & Jatisunda (2020). The findings in the operational skills category, where students and teachers feel competent in using computers/laptops, smartphones, and the internet, are consistent with the results of those two articles. As the ability to use hardware and software is the foundation of digital literacy (Iordache et al., 2017), a good level of operational skills is a solid basis for mastering other areas of digital literacy. Although respondents received an average score indicating moderate skills in the number of software types used, some of the software mentioned in the questionnaire are specialized tools, and therefore, the general usage of digital devices might not be fully reflected in those statement items.

The research results in the information skills category are similar to those of Dinata (2021) and quite comparable to Nahdi & Jatisunda's (2020) findings. In Dinata's (2021) research, the majority of student respondents, who were prospective mathematics teachers, claimed to possess good skills in searching for, selecting, and analyzing information in the digital realm, which aligns with the findings of this study. Meanwhile, Nahdi & Jatisunda's (2020) research discovered that most prospective elementary school teacher students had good information-related skills, such as identifying, selecting, comparing, and verifying. However, respondents also had varying responses (ranging from "good," represented by "yes," "moderate," represented by "partly," and "low," represented by "no") to the statement items addressing information analysis skills. Referring to Eshet's (2004) opinion, analyzing and evaluating information is a crucial skill for academics and

information users in the digital era; information skills are a high priority in both students' and teachers' abilities that must be maintained and enhanced.

Nahdi & Jatisunda's (2020) study did not extensively examine communication skills. However, there is a typical pattern between this research's findings and Dinata's (2021) communication skills, even though different aspects of communication were covered in each study. In this research, the three communication aspects discussed were expressing ideas, receiving ideas, and knowing communication ethics online. As seen in Figure 4, the ability to express ideas is an aspect with a lower average score than the others.

A similar pattern can be found in Dinata's (2021) study, in which most responses indicated a relatively weak skill average to the statement about the ability to negotiate opinions. However, other statement items that can be categorized as expressing ideas, such as the ability to explain concepts, received most responses indicating a relatively good skill average. Despite comparing these findings, communication skills are one of the critical competencies of this era, as more accessible access to the internet makes understanding and sending messages more crucial to participating in the increasingly participatory culture, among other reasons (Iordache et al., 2017). Therefore, teachers and students should continuously learn to communicate through digital media.

The field of strategic skills differs slightly from the previous categories as it focuses less on analyzing respondents' perceptions of specific skills and more on understanding their habits with digital media and assessing their mastery based on those habits. This difference arises from the fact that the utilization of information in digital media for personal and professional purposes is considered a high-level digital skill (van Deursen & van Dijk, 2014), and respondents who are more accustomed to using digital devices are likely to make better decisions (Iordache et al., 2017).

The high number of students and teachers who use digital devices in their daily lives and for hobbies is a positive sign, indicating that respondents actively utilize digital media. For the last statement item, most respondents not using digital devices for side jobs suggest that most students and teachers might not have additional jobs, such as selling products. Therefore, this final statement item is not considered a priority for schools' learning process and merely indicates that students and teachers who use digital devices for side jobs are likely to have higher digital literacy skills.

Creativity is one of the digital literacy categories discussed in Dinata's (2021) study. However, this research is more specific in mentioning the types of products respondents believe they can create in the statement items about the ability to create products, alongside other statement items not covered in this study. Most respondents answered that they can, although many students indicated they are not skilled in this area. Additionally, there was one statement item in Nahdi & Jatisunda's (2020) study regarding product creation, specifically whether respondents can create a website; most respondents answered negatively.

As a category that reflects the ability to create something new, form a creative expression, and integrate existing digital media content, the creative skills category represents individuals' capabilities to achieve specific goals in a better and more expressive way (Ala-Mutka, 2011; Iordache et al., 2017). The content of the statement items in this category are specific skills that digital device users do not always possess. Therefore, obtaining an average score in the middle range, like the respondents in this study regarding the statement item about creating software, does not necessarily imply low digital literacy skills.

With this data, one of the research objectives to discover the digital literacy perceptions of high school students and teachers has been achieved. Students and teachers generally have relatively high average abilities in all five types of digital literacy skills. With teachers' higher average perceived abilities compared to students, schools with profiles like this are relatively prepared to develop more lessons that utilize digital media. The ability to express opinions and be creative with digital media, which received relatively low scores in student and teacher responses, should be further explored with priority in school lesson implementation.

School Learning

The "school learning" section illustrates the profile of students' and teachers' interests in using digital media for school lessons, which is the second objective of this research. The high number for each digital medium shown in Figure 7 indicates that most of the respondents' schools have already

implemented digital media in their educational programs. Therefore, increasing the utilization of digital media would align with the profile of respondents who are already accustomed to it.

Meanwhile, the analysis of responses in the following three figures shows that video games, video editing software, and graphic design software are not widely used in schools yet but are desired by both students and teachers for implementation. Video games or digital gaming software are forms of entertainment that are highly popular, with the gaming market in Indonesia reaching US$880 million in 2017 and US$1.92 billion in 2021, according to Zhou (2019), US$1.1 billion in 2018 according to the AGI (Asosiasi Game Indonesia), n.d., and US$1.59 billion in 2022 according to Statista, n.d. Therefore, using them in education would tap into a large audience not unlike that of movies or concerts. Additionally, video editing and graphic design software have become increasingly popular due to the growing participatory culture in the digital realm, as mentioned by Iordache et al. (2017). This provides students and teachers with opportunities for creative expression and engagement with content creation on famous photo and video-sharing platforms on the internet.

CONCLUSION

This research contains a substantial amount of data from respondents to uncover the profile of interests and perceptions regarding the level of digital literacy among high school students and teachers. The results of the data analysis indicate that the overall level of digital literacy among respondents is already relatively high. However, certain aspects are comparatively lower than others and should be improved, such as the ability to express ideas through digital media and creatively produce specific products using digital tools. The analysis of respondents' interests also reveals that several digital media types are relatively underutilized in education but are desired by both students and teachers, namely video games, video editing tools, and graphic design software. These findings address some of the needs for profiles of interest and digital literacy skills in the educational context, which can be used to enhance further the quality and appeal of Indonesian education in the digital era. This study is limited to collecting data on the perceived level of digital literacy among high school students and teachers. To conduct a more in-depth analysis of digital literacy skills, it would be beneficial to incorporate testing methods so that the research outcomes are not solely based on respondents' feelings and experiences. Furthermore, to follow up on the findings of this research, it is suggested that future studies explore the best ways to implement video games, video editing tools, graphic design software, and similar software as engaging educational media in educational institutions.

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Media development board game to increase student motivation in studying regional culture

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ABSTRACT

Media development as an effort to introduce regional culture is considered essential to do. Technological developments make students' motivation to study culture begin to fade and shift with the emergence of Western civilization. This is motivated by the need for more interesting local culture introduction media for students and regional, cultural, and educational content in online or offline media. Therefore, learning media is needed to introduce regional culture. The objectives of this development research are: (1) Producing culture game education media board game products; (2) Testing and knowing the feasibility of culture game education media board game products; and (3) Knowing the effectiveness of culture game education board game media products in increasing learning motivation on material Sub Theme 2: "The Beauty of My Country's Cultural Diversity" for grade IV Elementary School. The development model used is ADDIE. The results of this development research are: (1) Learning media products, board game culture, and game education; and (2) Based on the validation that has been carried out on material experts and learning media experts, it is stated that the culture game education board game is suitable for use in the learning process and can be implemented for students with a percentage of the validity test of material experts, namely 89% and a percentage of the validity test of learning media experts, namely 98%. The results of the practicality test using the culture game education board game by the teacher obtained a score of 91%, while the trial results related to the percentage of students' motivation to learn culture through this media was 86%. The conclusion is based on the development done; the culture game education board game is declared appropriate when used as a medium to introduce regional culture.

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INTRODUCTION

Education is one of the components of nation-building that transforms the develop 21st-century learning. The skills developed in 21st-century learning is generally described in 4 classifications: (a) Ways of thinking: Creativity and innovation, problem-solving, critical thinking, learning to learn, and taking decision; (b) How to work: Collaborate and communicate; (c) Working tools: Technology, communication and information skills as well as general knowledge;

and (d) Way of life: Career, personal and social responsibility, awareness of competence and culture (Binkley et al., 2012). The teacher as a facilitator has a positive influence in supporting the effectiveness of student learning through the facilities provided to achieve 21st-century skills (Rahmawati & Suryadi, 2019).

Learning motivation can be interpreted as encouragement to carry out learning activities from outside or within individuals to impact the emergence of enthusiasm for learning (Monika & Adman, 2017). Motivation gives a person the will and desire to do something, and if feelings of dislike arise, they will try to avoid them. So, motivation naturally grows within a person but will get stimulation and response from the surrounding environment. According to Slameto (2011), physical, psychological, and fatigue can influence a person's motivation. At the same time, the external factors that influence a person's motivation are family, school, and community. Motivation has two main functions: encouraging students to be active and as a guide (Winarsih, 2009).

One of the efforts to support learning is by preparing a learning plan or instructional science by choosing the learning method to increase student motivation. One form of learning method currently being developed is gamification (Dichev & Dicheva, 2017). Educational gamification is a growing approach to increasing learner motivation and engagement by incorporating game design elements in educational settings. Educational gamification involves transferring game and video game mechanics to the educational field, aiming to seek behavior modification. To create an attractive and exciting didactic experience to increase student motivation, their commitment to learning the subject's content or the enjoyment of the pedagogical tasks themselves always uses motivational elements (Jusuf, 2016).

Using game mechanics can increase the ability to learn new skills by 40%. Educational content that uses game mechanics is interactive, rich in multimedia elements, and interesting (Kiryakova et al., 2018). Gamification combines the elements of game aesthetics, improving the ability to think, motivate, solve problems, and promote learning. Based on observations made on thematic learning in grade 4 of SD Negeri Samir, it is known that the learning method used by teachers at SD Samir is the lecture method, so it does not support 21st-century learning because learning is teacher-centered.

The learning media used are modules and Student Worksheets (LKS), making students less motivated to study thematically. One of the materials that is difficult for students to understand through conventional learning methods is the material for Sub Theme 2: The Beauty of Cultural Diversity in My Country. The variety of material makes it difficult for students to understand the material if the interaction only occurs in one direction. The characteristics of SD Negeri Samir students are that they are quickly bored and find it difficult to understand various materials. Meanwhile, this material is highly urgent to introduce each province's diversity in Indonesia. Students, as heirs to the nation's culture, have an essential role in maintaining and preserving the diversity in Indonesia.

In order to support meaningful learning, it is necessary to change the use of learning methods from conventional methods/lecturing methods to other methods so that students can be directly involved in the learning process: one method that can involve students directly, namely the method of gamification. LearnTech interprets gamification as the process of implementing the parts contained in the game towards activities non-game, which aims to strengthen positive learning behavior for students. The essential gamification elements are points, levels, leaderboards, and avatars (Ariani, 2020). The use of elements in gamification continues to experience development in line with the development of people's taste for gamification games. In addition, gamification has no minimum standard for using elements in a game.

According to, gamification is divided into two types: structural and content. Structural gamification is the implementation of game elements found in the learning material without making a change in implementing the learning material. One example of gamification is the usage platform LMS e-learning, which presents learning through PowerPoint, PDF, and video media with tools other supports in Moodle. Content gamification uses thought patterns and elements in a game on learning material so that exposure to the material resembles a game. The implementation of

content gamification is in the form of learning media designed into various game models. One of the games that is interesting to develop is a board game.

The board game was chosen because it is a game media that can improve children's ability to strategize, solve problems, and think critically (Setyanugrah & Setyadi, 2017). Board games simplify complex problems and systems, making them suitable for students' exploratory power in learning processes and concepts, such as motivation and computational thinking in formal and informal settings (Bayeck, 2020). Board games invite children to play face-to-face to encourage discussions and questions that benefit children's social and socio-emotion (O'neill & Holmes, 2022). Based on market share data, board game is expected to increase by USD 3.02 billion from 2021 to 2026, and market growth conditions, board game experienced an increase in CAGR with a percentage of 7.31%. So, the development opportunities for board games are tremendous (Technavio, 2022).

