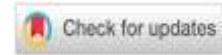




Comparison effectiveness of e-booklets and videos based on SESD on students' analytical thinking skills



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ABSTRACT

Analytical thinking skills are essential in science learning because they involve investigating a concept in everyday life, which is a product, fact, principle, and theory, and applying scientific methods as a problem-solving process. However, the analytical thinking skills possessed by junior high school students still need to improve. So, using media is one solution to improving analytical thinking skills. This research compares the effectiveness of SESD-based e-booklet media and SESD-based videos on analytical thinking skills. The method used includes quantitative comparative, which compares the effect of using e-booklets and SESD-based videos and tests the effectiveness of both media. The data analysis used was the Wilcoxon Test and effect size Cohen's *d*. The results of this study explain that video media and e-booklets influence analytical thinking skills. Still, SESD-based video media is superior to SESD-based e-booklet media in improving students' analytical thinking skills. The e-booklet and video media based on Science Education for Sustainable Development (SESD) is a learning media that integrates sustainable development education (ESD) into science learning, which contains the values of sustainable development for the future. So, the conclusion is that SESD-based video media is more effective than SESD-based e-booklet media.

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INTRODUCTION

Analytical thinking skills are one of the essential higher-level thinking skills students possess. Students with good analytical thinking skills can help them understand complex material and solve every problem in the learning process (Ilma, Hamdani, & Lailiyah, 2017; Suryanda, Azrai, & Wari, 2018). *Analytical thinking* is a thinking ability that emphasizes students' ability to solve problems



through the right solution. So that in the problem-solving process, students can describe, separate, and solve problems with the right solution (Yuwono, Sunarno, & Aminah, 2020; Zulfa & Rosyidah, 2020). Analytical thinking, in general, has three indicators, namely distinguishing, organizing, and connecting. (1) Distinguishing is the ability to group or classify into specific parts. (2) Organizing is a way to arrange and arrange certain parts to form order in a problem. (3) Connecting is linking one thing with another that still has a connection (Astriani, Susilo, Suwono, & Lukiati, 2018; Fitriani, Fadly, Fauziah, 2021). Analytical thinking is closely related to science learning.

Analytical thinking skills are needed in science learning because they involve investigating a concept in everyday life (Hasyim, 2018). *Science learning* is a scientific discipline emphasizing scientific methods directly related to analytical thinking skills. According to Risamasu (2016), science learning is a product of facts, principles, and theories, as well as the application of scientific methods used as a problem-solving process. The correlation between analytical thinking skills and science learning includes (1) the scientific research process; science learning often conducts practicum-based learning, where practicum collects data obtained systematically and adjusts the results to the theory. (2) decision making; science learning makes many decisions based on scientific facts. (3) the ability to find solutions to a problem; science learning requires analytical skills to identify problems and design solutions in the form of strategies that are appropriate to the need to be able to solve problems. Analytical thinking is crucial to help students develop a deeper understanding of scientific concepts by making good decisions based on scientific facts by science learning. So analytical thinking is a crucial ability to maximize learning in the classroom, especially in science learning (Ilma et al., 2017; Suryanda et al., 2018). However, analytical thinking skills in junior high school students still need to improve. According to Setiawaty et al. (2019), junior high school students' analytical thinking ability is still in the low category. In addition, Ilma et al. (2017) facts in the field show that the results of analytical thinking skills possessed by students still need to be higher. This is because students' ability to think analytically is less trained when in the learning process in class.

Based on interviews conducted with seventh-grade science teachers, students' analytical thinking skills are still in the low category, especially in class VII. One of the causes of this condition is the low motivation of students to discuss with the teacher. In addition, students also have difficulty in linking learning materials with everyday life. This causes teachers to face challenges in stimulating students to develop their analytical thinking skills. In addition, when the teacher tried to explain the material, most students ignored the explanation given. Instead, students prefer to be busy with their activities. This situation certainly adds to the complexity of the teacher's challenge in improving students' analytical thinking skills.

According to the opinion Annisa, Dwiastuti, & Fatmawati (2016), in the learning process in class, students rarely ask questions. Students prefer to answer questions from the teacher briefly, and not a few teachers also answer questions given to students. The average questions students give still range between C1 and C2 and are only dominated by sure students. Another factor that causes this is that most exam questions teachers give tend to be between C1-C3 and less to train students in solving C4 analysis-type questions. So Indonesian students still need to improve their ability in analytical thinking. Analytical thinking skills are essential for students. Students with good analytical thinking skills can help them understand complex material and solve every problem in the learning process. Thus, analytical thinking is a crucial ability to maximize learning in the classroom (Ilma et al., 2017; Suryanda et al., 2018). Therefore, educators are responsible for assisting students in improving analytical thinking skills; one of the efforts that can be made is to explore and utilize learning technology in science learning.

