

The Effectiveness of Multimedia Learning in Distance Education toward Early Childhood Critical Thinking during Covid-19 Pandemic

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Article Info	Abstract
Article History Received: April ,2026 Accepted: July ,2026 Keywords : Critical Thinking,Distance Education, Multimedia Learning,Early Childhood DOI: 10.5281/zenodo.21511263	<i>During the pandemic COVID-19, the government has issued the public meeting limitation, which is also closed educational places, one of which is early childhood school. Even though the method is different from the conventional conditions, students are expected to gain the same skills, include critical thinking skills. Therefore, teachers must provide distance learning innovation using relevant learning media, one of which is using multimedia-based learning media. This research aims to assess the efficacy of multimedia learning in early childhood distance learning. This research is quantitative with an experimental method using a quasi-experimental pretest and posttest design. Data collection technique with the questionnaire method given to 30 samples of early childhood. The existing data were then tested using the MANOVA statistical test (Hotelling Trace (T2)). The results of statistical data calculations show that multimedia-based learning in distance learning is proven to be able to develop critical thinking skills in early childhood during the COVID-19 pandemic. The results of this study can then be explored regarding the learning strategies applied to help improve critical thinking in early childhood.</i>

Introduction

Early childhood is an individual who is in the age range of 0-8 years (NAEYC, 2012). Early childhood education is characterized as learning to support the growth and development of children aged 0-8 years, holistically engaged in different interrelated areas of care and education. According to Agnihotri (2018), the first years of childhood are important to build a basic personality, values, and attitudes that will guide children in thinking, processing emotions, and socializing throughout their lives. One of the most suitable methods to be applied is learning by playing (UNICEF, 2018). Children can learn from the environment through playing activities, allowing children to practice various skills, including problem-solving skills, language development, and cognitive abilities ("Importance Play Early Child. Educ.," 2019). By playing, children will also be involved in various roles that will support the growth and development process as a provision for children to reach adulthood (Hsu, 2015; Yafie, Giavarini, et al., 2020). Since March 2019, the learning system applied in almost all countries has changed (Liu et al., 2020). This change occurred due to the outbreak of the Covid 19 virus. Its emergence began in Wuhan, China, spreading rapidly and expanding to almost all countries in the world (Liu et al., 2020). WHO then declared this outbreak as a global pandemic (Ahmed et al., 2020).

The spread of the Covid 19 virus has brought many changes in various fields of life (Donthu & Gustafsson, 2020), including in the field of education ("Impact of Coronavirus Pandemic on Education," 2020). In Indonesia, the government has started to implement a distance learning system to continue the education process (Abidah et al., 2020). Cooperation between teachers and parents is needed in distance learning (Luh et al., 2020). Efforts are made to ensure that distance learning applied to early childhood education or PAUD does not change the essence of learning by prioritizing all parties' health and safety (Schneider & Council, 2020). Distance learning requires innovative innovations so that learning objectives can be carried out as they should (Teräs et al., 2020). Not all societies are technology literate; educators in several regions in Indonesia are forced to implement a door-to-door system to deliver learning materials to their students (Abidah et al., 2020). Distance learning uses an online system through online networks such as social media via WhatsApp groups, text messages, and telephone (Dhawan, 2020). The application of various learning strategies is one solution to find the right ingredients in transforming knowledge to early childhood during distance learning. Learning in early childhood cannot be applied only by utilizing worksheets from schools. Moreover, the demands of the 21st century want a generation to have 4c's capabilities (Tang et al., 2020).

In the 21st-century, the existence of technology has begun to replace human resources so that in the future, it requires pregnancy skills that are needed by the times (Meyer & Norman, 2020; Yafie, 2016). The learning target during this era helps students to develop critical thinking skills as one of the HOT areas (Wujiati et al., 2019). This opinion is also approved by Wujiati et al. (2019), which state that critical thinking skills are essential for lifelong skills. Critical thinking is the ability to understand concepts, apply, synthesize, and

evaluate information obtained or information generated (Dekker, 2020; Florea & Hurjui, 2015). Critical thinking is a high-order thinking skill and has been known to play a role in moral development, social development, mental development, cognitive development, and scientific development (Fernández-Santín & Feliu-Torruella, 2020; Han & Brown, 2013; Lai, 2011; Yafie et al., 2019).