Research that has been done previously stated that the gamification method has a longer-lasting effect on student learning outcomes (Huang et al., 2020). Through method gamification, the level of activeness of students involving themselves in the learning process increases, positively correlated with students' motivation to learn (Buckley & Doyle, 2016). The gamification method can be implemented in various learning media, such as conventional, non-digital, or digital-based learning media, such as applications (Talan et al., 2020).

The novelty of this research is to produce learning media that helps students recognize the cultural diversity in East Java so that engaging media is expected to increase students' motivation in learning about the diversity in East Java province. Therefore, the research objective is media development board game Culture Game Education materi Sub-theme 2: The Beauty of My Country's Cultural Diversity and analyzing its application board game in motivating students to recognize diversity in East Java for grade IV. This research is contributed to increasing the elementary students' motivation in learning regional culture through board game.

METHOD

This research is a type of research Research and Development (R&D). This study initiated the activities with basic research to obtain needs assessment information. Development was done to develop specific products and conduct product effectiveness tests (Purnama, 2016). The research and development model for culture game education learning media uses the ADDIE model. The ADDIE model in this study uses an instructional design system. The systems approach divides the learning planning process into steps in a logical sequence by utilizing the output of each step and input in the next step (Cahyadi, 2019).

ADDIE was chosen because it is a development paradigm designed to use an instructional system that facilitates learning complexity (Rohaeni, 2020). This instructional design is centered on individual learning having immediate and long-term phases, is systematic, and uses a systems approach to knowledge and human learning. The simplicity of the concept ADDIE combined with various drives for inclusivity proved to be effectively used in design and development (Branch, 2009). So, it can be assumed that the developed product can answer needs and problems in the field (Rusdi, 2018). ADDIE model consists of five stages: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation—the stages in the ADDIE model implemented as in Figure 1.

The first stage is analysis; the activities analyze the need for developing teaching materials in learning objectives. The purpose of the analysis phase is to collect supporting data that underlies the creation of culture game education learning media. The analysis is carried out of students' needs, curriculum, and characteristics. The second stage is designed as a media product development process for the board game culture game education. Following are some of the steps taken in the design process, namely: (1) formulating learning objectives, (2) formulating material details, (3) developing assessment tools, and (4) designing media products, board game culture game education.

The third stage is development. Learning media product development stage Board game culture game education based on the validation results that have been carried out by experts and product revision with the development stages that have been carried out, namely as follows: (1)

product creation, (2) media validation carried out by learning media experts and material experts, and (3) revision, namely product improvement based on suggestions, input, and corrections made has been obtained from the results of validation by experts. The fourth stage, namely implementation, is the activity of using the product that has been made. Learning media is applied to students in real situations (usability testing) after being declared valid based on the results of expert validation. The fifth stage is evaluation. Evaluation is an activity carried out to provide an assessment of the development of teaching materials that have previously been made. This stage is carried out by providing formative and summative evaluations.

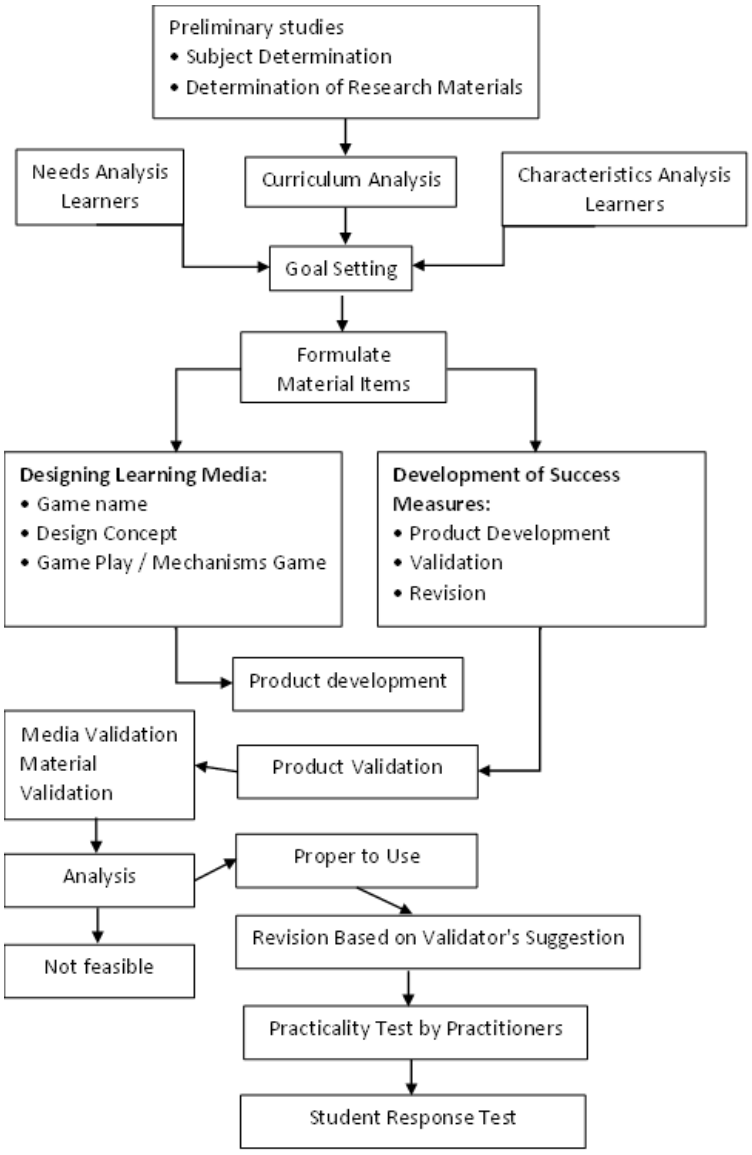

Figure 1. Research Procedure
Source: Modified Research Procedure (Rahmah et al., 2022)

The subjects in this development research were elementary school teacher education lecturers, educational technology lecturers, teachers, and students of SD Negeri Samir in Tulungagung Regency. The research subjects were 14 grade 4 students and grade 4 teachers as field practitioners. The types of data collected are descriptive quantitative and descriptive qualitative. Qualitative data were obtained based on the assessment of learning media's research

and development process in the form of suggestions and criticisms from learning media experts, material experts, and learning practitioners.

The expert and student assessment questionnaires were then analyzed through a quantitative descriptive method. The percentage of the validation questionnaire obtained is calculated using a Likert scale score calculation by Suasapha (2020) in Table 1.

Table 1. Rating Scale

Criteria	Score
Very Good	4
Good	3
Good Enough	2
Very Not Good	1

Assessment data were analyzed using qualitative and quantitative descriptive analysis techniques. Quantitative data processing is calculated using a Formula 1 and Formula 2 (Akbar, 2013).

$$V\text{–}ah = T_{Se}/T_{Sh} \times 100\% \quad (1)$$

$$V\text{–}pg = T_{Se}/T_{Sh} \times 100\% \quad (2)$$

The description of each formula is: V-ah means expert validation, V-pg means user validation, Tse means total empirical score obtained, and TSh means expected total empirical score.

The percentage of scores that have been obtained are then classified according to the qualifications contained in Table 2. The revision process is carried out during the media product validation process of the board game culture game education by the directions and input given by learning media experts, material experts, and learning practitioners. Products that have obtained valid criteria are then tested, based on the percentage of product feasibility criteria referred to in Table 2.

Table 2. Product Eligibility Percentage Criteria

No.	Achievement Level Product Validation	Product Validation Achievement Level
1	75.01 - 100	Very valid/exciting can be used without revision
2	50.01 – 75.00	Quite valid/interesting, can be used but needs to be revised small scale
3	25.01 – 50.00	Less valid/engaging, usable but necessary large-scale revision
4	01.00 – 25.00	Invalid/attractive, cannot be used

Source: Modification of (Akbar, 2013)

RESULTS AND DISCUSSION

Result

Media product development research board game culture game education on class IV thematic learning materials tested at SD Negeri Samir. Several experts validated this research. This research spent 3 (three) months, starting in January with the analysis stage until March 2023 with the following evaluation stages:

Analysis

The first stage is analysis, which aims to obtain supporting data that forms the basis for making media products, board games, and culture game education. This stage includes:

Needs Analysis

The first analysis carried out was an analysis of learning media needs. This is based on the fact that the learning media used by teachers are not for the needs of students. Based on the results of observations made by researchers, the following results were obtained: (1) Student motivation in thematic learning is still low. One of these behaviors is characterized by some students who prefer to talk to their peers during learning activities, so they ignore the teacher's explanation. Students need engaging learning media so that they are interested in learning the material presented; (2) The lecture method used by the teacher in learning makes students passive in learning activities. So, students need learning methods that make students active in learning; and (3) The learning media used are less innovative. The teacher's learning media are modules and Student Worksheets (LKS). Students need engaging learning media that involve students directly in the learning process.

Curriculum Analysis

The curriculum analyzed in this study is the 2013 Curriculum (K13). The essential competencies used in development research are class IV, semester 2, theme 7, and the material for Sub Theme 2: The Beauty of Cultural Diversity in My Country. The details of the essential competencies developed are as follows: (a) IPS - Identify social, economic, cultural, ethnic, and religious diversity in the local province as the identity of the Indonesian nation and its relationship with spatial characteristics; (b) SBdP - Demonstrating regional creative dance moves; (c) PPKn - Presenting various forms of ethnic, social, and cultural diversity in Indonesia, bound by unity and integrity; and (d) Indonesian - Exploring new knowledge contained in the text (Kusumawati, 2013)

Analysis of Student Characteristics

Based on the data obtained by the researcher, the characteristics of elementary school students who study thematic subjects have been obtained. Familiar characters, namely: (1) Students aged 9-10 years; (2) Learners consist of 9 boys and seven girls; and (3) Students' cognitive level is at the first level, where students can understand knowledge or lessons (knowing). The unique characteristics of students are that students have visual and auditory learning styles.

Design

The second stage is design, where the author takes several steps to facilitate the writer in developing culture game education learning media products. The following are some of the steps taken in the design stage, namely:

Formulate Learning Objectives

This learning objective was developed for Sub-Theme 2 material: "The Beauty of Cultural Diversity in My Country," as a reference result of student motivation, which is expected to increase after participating in learning. Based on the competency achievement indicators that have been analyzed previously, they have been reduced to learning objectives. The learning objectives set are: (1) Students can describe the social, economic, cultural, ethnic, and religious diversity in East Java; (2) Students can practice various cultures in East Java; (3) Students can classify the social, economic, cultural, ethnic, and religious diversity in every East Java cultural area; and (4) Students can identify the differences in every social, economic, cultural, ethnic, and religious diversity that exists in every cultural area in East Java.

Formulate Material Details

Material preparation is carried out in several stages, including: (1) Identify competency standards and essential competencies; (2) Identify the type of learning material; (3) Determine the material by competency standards; and (4) Choose sources for making teaching materials.

Develop Assessment Tool

The tool used to measure success in making this media is a questionnaire that was prepared by considering various aspects, including content feasibility, language feasibility, presentation feasibility, and practicality of use.

Designing Culture Game Education Learning Media

At this stage, the researcher designed the culture game education learning media with the following results:

Name Game

The name of this educational game is culture game education, which comes from English, which means cultural education game. The meaning of this game is the goal to be achieved, namely studying Indonesia's various cultures and diversity, which are discussed in each province.

Design Concept

This board game has several plans for the user interface and environment play. First, the game chooses the color of the palette in Figure 2, which is bright to attract children to use it.

Figure 2. Color Branding Board Game Culture Game Education

Manufacturing visual style board games made attractive and adapted to trend available. Font The one used is Montserrat.