Nowadays, the development of technology has increased significantly. These developments affect all aspects of life, especially in education. One of the uses of technology in education is the innovative use of learning media to maximize more varied learning (Purnasari & Sadewo, 2020). Learning media is a tool or learning resource that aims to convey information effectively and efficiently in learning activities to achieve learning goals (Zahwa & Syafi'i, 2022; Ulia, 2018). In addition, Yusmanto (2018) suggests that learning media is a tool to make it easier for teachers to convey information. According to other studies, learning media is a tool used to improve the quality of education. This media makes learning more effective and efficient (Nasaruddin, 2018; Santanapurba & Hidayanti, 2018). Currently, the science learning media used by most teachers and students are books that tend to contain long readings, few pictures, and the colors displayed are less attractive, so students are less interested in reading the book (Rostikawati, Susanto, & Rahayu, 2019; Hanifah, Afrikani, & Yani, 2020). So, it is necessary to utilize other learning media to attract students' interest in learning. Some of these media that can be utilized are e-booklet media and videos based on Science Education for Sustainable Development (SESD).

Science Education for Sustainable Development (SESD)-based e-booklet and video media are learning media that include sustainable development in science learning. According to Eilks (2015), the SESD approach is an approach that integrates sustainable development education (ESD) in science learning. ESD is a sustainable development prepared for the future (Indrati & Hariadi, 2016). In addition, according to UNESCO, ESD is an approach based on the principles underlying sustainability and ideals so that it can produce good quality education and encourage sustainable human resources (Perkasa & Aznam, 2016).

SESD-based e-booklets and video learning media are essential to efficiently and innovatively conveying scientific information. The utilization of learning media is needed to attract students' attention so that teachers and students can achieve learning objectives and have a meaningful learning experience. (Baharizqi, Iskandar, & Kurniawan, 2023; Nurrita, 2018). According to Gultom, Retnowati, & Yani (2022); (Ginting, et al. (2022), e-booklets and video learning media can improve critical thinking ability in students from moderate to high levels. Critical thinking skills are closely related to analytical thinking. According to Anugraheni (2019), critical thinking is analyzing, connecting, and creating all aspects of a given problem. In addition, according to Nuryanti, Zubaidah, & Diantoro (2028), someone with critical thinking skills can analyze and evaluate the information obtained.

At this time, there are no studies that discuss the comparison of SESD-based e-booklet media and SESD-based video media on students' analytical thinking skills, such as research by Putri (2022) which discusses the comparison of the effectiveness of e-booklet media and animated videos on the knowledge and attitudes of adolescents related to anemia of adolescent girls at Kosgoro High School in Bogor City. In addition, research by Baliasti, A'yun, & Hidayati (2022) discusses the effectiveness of education using video and e-booklet media on the level of knowledge about dental and oral emergencies during the COVID-19 pandemic in high school students. Therefore, researchers raised the title with the theme of comparison of the use of SESD-based e-booklet media and SESD-based videos on biodiversity material to find out which media has a better influence and effectiveness on students' analytical thinking skills.

RESEARCH METHODS

Research Design

This research is included in quantitative comparative research where the data obtained are processed using statistical methods and comparing the results obtained to determine the difference in the results of a variable from two different groups. This research is intended to compare the

effect of using e-booklets and video media based on Science Education for Sustainable Development on analytical thinking ability. Figure I. represents the research design.

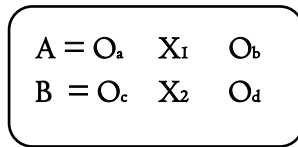


Figure I. Research Design

Note:

- A : e-booklet group
- B : video group
- O_a : pre-test e-booklet group
- O_b : post-test e-booklet group
- O_c : pre-test video group
- O_d : post-test video group
- X₁ : SESD-based e-booklet media treatment
- X₂ : SESD-based video media treatment

Population and Samples

This research was conducted at SMPN I Sawoo, Ponorogo Regency. The subjects of this study were all seventh-grade students at SMPN I Sawoo, totaling 154 students. The sample used amounted to 92 students. Then, the sample was divided into two groups: the e-booklet and video groups. In the sampling process, the researcher used a simple random sampling technique where the sample was taken randomly without regard to the strata in the population. This technique is used because the subjects in the population are homogeneous, so the selected sample can represent the population.