Critical thinking can be developed through play activities and children's interactions with their environment (Hsu, 2015; Wujiati et al., 2019). Not only adults who can develop critical thinking, but also young children (Bailin et al., 1999). It suggests that critical thinking can be developed in early childhood (Fernández-Santín & Feliu-Torruella, 2020). Critical thinking can also be developed by teachers in the classroom with teaching strategies, appreciating reason and truth, free-thinking, tolerance for different perspectives, and other people's thoughts (Kassner, 2006). Several studies have also shown that critical thinking can be developed through teaching (Han & Brown, 2013).

The application of learning in early childhood is different from learning at the primary and secondary school levels. In early childhood education, learning is carried out holistically with the method of playing child teaching so that children can reach every stage of development (Woolley & Rhoads, 2019). According to Piaget, children are at the pre-operational stage, with their characters not thinking symbolically (Hansen & Zambo, 2005). The process of acquiring knowledge is mostly done by interacting with the children's senses with the environment. Also, early childhood has low concentration capability, so that it requires strategies and learning media that can attract children's interest.

Distance learning applied during a pandemic is expected to develop children's critical thinking skills. Learning media such as blocks, sand, dolls, and outdoor playing equipment cannot be used by children while distance learning is being implemented ("Impact of the Covid-19 Pandemic on Early Childhood Care and Education," 2020). The problem is how distance learning continues to develop children's critical thinking skills. Thus, teachers must provide crucial distance learning innovation in using relevant learning media, one of which is multimedia-based learning media (Donohue & Schomburg, 2017; Yafie, 2017). Multimedia is defined as a material presentation by combining two or more elements. Text, graphics, images, photos, audio, and animation are some elements of multimedia-based learning media content (Abdulrahman et al., 2020).

Multimedia-based learning can create positive classroom environment conditions and be able to increase children's participation in learning activities (Aubrey et al., 2012; Chan, 2019; Yamamoto et al., 2006; Haqqi & Yafie, 2019). Research by Donohue & Schomburg (2017) shows that with multimedia, children can develop critical thinking skills by imagining, creating, and communicating. Multimedia can also develop children's social development, thereby increasing their readiness to enter elementary school (UNICEF, 2012). The researcher is involved in conducting research based on the description above entitled The Effectiveness of Multimedia Learning in Distance Learning in Early Childhood.

Early Childhood Critical Thinking during COVID-19 Pandemic

In the 21st century, one of the most needed skills is critical thinking skills (Santoso et al., 2018). Critical thinking is described as a way of thinking that has a useful purpose of proving something, interpreting what something means, or solving a problem; besides, critical thinking can also be a form of collaboration or not intimidate other people (Facione, 2016). In addition, the ability to think critically is a goal that many educational institutions want to achieve which is stated by Stephenson et al. (2019), where one of them is in early childhood education.

Critical thinking is defined as a habit of mind characterized by comprehensive exploration related to problems, ideas, concrete evidence that is around, and events before deciding to accept or formulate an opinion or produce a conclusion (Rhodes, 2010). The ability to think critically is rooted in constructivist learning theory, which focuses on enhancing the learning experience (Cowden & Santiago, 2016). Critical thinking can also be stated as the result of reflecting on one's learning and developing meta-awareness by "reflecting on one's thoughts, feelings, and actions," (Colley et al., 2012). Critical thinking skills will be perceived when children express curiosity by asking based on their knowledge, proposing initial explanations or hypotheses, planning and carrying out simple investigations, gathering evidence, explaining based on evidence, considering other explanations, and communicating final explanations or conclusions (Pellegrino & Hilton, 2013). Besides, children who are accustomed to thinking critically usually have an approach to thinking by approaching problems, questions, and more problems (Facione, 2016).

Engagement and interaction are necessary for children to achieve higher-order thinking (i.e., critical thinking, collaborative problem solving, etc.), build shared knowledge, and build learning communities (Khalili, 2020). Through encouragement to always ask questions actively and collaborate with colleagues about content, it will be able to deepen children's understanding of the lesson and develop critical thinking (Tan et al., 2020). Critical thinking is recognized as one of the key indicators of the quality of learning even though basically, humans are not natural critical thinkers (Stephenson et al., 2019).