Game Play / Game mechanics

The mechanism of this game are: (1) 2-4 people carry out the game with a time limit of 35 minutes or the equivalent of 1 lesson hour. At the beginning of the game, each player is provided with three coins; (2) The game starts by throwing the number of dice by the first player, the number that appears is the step that must be taken; (3) If the player stops at the blue dot, then Players have to take challenge dice and questions. The T/P letter that appears shows the card that the player must take; (4) Players who can answer questions or do challenges will get additional treasure in the form of food, goods, or coins, according to picture; (5) If the player stops at the market, then the player can buy food or goods; (6) If a player gets a food card and goods from the same area, then he can acquire the area; (7) If a player stops in an area acquired by another player, he must pay one coin to the area owner; and (8) If the player stops at the museum, he can take a museum card and view the animated video contained on the museum card by scanning a QR code.

Development

The third stage is developing a learning media culture Game Education based on expert validation and product revision results. The following are the development steps that have been carried out:

Product Development

There are several stages in developing media products, game Culture, and Game Education. The first stage is designing the board game culture game education. Culture game education is a classic board game with several players 2-4, so it can be categorized as a multiplayer elimination game if viewed from the manufacturer's purpose, including in educational board games. Components found in a setboard game: (1) A paper board with a size of 40 x 35 cm as a game area;

(2) A guidebook containing game procedures, instructions for implementing challenges, and instructions for answering question cards; and (3) Complementary components of the game are 40 coins, four pawns to represent players, 1 number dice, 1 TP dice, 30 food cards, 30 item cards, four museum cards, 15 question cards, and 15 challenge cards.

The second stage is the adjustment of the design style. The design style used in the design of the board game culture game education is adjusted based on the results of research that has been carried out on the target audience. The colors chosen are bright, attractive image illustrations, interesting video concepts, straightforward typography, and attractive decorative.

The third stage is designing the concept and content of board game culture game education. Students are invited to tour East Java and get to know the various diversity that exists in East Java. East Java consists of 4 major cultural areas: Matraman, Pandalungan, Arek, and Madura. Students can see various non-object cultures through animated videos when they stop at museum points. Through the question cards, students are invited to learn about social, economic, cultural, ethnic, and religious diversity and carry out various social practices related to this diversity. It takes one month to make this learning media product, from January to March 2023. The following Figure 3 shows the culture game education learning media that has been made.

Figure 3. Display Board game Culture Game Education

Validation

The validation stage was carried out by learning media experts and material experts. The validation phase uses instruments that have previously been designed at the design stage. The data obtained at the validation stage are qualitative in the form of comments, suggestions, and input, which are used as the basis for improving the learning media being developed. At this stage, the researcher also obtained quantitative data based on the score calculation data to assess the validity of the learning media being tested. Based on the validation activities that have been carried out, the following results are obtained learning media experts were validated by a Lecturer in Educational Technology at the Universitas Negeri Malang. The validation stage was carried out on February 20, 2023. The results of the validation of the media aspect assessment are presented in Table 3 (Modification from (Febrianti et al., 2021)).

Table 3. Aspect of Assessment

No.	Assessment Aspects	Score
1	Media component board game culture game education	20
2	Display organization	16
3	Interactivity	8
4	Overall evaluation	11
Total Score		**55**
Percentage		**98**

The result of recapitulation of the validation of learning media by expert got some comments. Some of them are suggestion about the media sets and identify of the developer. Overall, the comment about the learning media is generally good. The result can be shown in Table 4.

Table 4. Recapitulation of Qualitative Data Validation Results of Learning Media Experts

Aspect	Comment
Suggestion	1. Media sets can be stored in functional containers/packaging 2. Complete with the identity of the developer
General Opinion	-
General Conclusion	Generally good

After that, Elementary School Teacher Education Lecturers at the Universitas Negeri Malang carried out material expert validation. The validation stages were carried out on February 10, 2023. The validation results by material experts Modification from (Febrianti et al., 2021) are presented in Table 5.

Table 5. Material Expert Validation Result Data

No.	Assessment Aspects	Score
1	Content Eligibility	21
2	Language	11
3	Visualization	7
4	Evaluation Question	11
Total Score		**50**
Percentage		**89**

Table 6. Recapitulation of Qualitative Data Results of Material Expert Validation

Aspect	Comment
Suggestion	1. QR code must be considered again because it can hinder teaching and learning activities. 2. Provide a special place for the card
General Opinion	Culture game education is good and allows for small groups of elementary students.
General Conclusion	It can be used as well as further developed according to the suggestions that have been given.

The results obtained through the validation process state that the culture game education board game has a validity level percentage of the media validator, namely 98%, and the material validator, namely 89%, so it can be stated that this development product is feasible to be implemented to students without revision.

Implementation

The fourth stage is implementation. After media products, the board game culture game education goes through the development and revision stages based on expert advice and comments. The next step is product implementation. At the implementation stage, media products board game revised culture game education is implemented for students. The implementation involved class teachers as field practitioners and 14 fourth-grade students at SD Negeri Samir. Students were asked to respond through a written questionnaire that had been distributed about the use of culture game education Media

Samir State Elementary School teachers carried out practicality tests by practitioners. Practitioners' assessment is an essential reference to see the practicality of using culture game education learning media. The practicality of test results by practitioners (Rahmah et al., 2022) is explained in Table 7.

Table 7. Practicality Test Result Data by Learning Practitioners

No.	Aspects of Assessment	Score
1	Appropriateness of the time available in learning with the ease of operating learning media	4
2	Media learning ability as a tool to achieve learning indicators/objectives	3
3	Students' interest in learning by utilizing the developed learning media	4
4	The ability to learn media that will be used repeatedly according to the learning material	4
5	Media learning ability to create a sense of fun for students	4
6	Media learning ability in creating student learning motivation	3
7	The ability to learn media helps students understand information	3
8	The ability of learning media to spur the creativity of students	4
9	Media learning ability as a learning stimulus for students	4
10	The suitability of learning media as a learning resource	4
Total Score		**37**
Percentage		**92**

Table 8. Qualitative Data Summary of Practical Assessment by Field Practitioners

Aspect	Comment
Critics	The map used by "culture game education" should be more prominent so that every child can play.
Suggestion	Print the "culture game education" map in large size.

Student response trials were carried out by distributing questionnaires to 14 grade 4 students who had used culture game education media. The following Table 9 is a recapitulation of student trial data. The criteria of each item are: 1 means strongly disagree, 2 means disagree, 3 means agree, and 4 means strongly agree.

Table 9. Recapitulation of Student Trial Data

No.	Statement Sentence	Evaluation				Percentage
		1	2	3	4	
1	I am interested in learning to use board game media.		1	7	6	84
2	I am happy to be able to learn to use board game media.			8	6	86
3	I can explain about the material contained in the media	2	1	8	3	71
4	I got instructions for using the media	1	1	5	7	82
5	Board game media can increase my understanding of studying cultural diversity in East Java	1		3	10	89
6	The application of board game media helps me make it easier to learn about cultural diversity in East Java	1	2	7	4	75
7	Using board game media makes me passionate about studying cultural diversity in East Java.		1	3	10	91
8	The learning atmosphere in the classroom becomes more fun through the use of board game media	1	2	6	5	77
9	Using board game media has increased my motivation to study cultural diversity in East Java.			8	6	86
10	I am active in following the lessons in class using board game media	1		7	6	82
Total Score		**7**	**16**	**186**	**252**	**461**
Percentage						**82**

Evaluation

The fifth stage carried out in this development research is evaluation. The evaluation is based on data from the test results of 14 students at SD Negeri Samir in Tulungagung Regency. Based on these data, the level of practicality of board game media for learning practitioners is 92%, and the level of practicality of products for students based on trial results is 82%, so the use of board game

culture game education media products is considered attractive to be used to introduce various cultures in East Java.

Discussion

Media product development Board game culture game education aims to introduce diversity in East Java through the thematic subjects of class IV SD theme 7 Sub Theme 2: The Beauty of Cultural Diversity of My Country. Election board game as a learning medium is determined using Dale's Cone of Experience theory or Dale's Cone Experience to provide students with concrete learning experiences (Azhar, 2015) . According to Edgar Dale, students can remember what they do up to 90% of the time. Media use board games as concrete learning media to increase students' motivation because they are directly involved in the learning process.

Submitting accurate information through board game media makes it easier for students to receive and manage the information they get. According to constructivist learning theory, Learning through method gamification encourages students to build knowledge and form thinking concepts. This is to implement constructivist learning, namely creating direct interaction between students, paying attention to students' initial conceptions so that they know the correct concept, and changing concepts that previously could be wrong (Johar & Hanum, 2016). Cognitive structures that already exist in students are aligned with new information received so that they can build meaningful learning. The advantages obtained with meaningful learning are that the material will be remembered longer, increase understanding and ease in learning the following material that has an attachment, and the information obtained previously will leave a mark so that it helps the learning process on the following material that has similarities (Hanani, 2020).

Media product development Board game culture game education included in the form of conventional / non-digital board games. The traditional game board was chosen because it can give an impression at first glance and reduce errors in game operations. In addition, players will feel intimacy in the game, get sympathetic responses, increase social interaction, and traditional games can improve one's interpersonal relationships (Fang et al., 2016). Based on the benefits owned in board games conventionally, students can use the media to practice their social skills.

Board game culture game education has been tested through 4 product tests: material validation, learning media validation, learning practitioner trials, and product trials on students. The validation results stated that the material validity level was 89% and the learning media validation level was 98%, so the product board game was declared eligible for use with revision. The results of trials on learning practitioners and students stated that the level of practicality by learning practitioners was 92% and was able to increase student motivation with a percentage of 82%.

Although board game culture game education has been declared valid and feasible, there are some comments and suggestions that further researchers can make to increase the effectiveness of using board games as a medium of cultural recognition. The suggestions given are based on research that researchers have carried out to further research, namely: (1) Develop a media board game introduction to regional culture for other provinces in Indonesia; (2) Making travel and pawn storylines that have different strengths and weaknesses; and (3) Creating a game concept that can involve students in large groups.

CONCLUSION

Board game culture game education media products are suitable for learning media to introduce East Java regional culture to elementary school students. Board game culture game education media product development can be further developed to be used on a large scale. The revisions obtained from this media's development include adding a development identity to the media and a special place for each component, such as food cards, item cards, question cards, challenge cards, and museum cards. Based on the product validation results, the Board game culture game education media product was declared suitable for use with revisions with a material validation percentage of 89% and a learning media validation percentage of 98%. The results of field trials stated that the practicality percentage of the product carried out to learning practitioners

was 92% and could increase students' motivation to learn culture, namely 82%. It can be stated that the development of Board game culture game education media products has a high level of practicality and is ready to be tested in the field on a large scale to introduce various cultures in East Java with innovative, fun, and exciting media. So that students are motivated to learn about the various cultures in East Java.

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Development of virtual reality material: Archimedes' Law (VIRMA) in high school physics subjects to improve student learning outcomes

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ABSTRACT

The development of this virtual reality (VR) with an artificial environment consisting of scenes and 3D objects is expected to be a problem solution from a low conceptual understanding of Archimedes' Law material. This study aims to make physics learning media with virtual reality on Archimedes' Law (VIRMA) material. The purpose of his research is to describe the validity of making virtual reality learning media on material: Archimedes' Law (VIRMA), to tell the effectiveness of making virtual reality learning media on material: Archimedes' Law (VIRMA) based on learning outcomes and student response questionnaires. The type of research used in this research is development research according to the ADDIE model with one group pre-test post-test research design. The result showed that the development of virtual reality media in Archimedes' Law (VIRMA) material is very valid, with a percentage value of 85.9%. Using virtual reality media on material: Archimedes' Law can provide hands-on learning experiences, facilitate a deeper understanding of abstract concepts, and improve student learning outcomes with n-gain in the medium category 0,67. In addition, the response questionnaire showed that 93.7% of students agreed that virtual reality media was enjoyable and effective in helping to understand Archimedes' Law. Using the virtual reality media on the material is recommended: Archimedes' Law, which can increase student involvement, stimulate student interest in learning physics, and improve student learning outcomes.