Instruments


This research instrument is an essay test consisting of a pre-test and post-test, each with 5 analysis-based questions. The instrument used has undergone a validation test conducted by two validators and obtained very valid results. After that, validity and reliability tests were conducted on 30 respondents outside the sample. The reliability test results for 10 questions obtained a result of 0.745; this value is higher than the Cronbach Alpha value ($0.745 > 0.6$), so the instrument is reliable. The essay test instrument can be seen in Table I. and Table 2.

Table I. Biodiversity Pre-Test

No.	Indicators	Questions
1	Connecting	What is the relationship between littering behavior and biodiversity preservation?
2	Connecting	The Javan tiger (<i>Panthera tigris sondaica</i>) is a subspecies of tiger that lives on the island of Java. The Javan tiger was declared extinct in the 1980s. Based on your understanding, why did the Javanese tiger become extinct?
3	Organizing	Humans have an essential role in maintaining biodiversity; bad human behavior, such as littering and illegal logging, hurts biodiversity, causing scarcity and extinction of a species. Vice versa, good human behavior has a positive contribution to the preservation of biodiversity. What are some excellent human

		behaviors that affect the preservation of biodiversity?
4	Distinguishing	Conservation can be divided into two types: in situ and ex situ. Both types of conservation have the same goal of keeping biodiversity sustainable. But in its application, in-situ and ex-situ conservation have differences. What is the difference between in-situ and ex-situ conservation?
5	Distinguishing	In an area, residents found a tiger trapped in a pig trap made by an irresponsible person. The tiger suffered severe injuries to its legs and other parts of its body. So, with this condition, the tiger will not survive if released directly into the forest. Based on this problem, what conservation is appropriate for the tiger's condition? Why is this the case?

Table 2. Biodiversity Post-Test

No.	Indicators	Questions
1	Connecting	Take a look at this Figure 2. The picture is a picture of air pollution caused by motorized vehicles. 
		Figure 2. Pollution Caused by Motorized Vehicles. How is the picture related to the preservation of biodiversity?
2	Organizing	One of the factors that can affect biodiversity is climate change. Climate change is caused by global warming triggered by air pollution; one example comes from power plants burning fossil fuels, such as coal, oil, and natural gas. Based on this, what can be done to anticipate climate change so that biodiversity is maintained?
3	Connecting	In an area, it is known that the people there have a unique belief in sacred forests. The community believes that their ancestors inhabited the forest, so there are several rules or taboos from the sacred forest, namely not being allowed to go in and out without permission from the tribal leader and take a plant or hunt in the forest. The forest is only opened twice a year for spiritual activities of the local community. Based on this narrative, how can this behavior affect the preservation of biodiversity?
4	Distinguishing	In an area, residents found a tiger trapped in a pig trap made by an irresponsible person. The tiger suffered severe injuries to its legs and several other body parts. So, with this condition, the tiger will not survive if released directly into the forest. Based on this problem, what conservation is appropriate for the tiger's condition?
5	Distinguishing	The Ibu Kota Nusantara (IKN) is a city built by applying the environmentally friendly or green city concept. Unlike other

cities, which were built without applying green city. What is the difference between cities that use the concept of green city and cities that do not apply the concept of green city to preserving biodiversity?

Procedures

The research procedure was carried out through 3 stages namely, (1) The preparation stage, namely by compiling research instruments and conducting instrument validation tests. (2) The second stage is to collect data by conducting a pre-test followed by giving treatment to each group and then carrying out the post-test. (3) The next stage is to analyze the data obtained from the pre-test and post-test using IBM SPSS Statistic 22 software to compare the results obtained from each group.