There are various problem-based learning that can influence critical thinking and knowledge acquisition in various disciplines (Cowden & Santiago, 2016). Learning activities such as always doubting something,

explaining, evaluating, justifying, and building knowledge are components of critical thinking skills (Brooks et al., 2018). Other forms of assignments given, such as gaining experience, working in a group, or virtual environment, are expected to develop critical thinking later (Tan et al., 2020).

The initiation of critical thinking in students, including the words "subjective," "choose," "judge," "exclude," "bias," or "select," (Frazer et al., 2020). Someone who has critical thinking skills will be able to interpret, analyze, evaluate and conclude, besides, they can explain what they think, how they arrived at that judgment, apply their critical thinking capability to themselves, and prove their previous opinion. These two skills are called, "explanation" and "self-regulation" (Facione, 2016). Some indicators of critical thinking skills include:

Table 1. Indicators of critical thinking skills

Indicator	Sub Skills
Interpretation	Children can classify objects based on color, function, utility Children can provide simple explanations for the questions asked Children can describe ideas/opinions asked correctly
Analyzing	Children know the solution to the problems posed Children can make observations and consider the results Children can provide an assessment of the arguments/statements put forward
Evaluation	Children can solve problems independently Children can reason logically Children can make appropriate judgments about the topic proposed
Inference	Children can conclude what is asked logically. Children can form assumptions (hypotheses) Children can question the answers/evidence presented
Explanation	Children can provide compelling reasons Children can justify answers that they feel are wrong to statements from others and themselves Children can make convincing arguments
Self - Regulation	Children can review/consider the answers/conclusions drawn Children can test for similarities and conclusions Children can question, correct, validate an answer/statement

Distance Education

In a conventional situation, education happens face-to-face, and there is usually an interaction between teachers and students. Therefore, specific forms of collaborative learning require face-to-face interaction (Gürsul & Keser, 2009). However, in a situation such as the current pandemic, the learning carried out may change the way of learning because it requires the students and teachers to keep their distance from each other. As the COVID-19 pandemic spreads, as the indefinite closing of schools, colleges and universities are the only options left, there is a growing trend towards online teaching (Nguyen et al., 2020). Nowadays, In the COVID-19 outbreaks, where social distance is paramount, it is difficult to take classes regularly; thus, online teaching is undeniably a requirement that takes organizations and individuals to a melting phase (Mishra et al., 2020).

Online education has been a pedagogical transition from conventional methods to new learning techniques since the COVID-19 crisis, from classrooms to Zoom, personal to interactive, and seminars to webinars. E-learning, distance education, and correspondence courses were historically commonly viewed as part of non-formal education, but for now, it appeared that if pandemic conditions prevailed, it would eventually overtake the formal education system (Mishra et al., 2020). The coronavirus is destroying lives (EdSource, 2020) from pre-school to college levels, this poses a permanent challenge to our educational institutions and exacerbates the process of teaching and learning day by day. During the unexpected circumstances of COVID-19, limitations on traditional learning arose, which brings improvements to online education due to the expectation of confusion in pursuing traditional modes (Mishra et al., 2020).

Distance learning is the right solution when it faces a current situation. In the fight against the novel coronavirus disease COVID-2019 outbreak, countries have replaced traditional close-up education with distance education as a means of defense. Although many countries have previously been exposed to natural disasters and human-made disasters, distance education had not been used to solve the crisis as it is now the answer to coronavirus outbreaks (Al Lily et al., 2020). Teachers can provide digital skills to children at the threshold of cyber risk through digital intelligence, providing educational opportunities for success in future ventures, especially in a pandemic where children rely entirely on online learning (Park, 2019).

Since education now uses online media, it will not be easy to handle a teaching-learning situation in the post-COVID-19 education scenario without solely utilizing an online teaching platform. It can be expected that students will face several educational difficulties in the future, including quality education, hands-on experience, laboratory work, library visits, peer instruction, remedial teaching, study, and creativity, after seeing the

frightening coronavirus beast. Therefore, maintaining a compromise between online and offline learning classes is the provisional solution to post-COVID-19 education tantrums (hybrid mode) (Mishra et al., 2020).

The process of reforming the educational system that arises after the COVID-19 crisis has faced a range of difficulties in implementing it; these problems are connected to new viewpoints on online education and the complexities of technology. Online education was considered to be an education offered by open universities in India before this pandemic. Online learning, however, is a big challenge to face in a timeframe caused by COVID-19, and stakeholders have little ability to adapt to sudden shifts in education because they are technologically inept to accept the new situation. For the effective introduction of educational reform, therefore (in this case, it refers to a shift from traditional teaching-learning methods to online teaching-learning methods)(Mishra et al., 2020).