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INTRODUCTION

The millennial generation is now entering the era of the industrial revolution 4.0 and the age of society 5.0. In this era, humans are considered to have never known life without technology. In the Society 5.0 era, people can solve various problems by utilizing multiple technologies that emerged in the Industrial Revolution 4.0, such as Big Data, Artificial Intelligence, and the Internet of Things, such as the virtual world and the metaverse (Saragih, 2022). The existence of the era of Society 5.0 creates the availability of education more comprehensive, flexible, and innovative. This causes the use of technology in education to continue, such as virtual classrooms and even has the

potential to utilize robots in the learning process. Even so, according to the Ministry of Education and Culture in ditpsd.kemdikbud.go. There is a teacher role that cannot be replaced by technology, namely the emotional bond between teacher and student, direct interaction during class learning, character building, and exemplary teacher (Laila & Hendriyanto, 2021).

The role of the teacher in education in the Society 5.0 era is crucial in building students' character, soft skills, and hard skills. According to Risdianto (2019), students' skills in the 21st century are 4C (Critical Thinking, Creativity, Communication, and Collaboration). Learning methods and media are needed to achieve these essential learning activities skills. Learning media helps deliver material effectively and can increase student understanding, motivation, and interest in learning (Suryani, 2016). Indonesia is a country where people are active in using smartphones. This can be seen from the people who access the internet on an average of 34 sites per day, and 63 million are Facebook users (Sulistyowati & Rachman, 2017). So do not be surprised if almost every child knows and is even an expert in using laptops and smartphones because digital-based learning can be an exciting learning medium for students.

The quick development of education shows that learning methods and media in schools need to be developed following the integration of technology into the learning process. Online experiment simulations, e-learning, and online classrooms can be accessed anywhere and anytime (Sulaiman et al., 2020). Using three 3-dimensional (3D) media is one of the student's demands that learning is interactive, innovative, and more concrete (Dewi, 2020). One of the 3D learning media is virtual reality. Virtual reality (VR) is a technology that uses computer technology to create immersive simulated environments. VR is increasingly used in education and in recent years to develop skills through interactive learning environments (ILE) with VR implementation. Physics education is one area where VR has been used to improve the visual representation of educational content and stimulate the cognitive process of learning with interactive experiences (Geng et al., 2022; Zatarain-Cabada et al., 2023).

They are learning media as one of the supports to reduce student learning barriers. One of the learning barriers is in physics lessons. In learning Physics, students experience obstacles in solving problems because the physics questions given by the teacher directly use mathematical equations without the need for analysis, and students are required to memorize formulas as used in other problems (Azizah et al., 2015). In addition, the results of previous research mention that examples of students' physics learning barriers are the lack of quality teaching staff, inadequate learning media and practicum tools, lots of subjects with dense syllabuses, and unfavorable family, school, or community environmental conditions will also have an effect (Daun et al., 2020). This is the results of research conducted by Dewi & Anggaryani (2020) & Hafi & Supardiyono (2018), which explains that physics material is challenging to understand because the teacher conveys it with direct explanations using the media of textbooks, power points, and practice questions that only contain formulas.

Obstacles in learning physics cause students' difficulty in counting, difficulty solving and analyzing problems on questions, difficulty understanding material concepts, difficulty using physics equations, including difficulty interpreting symbols and units (Azizah et al., 2015; Daun et al., 2020; Haqiqi & Sa'adah, 2018). According to research by Azizah et al., (2015), the difficulty of learning physics for students can be seen from 26% on Temperature and Heat material, 21% on Static Fluid material, 17% on Elasticity and Hooke's Law material, 25% on Optical material, and 11% on Kinematic material.

Archimedes' Law is a sub-material of Static Fluids in Physics lessons. Several studies regarding mastery of the concept of Archimedes' Law material show that there are still many misconceptions and students' lack of understanding of Archimedes' Law (Anjelin et al., 2021; Lestari et al., 2017; Rohmayanti et al., 2020; Widodo et al., 2018). In addition, students' initial obstacles to Archimedes' Law material include not being able to determine the volume of objects that sink, the density of things that are in the fluid, and not understanding the conditions of sinking, floating, and floating when objects are placed in the liquid (Lestari et al., 2017). The results of other studies also show that students' mastery of this material is relatively low, especially when

determining the equations of Archimedes' Law, causing difficulties in mathematical calculations (Widodo et al., 2018).

Based on research on the use of virtual reality media in education, there has yet to be any development on Archimedes' law material at the high school level. In addition, students' understanding of this material still needs to be improved. The description above-inspired researchers to make physics learning media with virtual reality on material: Archimedes' Law (VIRMA). This research aims to test the feasibility or validity of virtual reality learning media on the material Archimedes' Law (VIRMA). The second is to describe the effectiveness of virtual reality learning media on material: Archimedes' Law (VIRMA) based on the pre-test and post-test scores and increased learning outcomes from n-gain. Third, to describe the effectiveness of virtual reality learning media on material: Archimedes' Law (VIRMA) based on student response questionnaires.

METHOD

The type of research used in developing virtual reality learning media is development research according to the "ADDIE" model (Analysis, Design, Develop, Implement, Evaluate) (Branch, 2009). The flow of virtual reality media development that will be used is shown in Figure 1.

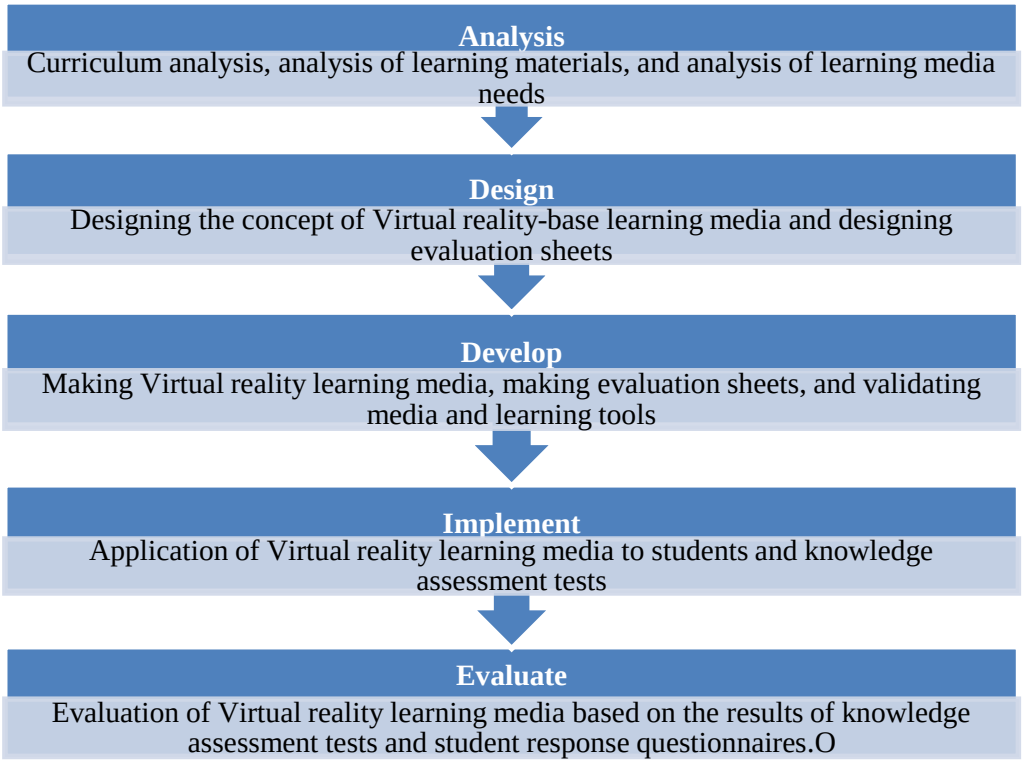

Figure 1. The Flow of Virtual Reality Media Development

This research was conducted at SMAN 3 Ponorogo and the Department of Physics, Universitas Negeri Surabaya, in the 2022/2023 academic year. This research was applied to class XI students at SMAN 3 Ponorogo using a limited test on students from class XI. The subject of this study was the development of virtual reality on material Archimedes' Law (VIRMA); validation was carried out by two lecturers from the Physics Department at Universitas Negeri Surabaya and one Physics teacher from SMAN 3 Ponorogo.

The research design used was a one-group pre-test and post-test design. This design can be described in Formula 1.

$$O_1 \text{ X } O_2 \quad (1)$$

Description:
O_1 = Pre-test
O_2 = Pro-test (after being given treatment)
X = Treatment

The research procedure gives a pre-test to determine the student's initial knowledge, and then the learning treatment uses virtual reality-based media on Archimedes' Law material. After that, the students were given a response questionnaire and a post-test to determine the increase in learning outcomes. The thing tested is the difference between O2 and O1. If there is a difference where O2 is more significant than O1, then the VIRMA media positively improves student learning outcomes. If O2 is smaller than O1, the n has a negative impact (Sugiyono, 2009).

This study only consisted of one group that was given the treatment. The population in this study were all students of class XI SMA Negeri 3 Ponorogo, which consisted of twelve classes. In this study, the sampling method used is probability sampling. The physics lesson schedule was in class XI IPA 3 SMA Negeri 3 Ponorogo during the research. The researcher conducted research in that class with 34 students sampled.

The research instruments for obtaining data were validation sheets, knowledge or understanding test sheets, and student response questionnaire sheets. The validation sheet is an instrument given to the validator to validate virtual reality media on the material: Archimedes' Law (VIRMA) media products that researchers have developed. Meanwhile, there are pre-test and post-test forms of knowledge or comprehension test sheets to determine increased learning outcomes after virtual reality media treatment. Validation used a "Likert Scale". According to Riduwan (2007), to determine the percentage validity of learning media, the assessment scores of all validators are calculated using the following Formula 2.

$$P = \frac{K}{n} \, x \, 100\% \quad (2)$$

Description:
P = Percentage of assessment
K= Sum of all scores obtained
n = Maximum number of scores

Analysis of students' knowledge or understanding tests using a minimum passing score for physics subjects is 70. Furthermore, pre-test and post-test scores are used to determine the results of increased student learning using "n-gain" equation in Formula 3 (Hake, 1998). Increasing student score based on "n-gain" scores can be categorized in Table 1.

$$(g) = \frac{\%\,(G)}{\%\,(G)_{max}} = \frac{\left(\%(S_f)\right) - \left(\%(S_i)\right)}{(100\% - \%(S_i))} \quad (3)$$

Description:
(g) = Increase of Student score
(S_i) = Pre-test score
(S_t) = Post-test score

Table 1. Gain Score Category

Gain score (g)	**Categories**
$more\ excellent(g) > 0{,}7$	High
$0{,}3 < (g) \leq 0{,}7$	Medium
$(g) < 0{,}3$	Low

An increase in student learning outcomes is seen from the close in $(\boldsymbol{g})$ reaches the medium or high category. Furthermore, for the analysis of student response questionnaires using the Guttman Scale. Students must complete a questionnaire with "Yes" or "No" answers. The percentage value of the response questionnaire is obtained from Formula 4.

$$P = \frac{F}{n} x\ 100\% \quad (4)$$

Description:
P = Percentage of all answers from the response questionnaire
F = Number of positive replies from respondents
n = Number of all respondents

Assessment of virtual reality learning media based on validation results, understanding test scores, and student response questionnaires is declared valid and effective if the percentage is ≥ 61% or in the excellent/effective category.

RESULTS AND DISCUSSION

Results

This section discusses the results of each stage of developing virtual reality-based learning media on Archimedes' Law material carried out with the "ADDIE" model.