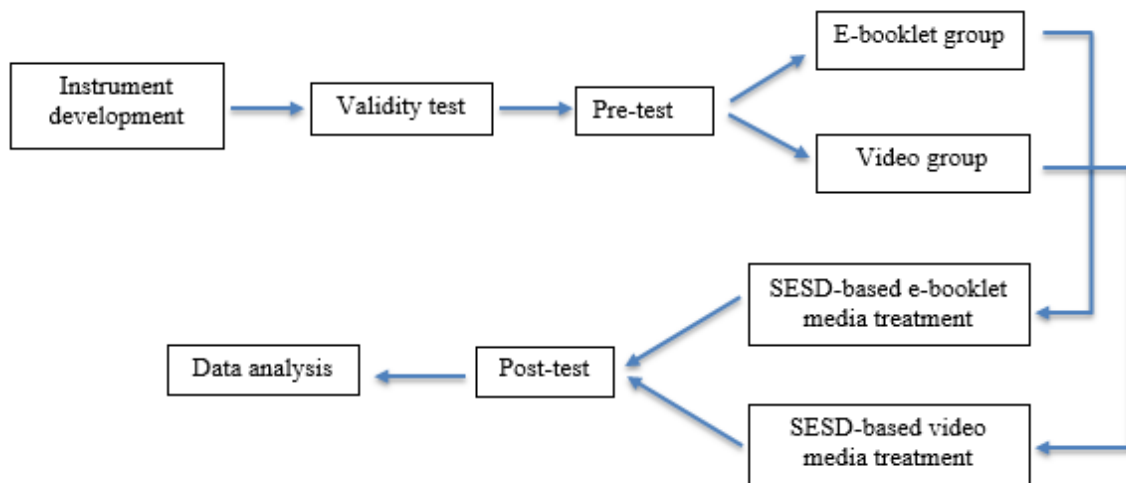


Figure 3. Research Procedures

Data Analysis

The data analysis used is a prerequisite test, namely the normality test and homogeneity test. If the prerequisite test meets the predetermined criteria, proceed with the hypothesis test, namely the paired sample t-test. However, suppose the prerequisite test needs to meet the criteria. In that case, the hypothesis test uses the Wilcoxon test, to determine the effect of the two media on students' analytical thinking skills. In addition, data analysis also uses the effect size Cohen's d, which is used to determine the effectiveness of using SESD-based e-booklets and video media.

Table 3. Categories Effect Size Cohen's d Distribution

Effect Size (ES)	Interpretation
$0,00 \leq ES < 0,20$	Very low
$0,21 \leq ES < 0,50$	Low
$0,51 \leq ES < 1,00$	Moderate
$1,00 < ES$	Large

(Cohen's in Utami & Roektingkroem, 2018)

RESULTS

This research examines and compares how SESD-based video and e-booklet media improve students' analytical thinking abilities by providing the same learning to both experimental groups.

Students who were taught using e-booklet media in the pre-test had a Sig. The value is 0.000, smaller than the α value ($0.000 < 0.05$), thus indicating that the data is not normally distributed. On the other hand, in the post-test normality test, the e-booklet obtained a value of 0.099, thus indicating a normal distribution because it was more significant than the α value ($0.099 > 0.05$). Furthermore, the students who instructed via video got Sig, especially in the pre-test. 0.022. It is not normally distributed because the value is smaller than the α value ($0.022 < 0.05$). The video media post-test findings also showed that the results were not normally distributed with Sig. The value is 0.030, smaller than the α value ($0.030 < 0.05$). The prerequisite test results do not meet the criteria, so the Wilcoxon Test is used as a substitute for the Paired Sample T-Test in non-parametric tests to determine the comparison of the increase in the utilization of SESD-based e-booklets and SESD-based videos on students' analytical thinking skills on biodiversity material.

Table 4. Normality Test Results

Media	Shapiro-Wilk		
	Statistic	df	Sig.
Pre-test e-booklet	.812	46	.000
Post-test e-booklet	.958	46	.099
Pre-test video	.941	46	.022
Post-test video	.945	46	.030

The Wilcoxon test results in Table 5. show that the Video and E-booklet groups obtained an Asymp. Sig value of 0.000, where the Asymp. sig value is smaller than the α value (e-booklet = $0.000 < 0.05$ and video = $0.000 < 0.05$). So, comparing the use of SESD-based e-booklets and SESD-based videos both experience a significant increase in students' analytical thinking skills.

Table 5. Wilcoxon Non-Parametrik Test Results

	Post-test – pre-test (e-booklet)	Post-test – pre-test (Video)
Asymp. Sig (2-tailed)	.000	.000

A comparison of the improvement in the use of SESD-based e-booklets and SESD-based videos in detail can be seen in Table 6. The average post-test score on e-booklet media is 59.11, more significant than the average pre-test on e-booklet media, which is 42.20, with the highest score on the post-test score of 94. In addition, on video media, the average post-test score was 59.30, more significant than the average pre-test, which was 41.28, with the highest score on the post-test score of 88.