Globally, the process of teaching and learning is increasingly changing from a conventional classroom setting to a hybrid of traditional learning plus online learning. Cheap and ubiquitous devices such as smartphones or laptops and numerous apps, such as YouTube, Facebook, WhatsApp, are available. Changing the way individuals live, connect, and even their educational habits(Tiyar, FR, & Khoshshima, 2015). Even though the idea of online learning is not new, it has never been used as the primary teaching mode, especially after the widespread popularity and success of MOOCs (Massive Open Online Courses) such as Coursera, EdX, and Udemy, among others(Hidalgo, FJP, & Abril, 2020). From kindergartens, classrooms, colleges to higher education centers, the growth of the COVID-19 pandemic has deeply affected all learning institutions globally. Strict social distancing steps were applied internationally to avoid the spread of the virus by flattening the "growth curve," resulting in the physical closing of all kinds of learning institutions. This situation causes educational institutions worldwide to use the "online-only" paradigm of exclusivity for teaching and learning purposes(Pal & Vanijja, 2020).

Other research which focuses on distance education systems, by Harnish & Reeves (2000), characterizes the form of distance educational evaluation particularly in terms of:

1. Training (programming skills, barriers, availability, identification of needs, costs),
2. Implementation (administration, fees, course credit costs, institutional ownership, priority of use, integration, coordination),
3. Use of the system (information collection, electronic data collection, accuracy),
4. Communication (sharing information about internal, local, and regional issues of concern related to distance education),
5. Support (fiscal, staff, faculty, instructional, administrative resource allocation).

Multimedia Learning

Just like when learning which includes asking questions, critical thinking cannot be done alone and needs to involve other people(Santoso et al., 2018). When distance learning is carried out, interactions with others are limited. The interaction factor is one of the most significant variables relevant to e-learning(Michael G. Moore, 2001; Picciano, 2002). When thinking about distance learning, individuals automatically think of the lack of interaction aspects(Bouhnik & Marcus, 2006)as usual in the classroom. There is a connection between students and the material or subject matter provided for students. Interaction with learning material occurs when, with the aid of teachers or teaching institutions, students may create new knowledge by finding new information and comparing it with established knowledge(Bouhnik & Marcus, 2006). Moore (1989) notes that the learning process cannot take place without this form of interaction because the process involves the intellectual interaction of the student with the material, resulting in improvements in the perception of the student, the viewpoint of the learner, or the cognitive structure of the mind of the learner.

Herein lies the role of multimedia-based learning. Multimedia is a mixture of more than one form of media, such as text (alphabet or numeric), symbols, pictures, images, audio, video, and animation, typically using technology to enhance memorization comprehension(Guan et al., 2018). With the use of static and dynamic images in the context of visualization technology for better speech and comprehension, verbal instruction is supported(Alemdag & Cagiltay, 2018). Multimedia technology is the hardware and software used to build and run multimedia applications(Kapi Kahbi et al., 2017). There are several features of multimedia technology, such as integration, diversity, and interaction that enable individuals to communicate information or ideas with digital and print elements. In this sense, digital and print elements apply to multimedia-based software or methods used to transmit people's information for a better understanding of the term. Indeed, the advent of Information and Communication Technology (ICT) is transforming various aspects of human endeavour, particularly the education sector. ICTs involve using hardware and software to collect, process, store, present, and share information, mostly in digital form(Guan et al., 2018). It involves a combination of several technologies to provide the best format, package and size of information.

Through multimedia-based learning, the presence of teachers or students feels closer. By using various media components, supporting information processing, multimedia or interactive learning tools help students achieve excellent mental representation. Information, consisting of material and sometimes learning activities, is

conveyed through digital learning sources using text, images, video, and audio. Through studies using multimedia for learning, it has been established that students who combine pictures and words have more positive outcomes than those who use words only (Chen & Liu, 2008). According to Altuna & Lareki (2015), different pedagogical methods are implemented using digital resources. Their studies present how writers can incorporate, exhibit, inspire groups, make available various types of text, and engage students in interactivity with students' topics. In general, it is possible to categorize interactive technology for educational purposes whether it is used for teaching or learning. Moreover, based on Guan et al. (2018), the value of multimedia technology for education and the widespread use of multi-media tools have been identified in several studies. As a result of its many advantages, multimedia typically includes the use of technology and the widespread acceptance of multimedia applications in education. (Almarabeh et al., 2015). Some of the advantages of the teaching and learning process with multimedia application resources are summarized as follows.