Analysis

First is an analysis of the Curriculum. The educational curriculum used as a reference in this research is the Revised 2013 Curriculum (K-13 Revision). The 2013 curriculum implements a learning center for students; it is hoped that it will encourage students to have the ability to observe, ask questions, communicate, and reason actively, creatively, and innovatively. The expected student competencies in the 2013 Curriculum include attitude, skill, and knowledge competencies (Nurhasanah et al., 2021). So, in learning physics with the 2013 curriculum, students must be more active and creative in discovering natural phenomena around them and solving problems in these phenomena. Observations of natural wonders in the learning process of the 2013 curriculum are often faced with limited student experience and the surrounding environment. In abstract material, it is difficult for students to find examples of natural phenomena around them, so the learning process must be distinct from elements of learning media to achieve the desired competencies.

Second is an analysis of Learning materials; the material to make virtual reality learning media is static fluid, especially in the Archimedes Law sub-material. At this stage of material analysis, the researcher conducted a study of the Basic Competency (KD) of physics in static fluid material contained in the "Regulation of the Minister of Education and Culture Number 37 of 2018", with the following essential competencies: "3.3 *Menerapkan hukum-hukum fluid statik dalam kehidupan sehari-hari*". Based on KD 3.3, students are expected to be able to identify the application of Archimedes' Law in everyday life, develop ideas and solve problems related to Archimedes' Law in everyday life, identify the variables that affect the amount of buoyant force, and be able to analyze the phenomena of floating, drifting and sinking.

However, in practice, many students still need to gain a higher understanding and mastery of the concept of Archimedes' Law, causing the achievement indicators of KD 3.3 to be partially achieved by students. As in the research of Lestari et al., (2017), study results explain that students cannot apply Archimedes' Law in determining the volume of objects that have fallen and cannot identify the state of things that float, float, or sink when immersed in a fluid. To optimize the achievement of essential competencies, it is necessary to use suitable learning media. Not only through practicum tools but innovative learning media at the learning orientation stage can help students understand the concept of Archimedes' Law and its application in everyday life in their limited surroundings.

Third is an analysis of Learning Media. Learning media analysis was carried out by analyzing previous research regarding the use of virtual reality media, which was researched by Dewi (2020). The development of Revolution 4.0 causes students to want innovative learning activities, can attract interest in learning, and lead to 3-dimensional (3D)-based media. The study results from this research show that virtual reality as a learning media has the advantage of providing visualization of abstract and difficult-to-explain material. In addition, 3D media based on virtual reality effectively increases student learning outcomes and interest.

However, the availability of virtual reality learning media still needs to be expanded to certain materials and fields of knowledge. Hence, it needs to be developed and tested at various levels of schools and other areas of expertise. Based on the facts and demands on fundamental competency analysis, material analysis, and media analysis, this has encouraged researchers to develop virtual reality learning media on Archimedes' Law material.

Design

In this section, the planning and design of virtual reality learning media is carried out. At the media planning stage, the researcher determines the software and concepts used. Next, the researcher compiles a virtual reality script in which material from Archimedes' Law will be presented and an overview of what student activities they must achieve in the virtual reality world. For designing virtual reality learning media, researchers choose the following platforms or software. Frame VR platform, accessed on the link https://learn.framevr.io/, is used to design 360 views and layout of 3D objects. The first step is to develop a virtual environment (scene) that will be used as the location and flow of material delivery to students. The second step is to create and compile material for Archimedes' Law. In developing VIRMA media, the authors use the Frame VR platform because there is no need to download or install separate programs for VR creators and users so that students can participate directly in the browser via laptops, mobile phones, and VR headsets. In Frame VR, students are players, and there are 3D avatars for each user, so it is an immersive environment, a social presence, and interaction with other users.

In addition, Frame VR is used as a learning medium because it enables teachers and students in the same virtual environment and during the learning process to upload various content during the learning process, such as photos and videos, PDFs, whiteboards, shared screens, files, 3D models, etc. For a continuous learning experience, Frame VR can be used as an effective and sustainable learning medium because it is adaptive; students can also access and interact with Frame VR before and after class (Lee & Hwang, 2022).

In research conducted in Korea, the results also show that e-learning with virtual reality using the Frame VR platform, students feel class in a virtual environment such as face-to-face classes, students in a virtual environment can organize authentic knowledge and build an interactive learning community with other players (Hwang et al., 2023) . In addition, avatars or players in Frame VR help students be more active and foster a sense of connection that is very different when using Zoom or other media conferences (Jeong et al., 2022). Besides that, the researcher uses Filmora software to create, edit, and combine videos regarding Archimedes' Law material, which is then presented on Frame VR. Researchers also used Sketchfab. Sketchfab is a platform for visualizing and sharing content for 3D creators. This platform is used to create and find 3D objects needed to support the visuals and virtual reality concepts that have been designed.

In addition to designing virtual reality learning media, researchers also developed a guidebook for using VIRMA learning media, which contains features on Frame VR, virtual reality scene images, and activities that players in VIRMA learning media must carry out. This guide will help users, especially beginners who have never used the VR medium before, to make things easier.

Development

The development section is the stage of making VIRMA learning media per the media design using the platform and software selected to create the required scene and material. The results of creating virtual reality learning media on Archimedes' Law material is also used as a learning video that can be accessed on YouTube with the link address

https://youtu.be/xE3HxApZ6GY. The visualization of virtual reality on Material: Archimedes' Law (VIRMA) is in Figure 2.

Figure 2. Visualization of VIRMA Learning Media

Furthermore, the VIRMA learning media made is submitted to the validator to validate the feasibility of the press based on audiovisual aspects, aspects of media operation, and aspects of material content—recapitulation of VIRMA learning media assessment in Table 2.

Table 2. Score Validation of VIRMA Learning Media

No.	Assessment Aspects	Score from Validator			Percentage and Criteria
		Physics lecturer	Physics media lecturer	Physics Teacher	
1	Display aspects and media concepts	26	27	25	86,7% (Very Valid)
2	Audio aspects	5	5	3	86,7% (Very Valid)
3	Media processing aspects	12	13	12	82.2% (Very Valid)
4	The suitability of physics learning materials	24	23	19	88% (Very Valid)
	Average				**85.9% (Very Valid)**

The results of Table 2, the recapitulation of the validator's assessment show that the percentage of validity of the VIRMA learning media is 85.9%. Hence, it is very valid and suitable as a learning medium to support the physics learning process on Archimedes' Law material. Furthermore, the researcher also made a student response questionnaire and a knowledge or understanding test instrument consisting of pre-tests and post-tests for evaluation sheets. Furthermore, validation of knowledge tests related to content and construction feasibility aspects. Based on the assessment of three validators, the percentage of validity of the evaluation sheet in the form of knowledge test questions is 85.2%. The validation results for student response questionnaires obtained a fact of 88.9%. The overall validation percentage results show that both instruments are valid and suitable for use.

Implementation

The application of VIRMA learning media uses one group pre-test and post-test design. The procedure is that students will be given a pre-test as an initial test before being treated using VIRMA learning media to know the initial abilities of students and then treated with virtual reality media. Furthermore, students are given a post-test to determine their final ability after being treated with VIRMA media. Knowledge assessment using the pre-test and post-test covers the cognitive domains C1 to C6 with ten questions in multiple choices. The results of implementing VIRMA learning media can be seen based on the pre-test and post-test values in Table 3.

Table 3. The Results of Pre-test and Post-test Scores

Respondent	Pre-test	Post-test	Description	Respondent	Pre-test	Post-test	Description
1	30	90	Pass	18	30	90	Pass
2	20	70	Pass	19	40	70	Pass
3	30	70	Pass	20	20	70	Pass
4	40	90	Pass	21	40	90	Pass
5	20	40	Failed	22	40	90	Pass
6	40	90	Pass	23	10	60	Failed
7	10	70	Pass	24	30	80	Pass
8	20	90	Pass	25	40	70	Pass
9	30	70	Pass	26	50	100	Pass
10	20	70	Pass	27	40	90	Pass
11	40	70	Pass	28	30	70	Pass
12	30	80	Pass	29	20	80	Pass
13	10	80	Pass	30	20	80	Pass
14	10	70	Pass	31	30	60	Failed
15	50	80	Pass	32	40	80	Pass
16	40	100	Pass	33	40	70	Pass
17	10	30	Failed	34	30	70	Pass
Average of pre-test score					**29.4**		
Average of post-test score					**75.9**		

Based on Table 3, it is known that none of the students' pre-test scores met the minimum score of completeness. It is also known that the post-test scores of each student have increased after being given the learning treatment with VIRMA learning media. Apart from that, it can be seen that as many as 30 students have passed the minimum score in physics subjects ≥ 70, and the average pre-test of students gets a score of 29.4 while the average post-test has increased with a score of 75.9.

Evaluation

Evaluation is used to assess the effectiveness of using virtual reality learning media in the material Archimedes' Law based on the results of the student reaction questionnaire. Recapitulation of Questionnaire Results Responses for using VIRMA media are mentioned in Table 4. Based on

Table 4, the student response questionnaire results obtained an average percentage of 97.3%, which means perfect criteria.

Table 4. The Results of the Student Reaction Questionnaire

No.	Statement	Percentage (%)	
		Yes	No
1.	This virtual reality learning media is easy to operate and functions well	97	3
2.	Object illustrations and videos in virtual reality learning media can help to understand Archimedes' Law material	100	-
3.	The material presented on virtual reality learning media is easy to understand	100	-
4.	Learning media with virtual reality is attractive in terms of appearance and concept of presenting the material	100	-
5.	Archimedes' Law material in virtual reality learning media is compatible with the teacher's explanation	100	-
6.	The illustrations through this virtual reality learning media can increase my motivation to study physics	97	3
7.	The virtual reality learning medium has helped my learning process become more interactive and fun	97	3
8.	This virtual reality learning media aroused my curiosity.	97	3
9.	Using virtual reality-based learning media has kept up with current technological developments	100	-
10.	This virtual reality learning media is flexible and can be used in various software	85	15
	Average	**97,3**	**2,7**

Discussion

Research on the development of virtual reality learning media on the material: Archimedes' Law (VIRMA) is to create valid and effective learning media to improve learning outcomes and students' learning motivation in physics learning activities.

Appropriate based on the validity of VIRMA learning media

The average score of VIRMA learning media includes four aspects: display aspect and media concepts, audio aspects, media processing aspects, and the suitable f Physics material. The result of each category can be drawn in Figure 3.

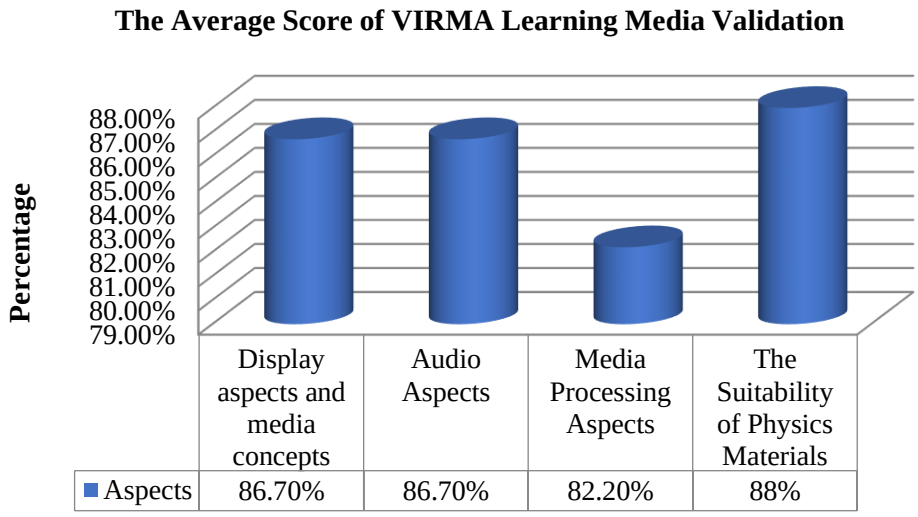

Figure 3. The Average Score of VIRMA Learning Media Validation

Based on Figure 3 recapitulation of the validation of virtual reality learning media on Archimedes' Law, it was found that the learning media created had an average percentage of 85.9% in the very valid category. Of the aspects assessed in the validation of the VIRMA learning media, the first is the visual aspect, which gets a percentage of 86.7%, which means the layout of the material, the selection of colors or fonts, and the concept of VIRMA media presentation has been declared very valid and have the opportunity to be developed according to technological advances. Except for audio aspects such as intonation and audio clarity, learning is also excellent, with a percentage of 86.7%.