Table 6. Descriptive Statistics Wilcoxon Test

	N	Mean	Std. Deviation	Min	Max
Pre-test e-booklet	46	42.20	11.181	24	94
Pre-test Video	46	41.28	9.162	24	65
Post-test e-booklet	46	59.11	17.240	29	94
Post-test video	46	59.30	16.153	29	88

Based on table 6. shows an increase in the average score of both media groups. Students with video learning media experienced a higher increase than those using e-booklet media. However, the

average difference between video and e-booklet media is insignificant. From this, video media is slightly better than e-booklet media in improving analytical thinking skills.

Effect size Cohen's *d* test is used to determine how effective SESD-based e-booklet and video media use is in improving analytical thinking skills. Effect size Cohen's *d* values for e-booklet and video media are 1.07 and 1.17, respectively. So, SESD-based e-booklet media and SESD-based video media fall into the "large" category. Based on this, students who learn using SESD-based video media are slightly superior to those who use SESD-based e-booklet media.

Table 7. Effect size Cohen's *d* Results

Media	Effect Size	Category
SESD-based e-booklet	1,07	Large
SESD-based video	1,17	Large

DISCUSSION

Considering the outcomes of the Wilcoxon test in Table 5. Comparison the use of SESD-based e-booklet media and SESD-based video media both experienced an increase in analytical thinking skills, so it can be said that the research conducted here is by what was done by (Gultom et al., 2022; Ginting et al., 2022) that e-booklet and video learning media can enhance critical thinking ability in students from middle to high levels. Critical thinking ability has a strong relationship with analytical thinking ability. According to Anugraheni (2019), critical thinking is analyzing, connecting, and creating all aspects of a given problem. In addition, according to Nuryanti et al. (2028), someone with critical thinking skills can analyze and evaluate the information obtained. However, both media significantly affect analytical thinking skills, based on Table 6. and Table 7. SESD-based video media is more effective than SESD-based e-booklet media in improving analytical thinking skills.

E-booklets are learning media that present material content in a concise manner and are combined with various images to attract student interest and assist students in broadening their horizons, which is reachable through modern gadgets like computers, tablets, and smartphones (Darlen et al., 2015; Asyhari & Diani, 2017). The utilization of reading materials must be tailored to relevant information as well as the needs and abilities of students to motivate students and improve their analytical thinking skills. Meanwhile, learning videos are audio-visual media that produce dynamic and exciting impressions and can channel messages through thoughts, feelings, and attention that are useful in learning (Yudianto, 2017; Amir, 2016). Video media has quite a lot of interest as it can be accessed quickly and can help students obtain information without a teacher's assistance. (Hasiru, Badu, & Uno, 2021; Arsyad in Yudianto, 2017).

Science Education for Sustainable Development (SESD)-based e-booklet and video media are learning media that contain sustainable development values for the future. SESD integrates sustainable development education (ESD) into science learning. The Science Education for Sustainable Development approach emphasizes the importance of comprehending and protecting the environment, such as climate change, pollution, biodiversity, and natural resource management.

In addition, the SESD approach also emphasizes the importance of understanding social and developing knowledge and skills to prepare for future challenges. Through the SESD approach during the learning process, students are taught to understand the impact of human activities on the environment and how science can solve problems that arise from human actions. In addition, in the classroom learning process, students are also taught about the importance of maintaining economic and social sustainability in sustainable development and helping students develop responsible attitudes towards society and the environment. Students are taught to respect cultural

and social values, respect and maintain biodiversity, and actively participate in environmental conservation efforts in sustainable development (Eilks, 2015).

CONCLUSION

Based on this research, SESD-based video learning media and SESD-based e-booklets are learning media that affect students' analytical thinking skills. This research reveals that the use of video media is superior to the use of e-booklet media in improving analytical thinking skills. Science Education for Sustainable Development (SESD)-based e-booklet and video media are learning media that contain sustainable development values for the future. Video media and SESD-based e-booklet media can provide maximum results if adjusted to the needs of students at the student's ability level. Based on the results of this discussion, several suggestions are proposed which are expected to have usefulness in this study. For further researchers, this research can be used as a reference in studying more broadly by connecting to other variables to obtain more valuable results.

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