Second, based on media work such as software selection for developing VIRMA learning media, the media's flexibility, and ease of operation, the average percentage of media validity is 82.2%. So that VIRMA learning media can be declared feasible from the aspect of media work. Third, based on the material aspects of Archimedes' Law and the effectiveness of the media to make physics learning interactive and support independent learning, an average percentage of 88 is obtained. This shows that the VIRMA learning media is by the concept of Archimedes' Law and is in a very valid and feasible category to use.

The effectiveness of VIRMA media based on improving student learning outcomes

The effectiveness of the media is based on the increase in student learning outcomes seen from the pre-test and post-test evaluations. The determining indicator for the success of VIRMA learning media is that students' post-test scores can pass a minimum score of ≥ 70, which can be drawn in Figure 4.

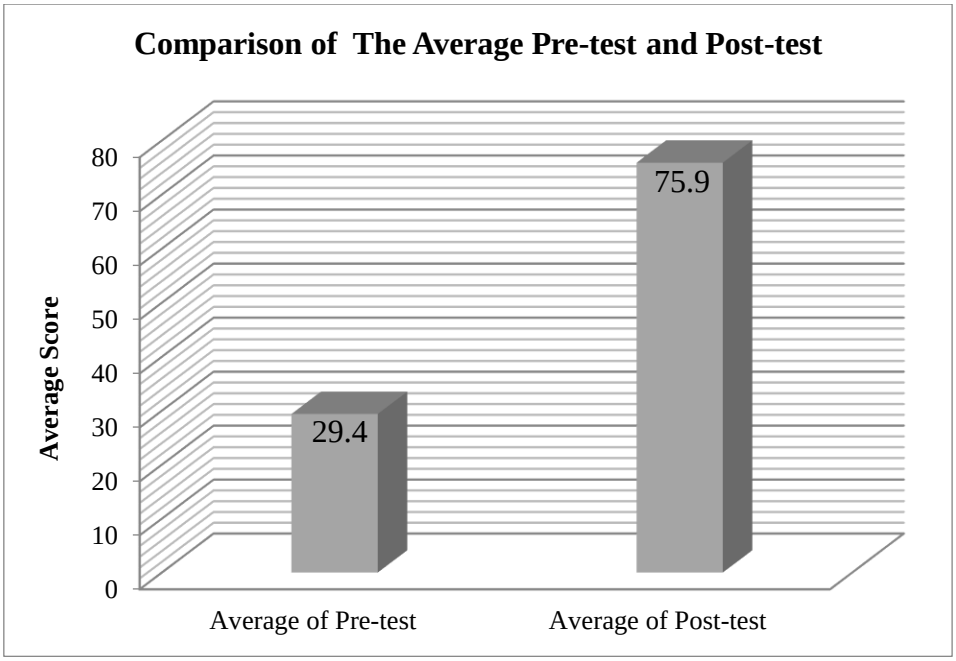

Figure 4. Comparison of The Average Pre-test and Post-test

Based on Figure 4, the post-test scores showed an increase of 60.96% from the students' pre-test scores. It is known that the post-test scores of each student have increased after being treated with VIRMA learning. The following Figure 5 is a graph of the number of students passing the minimum score.

Based on Figure 5, the percentage of students who pass the minimum score is calculated using Formula 5.

$$\%\ Pass\ rate = \frac{The\ number\ of\ students\ who\ passed\ the\ test}{The\ total\ number\ of\ students}\ x\ 100\% \qquad (5)$$

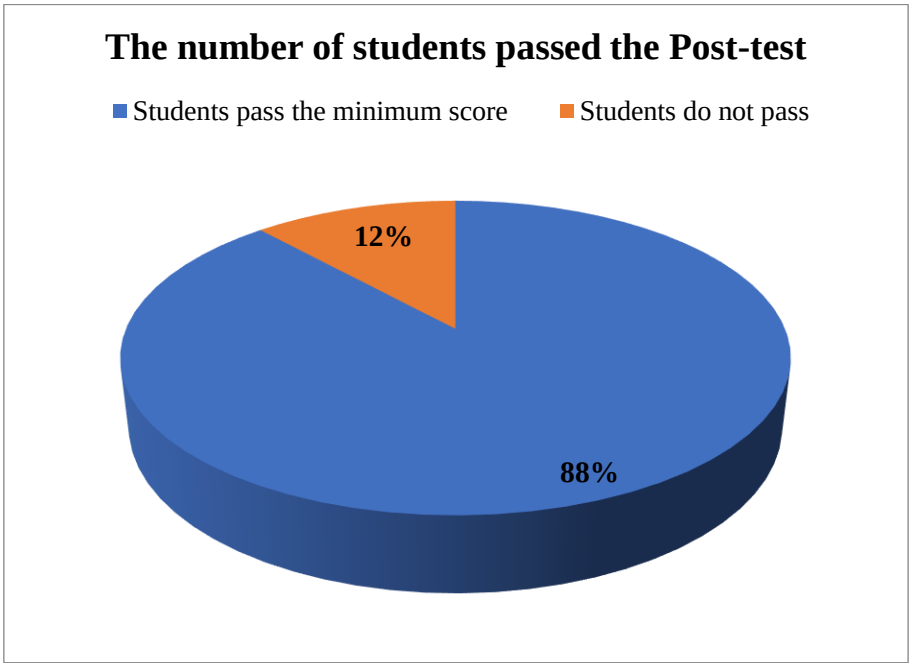

Figure 5. The number of Students Passing the Post-test

The percentage of students who pass the minimum score is 88%. This is also explained in the results of research conducted by Dewi (2020), which shows that after being treated with 3D media, the development of students who pass the minimum score did not get a percentage of 100%. This result indicates that learning activities do not occur optimally if the media entirely replaces the teacher's role. However, this percentage still meets the effective virtual reality learning media criteria.

Furthermore, the N-gain equation will calculate the increase in eating learning outcomes. The results of the N-gain recapitulation are mentioned in Table 5.

Table 5. Student n-gain Scores

Criteria	Number of Students	Average n-gain score (g)
High	15	
Medium	17	0.67 (Medium)
Low	2	

The increase in learning outcomes based on Table 5 is a normalized n-gain of 0.67 in the moderate category. Based on the results of students who pass the minimum score and n-gain calculations in Table 5, VIRMA learning media's development positively impacts improving and completing student learning outcomes. This shows that VIRMA learning media can help the process of learning Physics activities well.

The results of the research on the effect of virtual reality Media are also supported by the analysis of Abdillah et al., (2018), which shows that the test data show significant differences in improving students' analytical abilities in the aspects of distinguishing, attributing, and organizing and in the use of virtual reality media in experimental classes in natural sciences subjects.

The effectiveness of VIRMA learning media based on student response

After the learning treatment with VIRMA media, students will be given a response questionnaire to assess the effectiveness of the developed VIRMA learning media. In this student response questionnaire are ten statements, as in Table 4 the reaction to VIRMA learning media can be drawn in Figure 6.

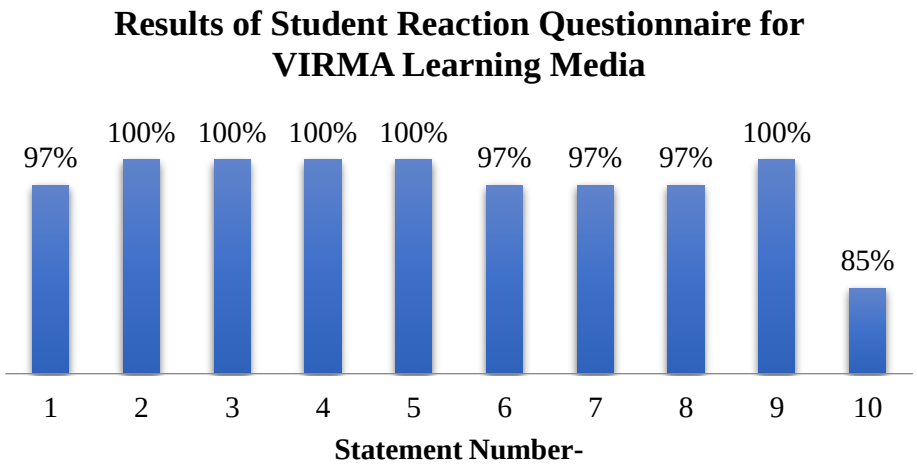

Figure 6. Results of Student Reaction to VIRMA Learning Media

Based on Figure 6, the first statement regarding the media's function and ease of operation gets a percentage of 97%. Not all students agree that VIRMA media is easy to operate because students who have never used virtual reality are surprised and confused by the functions of the features in Frame VR. In addition, research also shows that in VR, students feel dizzy over time because when moving between scenes and material, there is a sudden change in appearance before their eyes (Devianti & Anggaryani, 2022; Pirker et al., 2017). In the second to fifth statements, the percentage is 100%, which means all students agree that the illustrations of objects in the VIRMA learning media are attractive and concept. The material presented is easy to understand and identical to the teacher's explanation. The sixth to eighth statements about illustrations on media that can increase learning motivation, make learning more interactive and increase curiosity get a percentage of 97%.

In the ninth statement, all students agree that virtual reality learning media follows current technological developments. However, the tenth statement about VIRMA learning media, which is flexible to be used in various devices, only gets a percentage of 85%. This is because some student devices are incompatible, and the network speed could be better. So, they could have gained a better experience when operating VIRMA media. Although most students agree that virtual reality media is flexible and helps improve their learning, some think it is a complicated technology. According to them, this is due to several aspects: requiring a fast internet connection, less understanding of new technology, and equipment or gadget performance that does not support VR (Olivas Castellanos et al., 2022). The recapitulation of student responses obtained an average percentage of response questionnaires of 97.3%. The ratio shows perfect criteria. Based on this, learning media assessment is declared effective if it gets a value of ≥ 61%, so applying VIRMA media is practical for physics learning activities.

Student response questionnaires show that media concepts and attractive 3D object illustrations on VIRMA media receive positive reactions from students and can increase the percentage of students who pass the minimum score. The VIRMA learning media displays the application of Archimedes' law in life and the working principles of Archimedes' Law in technology. The artificial environment designed in virtual reality aims to facilitate learning that cannot be done by direct observation around the limited student environment. This is because the virtual reality environment can bring a learning environment that is considered impossible for direct observation by students into an artificial environment that can be accessed safely and from anywhere. With a learning virtual reality environment that requires facilities that are too expensive to be accessible or experiments that are dangerous for students, it becomes possible to provide students with artificial scenes that adapt to the natural environment (Allcoat & von Mühlenen, 2018).

Several studies show that the rapid development of technology makes it difficult for education to keep abreast of the latest advances. Even though the world of education has difficulty keeping up with technological developments, researchers and practitioners have contributed to increasing knowledge and experience (Campos et al., 2022; Lege & Bonner, 2020). This research can be a practical contribution to the world of education to continue to develop and adapt to using technology as part of innovative learning media.

CONCLUSION

Based on the description of the problem formulation, research objectives, and research data, it can be concluded that the development of virtual reality media in the material Archimedes' Law (VIRMA) is very valid with a percentage value of 85.9%. Then, VIRMA learning media effectively improves student learning outcomes with n-gain in the medium category of 0.67. At the same time, the percentage of class learning completeness shows that 88% of students passed the minimum score. It means the development of VIRMA learning media can positively impact the improvement and completeness of student learning outcomes. VIRMA learning media is also effective according to the results of student responses obtained an average percentage of questionnaire results of 97.3% with an outstanding category.

An internet network speed of 15-25 Mbps is recommended when running VIRMA learning media for a better user experience. Overall, using VR on material Archimedes' Law can enhance student engagement, provide hands-on learning experiences, and facilitate a deeper understanding of abstract concepts. It offers a unique and immersive approach to teaching and learning physics. Then, it must be developed on other physics materials requiring visualization and concrete implementation to make learning more interactive, exciting, and fun.

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Virtual reality video project design to improve vocational teachers' skills in implementing Kurikulum Merdeka

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ABSTRACT

This project aims to improve the skills of vocational teachers in implementing the Merdeka Curriculum, with the design of the Merdeka Curriculum virtual reality video project to encourage the use of a learner-centered approach and prioritize skills-based learning relevant to the world of work. VR video content is designed to improve vocational teachers' understanding and skills in implementing the Merdeka Kurikulum. The purpose of this research is to facilitate teachers to have pedagogical skills in preparing teaching materials to evaluate learning. The method in this research is Action research with the VR video content development process involving determining clear learning objectives, designing a VR curriculum, preparing VR materials and content, and making VR videos using relevant technology and software. Furthermore, VR video content is implemented in vocational teacher learning by providing access to VR devices and clear usage guidelines. Evaluation is conducted to measure the effectiveness of VR videos in achieving learning objectives and obtain feedback from vocational teachers. The results of this project show that using VR videos in vocational teachers' learning can improve their engagement, understanding, and skills in the context of the Merdeka Curriculum. Vocational teachers experience a more interactive and immersive learning experience through a realistic virtual environment. Students also benefit from using VR videos, with an increased understanding of vocational concepts and their readiness for the world of work. The project also faced some challenges, such as the accessibility of VR devices and technical constraints. In discussing the project results, it is recommended to collaborate with related parties and share experiences with the education community so that the use of VR videos in vocational learning can expand and continue to grow.

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INTRODUCTION

Vocational teachers must continuously develop themselves through training and courses relevant to their vocational field. Participating in training organized by educational institutions or related institutions will help vocational teachers keep up with the latest industry developments.

Vocational teachers can improve their competence by collaborating with fellow teachers or professionals. Through exchanging knowledge and experience, vocational teachers can broaden their understanding of the vocational field of learning.

The data obtained about the learning process in cultural arts at Vocational High Schools, there are still several problems, including: 1) The learning methods used by teachers are too oriented towards theoretical aspects and learning materials do not balance the achievement of students' cognitive, affective, and psychomotor competencies; 2) Not yet able to utilize school potential and integrate it into each basic art competency; 3) Students are not trained in the creativity of creating works of art 4) Students are more dependent on traditional art learning tools; 5) Learning resources are still limited (Yuara et al., 2019).

In terms of utilizing technology during the pandemic, many art activists made innovations so that they could still work amid the pandemic. Music performances must now be done virtually (Afifah et al., 2022). This learning project model is suitable for developing a deeper understanding of a particular topic or concept, improving critical and analytical skills, expanding cooperation and communication skills, and encouraging applying students' knowledge and skills learned in a real-world context. The model in project-based learning helps students in learning, namely knowledge and skills that are dense and meaningful (meaningful-use) built through authentic tasks and work, expanding knowledge through the authenticity of curricular activities that are accommodated by the learning process planned (designing) or open inquiry, with results or answers that are not predetermined by a particular perspective, and building knowledge through real-world learning experiences and negotiation of interpersonal cognition that takes place in a collaborative work atmosphere (Santi, 2011).

Regarding technology, learning projects can also utilize digital tools and resources to facilitate and extend learning—using apps or software to create presentations and virtual reality videos. Virtual reality refers to using intelligent reproduction for the benefit and opportunity of participating in visible conditions, such as natural objects and events, and the experience gained in the virtual world (Ghali et al., 2012). It is emphasized that learning is a communication process, in other words. Learning activities occur when there is communication between the recipient of the message (P) and the source (S) through the media (M). However, the communication process only occurs after a backlash (feedback). Based on the description above, it can be briefly stated that learning media is a vehicle for distributing learning messages or information (Syamsuri, 2020).

Exploration of technological fields is widely done to support the teaching of subjects (Chauhan, 2017). The innovation is the development of digital appreciation learning media with virtual reality videos (Efendi et al., 2021). Virtual reality is a technology that allows users to be in a virtual world and interact in it; it is a technology-based thing combining entry and exit devices, specifically so that users can interact in virtual reality. Students outside of class hours can use virtual reality-based multimedia learning media. Learning media can be used repeatedly and does not damage its objectivity.

The Virtual Reality (VR) video learning project for vocational teachers in implementing the Merdeka Curriculum is an exciting idea. This project can provide an interactive and immersive learning experience for vocational teachers to be better prepared for the challenges and requirements of the Merdeka Curriculum. Professional teachers must possess the competencies to carry out their duties and functions: teaching, educating, guiding, training, directing, assessing, and evaluating their students. Teachers must also master skills in adaptability to new technologies and global challenges (Yuara et al., 2019). Professionalism in question is a process that moves from ignorance to knowledge, from immaturity to maturity. Meanwhile, Glickman in Bafadal emphasizes that someone will work professionally if that person has the ability of professionalism if he has high ability and motivation to work (Fitriani et al., 2017).

Merdeka Curriculum is a term that is not very specific and may vary in context. However, when referring to the concept of education that provides more experience for students to direct their learning, some steps can be taken to implement the concept: Education adopts an independent campus curriculum. This curriculum emphasizes freedom and improving human resources and the quality of education. Education can start from primary education to higher education, so every level

is needed in the education that has been planned. Implementing quality education requires the availability of accuracy in processing the curriculum, as stated by Richard and McNeil, a very strategic role that determines the success of education. In line with that, curriculum development is necessary (Suwandi & Maret, 2020).

The purpose of this research is to facilitate teachers to have pedagogical skills in preparing teaching materials to evaluate learning. To prepare students in pedagogical terms. Pedagogical statements can direct students' experiences from something impartial and turn into something present (Sukmayadi, 2014).

Talking about effectiveness in learning needs to be managed and matched by a curriculum, as well as the role of the teacher. Achievement of competency is not only knowledge or skills, but also teachers are led to complex things. In other words, competence can be interpreted as an effort done correctly by someone who has mastered it. According to Law No. 14 of 2005, which regulates teachers and lecturers, competence between teachers and lecturers is identified as knowledge, skills, and attitudes that must be put forward in carrying out professional duties later (Andina, 2018).

Vocational teachers, in responding to the readiness of this industrial era, also cause other factors; teachers must equip students' abilities to face the 21st century (Yuara et al., 2019). This research is entitled A Learning Multimedia Project. To keep up with the development of digital technology that is very fast, it cannot be denied that traditional arts, especially dance, need to be juxtaposed with the latest digital technology. This problem has a connection between social (5.0) (Smart information) and industry (4.0) (Technology). In the current era, Generation Y has elementary school-age children; the generation years born are 1980 to 2000 (Hardianto & Wati, 2023). To increase the attractiveness of learning traditional dances, it is necessary to develop the latest media in learning.

Agreeing with the course of education in Indonesia, the concept of independent learning can be accepted in classroom learning, given the vision and mission of Indonesian education, for the creation of quality human beings who can compete in various fields of life (Sibagariang et al., 2021).

In digital learning media, technology is utilized in classroom learning. Teacher media plays a role in assisting students in understanding learning materials that, in realization, cannot be brought into the classroom, for example, far in the range of time and place (Fatimah & Bramastia, 2021).

In this study, the researcher focuses on developing vocational teacher skills for implementing the Merdeka Curriculum, which can include using new technologies such as Virtual Reality (VR) to provide a more interactive and immersive learning experience. Here is a step-by-step guide to developing a Virtual Reality video project in the implementation of the Merdeka Curriculum: Identify learning objectives: Determine the learning objectives you want to achieve through this VR project. For example, do you want students to understand certain concepts, develop specific skills, or explore new environments? With this country's advancement of technology and socio-cultural development, citizens can easily watch videos (Fadhli, 2016).

A selection of topics or subjects that are relevant to the curriculum and match the students' interests. For example, if you teach history, you can create a VR experience about a specific historical event. If you teach natural science, you can create a VR experience about an ecosystem or planet. Design a scenario: Create a scenario or story that will be implemented in the VR project. Plan the storyline, interactions, and challenges to be faced by the students in the virtual environment. Design the virtual environment: Use appropriate VR software to design the virtual environment. You can use VR development tools such as Unity or Unreal Engine. Design an environment that matches the topic or subject you have defined. Add interactions and challenges: Add interactive elements in the virtual environment to actively engage students. For example, students can solve puzzles, answer questions, or interact with objects in the virtual environment. Test and refine: Pilot the VR project with students to get feedback and make improvements. Evaluate how the VR project supports the learning objectives and identify areas that need improvement or enhancement.

Virtual reality is meant to be a powerful technology to simplify a real-world problem today. Virtual reality is a rapidly advancing technology with enormous potential to facilitate teaching and

learning for general educational purposes (Sun, Lin, & Wang, 2010). Implement it in the learning process, provide opportunities for students to live the VR experience, and discuss their learning outcomes. Evaluation and reflection: After implementation, evaluate the impact of the VR project on student learning. Check whether the learning objectives have been achieved and whether aspects need improvement or enhancement. In implementing the Merdeka Curriculum, it is essential to provide flexibility to students to choose VR projects that suit their interests and needs. Adequate support to ensure students can optimize the learning experience with the project.

This activity is essential in designing learning involving research elements such as experimentation, presentation, collaboration, and reflection. Learning projects aim to enable students to learn actively and engage in the learning process. Similarly, according to Wrigley (1998), Curtis (2005), and National Training Laboratory (2006), the discovery of a project-based learning model is quite helpful in making learning more effective so that it can adequately accommodate potential learning (Sastrika et al., 2013). Akbar (2013) says the learning process will run effectively if a teacher can utilize sources and media (Akbar & Holid, 2013).

In terms of realizing this project implementation, the Student Team Achievement Divisions learning model is a cooperative learning strategy that can be done by making the class into large groups with different backgrounds of student abilities. According to Rusman (2013), the STAD model was raised by Robert Slavin Johns at Hopkins University. According to Slavin (2013), STAD is a sufficient model for study groups. Explanation of cooperative learning with the STAD model: Students in groups have varying abilities (Hazmiwati, 2018). This model has five essential elements that are emphasized, namely:

1. Collaborate for a good thing, students interact and exchange abilities that aim to collaborate on their weaknesses and shortcomings in processing multimedia,
2. Face-to-face is an interactive thing through dance multimedia that is done,
3. Demanded independent responsibility in student learning for what has been discussed with their group friends,
4. Students are required to be skilled in actively socializing with fellow students to find solutions together,
5. The process is carried out in groups to achieve cooperation (Silaban & Sukmayadi, 2022).

In this context, the expected contribution of this research is to provide empirical evidence of the effectiveness of the STAD model in enhancing collaboration, social skills, and multimedia learning of students, as well as to offer practical guidance for educators in integrating this model into the implementation of the Merdeka Curriculum.

METHOD

Research methods can be used in the Virtual Reality (VR) Video learning project for vocational teachers to implement the Merdeka Curriculum. The research involves the researcher with the object of research, using an action research approach. Classroom action research is a research approach focused on improving and developing learning and teaching processes in the classroom. This research is conducted by teachers in their classroom environment to understand and improve learning practices and achieve better student results (Adelman, 1993). Action research by Lewin aims to find solutions to societal interaction developments (Aqib, 2008). This action research is not concerned with what the group will develop fundamentally, nor with the development starting from within (Suparno, 2008). All stages of the process require various scientific expertise and skills, which combine in a unified work team to produce a good design that can be operated flawlessly (Said, 2016).

This approach describes the objective conditions of vocational teachers' abilities in designing learning media developing teacher skills in designing virtual reality video projects with the results of improving teacher skills. Researchers are directly involved in the learning process and make sustainable changes based on the results of evaluation and reflection. Research Subjects: The research subjects are vocational teachers involved in implementing the Merdeka Curriculum. The selection of subjects was carried out by purposive sampling by considering the needs of the project

and the expertise of related vocational teachers. VR Video Content Development: VR video content development is carried out through the following stages:

1. Identify learning objectives that are specific and relevant to the Merdeka Curriculum,
2. Design of the VR curriculum, including the selection of concepts to be presented in a virtual environment,
3. Preparation of VR materials and content, including the collection of images, videos, or objects required for the creation of VR videos,
4. VR video creation using relevant software and technology.

VR video content is implemented in vocational teachers' learning using available VR devices. A clear user guide is provided to assist vocational teachers in using VR videos effectively. Observation is conducted to monitor vocational teachers' interaction with VR videos in responding to the use of this technology. Interviews were conducted to gain a deeper understanding of vocational teachers' experiences in using VR videos. The data collected was analyzed using a qualitative approach. Qualitative analysis was conducted by identifying patterns of findings in interviews and workshop observations. The research results are analyzed and discussed to identify the success of using VR videos in vocational teachers' learning in implementing the Merdeka Curriculum. Challenges faced and suggestions for further development are also discussed. This research method provides a holistic approach to describe the use of VR videos in vocational teacher learning. By actively involving vocational teachers in the research process, deep insights into the experience and impact of using VR videos in implementing the Merdeka Curriculum can be obtained.

RESULTS AND DISCUSSION

Results

Virtual Reality Video Project Design to Improve Vocational Teachers' Skills

In this Virtual Reality Workshop, the class action method is carried out by researchers to workshop participants or vocational teachers. Researchers provide stages in introducing Video Virtuality in art learning to improve Vocational Teacher skills. Vocational Teachers must determine the objectives in the learning offered by the researcher (VR Project), the teacher must determine which art concept (Dance) will be used as an example in the virtual reality video playback, and the Vocational Teacher must determine the choice of content to be created. The Vocational Teacher creates content until the editing stage and is presented and then shown to other workshop participants. This project emphasizes improving the skills of Vocational Teachers and collaboration from various disciplines such as Art, ICT, and Multimedia. The following in figure 1 and figure 2 are the content prepared by researchers in the Art learning workshop for vocational teachers.

Figure 1. VR Trial to Students

Figure 2. Youtube Endra toyan Pendet Dance 3600

However, in this virtual reality, researchers provide an overview of SWOT analysis. According to (Ratnawati, 2020), SWOT is a systematic identification of factors to formulate strategies; this analysis is based on logic in emphasizing multimedia's strengths and opportunities while minimizing weaknesses and threats (Ratnawati, 2020). SWOT analysis is carried out with the stages of data collection (internal and external conditions), data analysis, and decision-making (Taruna, 2017).

Strengths Regarding virtual reality, the strengths seen in the media are about current technology. Weaknesses In areas where technology is spread, especially in remote areas, there is still an uneven understanding of current media, user use must be regulated, and eye health needs to be regulated. Opportunities However, the most significant opportunity is that this media will become the current media so that Indonesian dance art will enter this virtual reality and can be known or known by people in the modernization area. Threats This media will continue growing, so human resources must be quickly matched.

1 Students must follow the learning process starting from learning traditional dance, ICT, Indonesian Language, and other subjects.
2 Students create study groups in class by determining the topic that will be made into a virtual reality project.
3 Students discuss the topic that will be made into a virtual reality project.
4 Students create virtual reality projects
5 Students are able to present the project using correct Indonesian language.

Figure 3. Schematic of the Learning Stages

The Virtual Reality Video Project is a collaboration between learning Cultural Arts (Dance), ICT, and Indonesian Language. Figure 3 is a schematic for completing projects in the class. It has to do with improving students' skills. James Kulik's research (Heinich, Molenda, Russell, & Smaldino, 1996, p. 217) stated that technology in learning, student achievement increased by 10-18%, the comparison is in conventional learning (Dosi & Budiningsih, 2019). There is a need to provide tools that can positively impact and be used as a communication medium in learning activities (Sihkabuden, 2011), as shown in Figure 4.

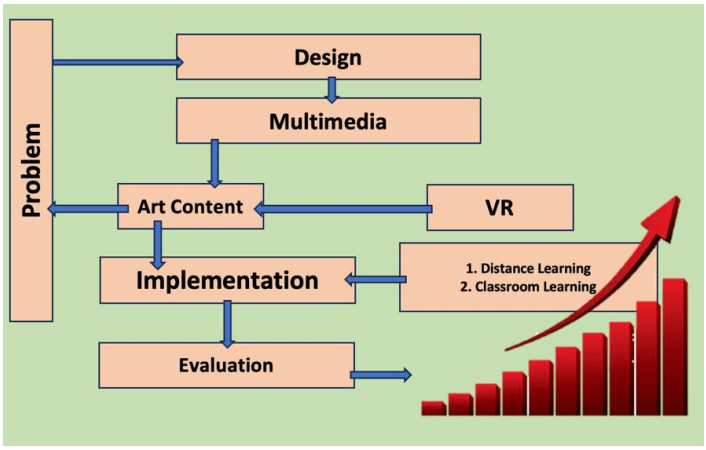

Figure 4. VR Project Schematic

C explains design as a design research procedure more broadly and in detail. Jones, in the book 'Design Method,' describes procedures for designing, which are shown in Figure 5:

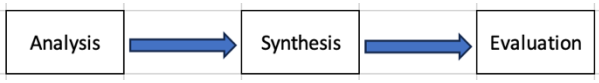

Figure 5. Design Research Procedure

In the analysis process, the designer's task is to identify and analyze all problems related to engineering, commercial, production, distribution, and ergonomic functions. In the synthesis process, the designer searches for and develops a model; it is then evaluated based on the desired objectives (Zainuddin, 1995).

Discussion

Implementation of the Merdeka Curriculum

The steps that can be considered in carrying out this project:

1. Identify learning objectives: Determine the objectives to be achieved through using VR videos in learning. Do you want to improve teachers' understanding of Merdeka Curriculum principles? Or do you want to provide a real-life simulation experience in a specific vocational environment? Define your objectives clearly so that the project can be well-directed.
2. Design the VR curriculum: Create a VR curriculum framework that includes the topics and competencies you want to deliver to vocational teachers. Determine the learning scenarios and activities that will be conducted in the virtual environment. For example, simulation of vocational practices, exploration of the work environment, or interaction with equipment and tools used in their work.
3. Prepare VR materials and content: Create VR content that matches your designed curriculum. Use VR authoring software or tools to create realistic and interactive 3D environments. If possible, also involve students in the VR content creation process to increase their engagement in learning.
4. VR video creation: Use a 360-degree camera or other VR recording tools to record videos used in this project. Ensure good video and audio quality to provide a satisfying experience for VR users. If you cannot access VR recording equipment, you can also use software to create VR videos from standard images and footage.
5. Implementation and evaluation: Provide access to VR devices, such as VR headsets, for vocational teachers to experience learning through VR videos. Make sure they have clear usage guidelines. After implementing the VR video, evaluate its effectiveness in achieving the

set learning objectives. Get feedback from vocational teachers and use the information to improve and refine future projects.

6. Deployment and sharing: If the project proves successful, consider sharing your experience and lessons learned with the education community. You could present the project in a seminar or conference or publish an article on using VR in vocational learning.

Be sure to consider the resources and budget you have available for this project.

Figure 6. Classroom scheme

Figure 6 is a Virtual Reality (VR) Video learning project for vocational teachers in implementing the Merdeka Curriculum; it is essential to do this. Teachers' skills must be improved, teachers must keep pace with increasing technological developments, and teachers must utilize existing technology/media. Teachers must have knowledge of technology/media that develops in education and education to become modern and contemporary teachers.

Learning effectiveness: Evaluate the extent to which the use of VR videos in learning has achieved the set objectives. Review whether vocational teachers successfully understand the principles of the Merdeka Curriculum and can apply them regarding the facilities and infrastructure that need to be considered in considering the achievement of the implementation of an independent curriculum with the availability of infrastructure. Facilities and infrastructure also support the successful implementation of the independent curriculum in the driving school. Complete facilities and infrastructure support implementing the independent curriculum in the driving school, especially in the availability of IT equipment. The driving school receives financial assistance to complete the availability of infrastructure that supports the independent curriculum (Rahayu et al., 2022).

According to an interview with vocational teacher participant Yusuf Rizal (31/05), Bandung, they are learning during the driving school program. In the Art Learning Workshop Activities for Vocational Teachers, the experience of participating in the workshop gained new knowledge in curriculum development, especially art in technological media, can be united and developed because usually the field of art only introduced its separate sub-fields of art such as dance, music, separate forms. Art learning is not this ancient but can be collaborated with the latest technology. The introduction of this media has been known for a long time. Art learning and VR multimedia can be implemented into classroom learning because it is related to schools, including those that are not strategized in watching less performing arts; by using VR, students can gain experience or appreciate it directly by using VR. Art learning using VR multimedia is very appropriate in implementing the independent curriculum because it is required to make types of learning outside the classroom in the independent curriculum points. VR multimedia will be used in class learning, even though infrastructure is limited in the material or subject of cultural art appreciation.

Miarso (2004) says that the effectiveness of learning is one of the quality standards of education and is often measured by the achievement of goals, or it can also be interpreted as accuracy in managing a situation, "doing the right things" (Rohmawati, 2015).

Figure 7. Art Learning Workshop for Vocational Teachers, VR Trial to Vocational Teachers

Figure 7. uses VR technology, which provides a more exciting and interactive experience compared to traditional learning methods. Vocational teachers feel more motivated to learn and develop skills through VR videos.

Competency improvement: Evaluate whether using VR videos has helped improve vocational teachers' competencies in certain aspects relevant to the Merdeka Curriculum. Review whether they gain a deeper understanding of vocational materials, work skills, or problem-solving through the VR experience.

Benefits to students: Discuss the impact of using VR videos in vocational teacher learning on student progress. Whether VR technology improves student skills, a better understanding of concepts, or increased readiness for the world of work, evaluate whether VR videos can help students better prepare for the demands of the Merdeka Curriculum.

Challenges and suggestions: Identify the challenges faced during project implementation and how you overcame them. Review technical aspects, accessibility of VR devices, or other constraints that may have affected the project's success. Also, discuss suggestions and recommendations to improve the future use of VR videos in vocational learning.

Dissemination and collaboration: Discuss ways of disseminating the project results to the broader community of vocational and education teachers. Share your experience through publications, seminars, or conferences. Discuss potential collaborations with other parties, such as educational institutions, industry, or related communities, to further develop the use of VR videos in vocational learning.

CONCLUSION

Conclusion in Virtual Reality Video Project Design to Improve Vocational Teachers' Skills in Implementing the Independent Curriculum. Virtual Reality (VR) effectively improves vocational teachers' skills in implementing the Merdeka Curriculum. Using VR, teachers can practice interactively and realistically in simulating real situations in the field. The VR video project provides vocational teachers with an immersive and engaging learning experience. They can engage directly in teaching and get instant feedback, which helps improve their skills and confidence. VR videos also facilitate self-directed learning for vocational teachers. They can access training materials anytime and anywhere, thus increasing flexibility and convenience in the learning process. The design of VR video projects should be based on a comprehensive needs analysis of vocational teachers. Aligning the content and simulation scenarios with the real challenges teachers face in implementing the Merdeka Curriculum is critical to success. Developing VR video projects requires collaboration between technologists, instructional designers, and vocational education practitioners. The synergy of various expertise will result in an optimal learning experience. The VR video project should be evaluated periodically to measure its

impact and effectiveness on improving vocational teachers' skills. Feedback from teachers and students should also be taken to improve and refine the project continuously. Using VR in vocational education also opens opportunities to develop more engaging and interactive learning content for students. Teachers can create an innovative learning environment and support students' skill development by the demands of the curriculum. In conclusion, the use of Virtual Reality technology in video projects to improve vocational teachers' skills in implementing the Merdeka Curriculum is an innovative step that has the potential to have a positive impact on improving the quality of vocational education and preparing students to face the challenges of an increasingly complex world of work.

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