1. Able to change abstract concepts into concrete content;
2. Able to present large amounts of information in a limited time with minimal effort;
3. Ability To stimulate student interest in learning;
4. Giving teachers the ability to know the position of students in multimedia learning designed for learning refers to the process of building representation.

Through video and voice calls, learning can still be packaged in a variety of ways. Multimedia learning provides easy access, which makes learning more effective and efficient. Multimedia technology enables abstract information to be condensed, allows people to be distinguished, and allows dynamic representations from different viewpoints. It can be invaluable to use computer-based techniques as an interface between students and what they learn from unsuitable fonts and designs (Abdulrahman et al., 2020).

Method

This research is quantitative with an experimental method using a quasi-experimental pretest and posttest design. Data collection technique with the questionnaire method. This research is quasi-experimental (quasi-experimental), with a pre-test-post-test non-equivalent group design.

Table 2. Design Quasi experiment

Group	Pretest	Treatment	Posttest
A	O ^{A1}	X ¹	O ^{A2}
B	O ^{B1}	X ²	O ^{B2}

Where A: Experimental group, B: Control group, O^{A1}: Experimental group pretest, O^{B1}: Control group pretest, X¹: experimental group treatment, X²: control group treatment, O^{A2}: experimental group Posttest, and O^{B2}: control group Posttest.

This research was conducted in December 2020. The population of this research is students at Al-Fikri Kindergarten Bekasi as many as 4 classes. Samples were taken randomly that one class is chosen which then would be divided into two groups.

The instruments used in this study were test and non-test instruments. The instrument for testing critical thinking skills is in the form of multiple-choice questions regarding critical thinking skills. The non-test instrument is in the form of a questionnaire regarding their opinion when learning using multimedia-based learning, which is applied using a Likert scale. Before being given the treatment, all students in the class chosen were asked to fill out a questionnaire about their opinions when learning using multimedia-based learning. After both classes were given treatment, students in both classes were asked to fill out a questionnaire about multimedia-based learning and work on post-test questions.

Descriptive analysis is used to describe the characteristics of the research data and to answer descriptive problems. This descriptive research analysis for multimedia-based learning data is the minimum value, maximum value, average, standard deviation, and variance. The research data analyzed are data from the pre-test and post-test results in mathematics learning achievement and the results of filling out a multimedia-based learning questionnaire. A statistical test one-sample t-test was used with SPSS 24 for windows to determine the effectiveness of learning in terms of students' critical thinking skills. The assumption test that must be met is the normality test of the post-test data on student achievement and interest in learning mathematics in both groups using the Kolmogorov-Smirnov method with the SPSS 24 for Windows program. The data criteria are typically distributed if the data value is more than 0.05.

To find out the differences in the two experimental groups' initial and final conditions in terms of students' critical thinking skills through multimedia learning, the MANOVA test (Hotelling Trace (T2)) statistical test was used. The assumption tests that must be fulfilled are the homogeneity test and normality test on the pre-test and post-test results of students' critical thinking skills through multimedia-based learning in both groups. The homogeneity test uses Box's M Test with homogeneous data criteria if the significance value is more than 0.05, and the normality test uses the Kolmogorov-Smirnov test with the help of SPSS 24 for Windows with normal data criteria if the significance value is more than 0.05. The univariate statistical test (independent samples t-

test) is used using SPSS 24 for Windows to determine whether learning using multimedia is more effective than learning without using multimedia in learning achievement and students' interest in learning mathematics.

The assumption tests that must be fulfilled are the homogeneity and normality test of the post-test data on learning achievement and the final data on students' thinking abilities. When the significance value is more than 0.05, the homogeneity test uses the Levene test with homogeneous data parameters. If the significance value is larger than 0.05, the normality test uses the Kolmogorov-Smirnov criterion for customarily distributed results. The assumption tests that need to be met are the homogeneity and normality test of the post-test learning achievement data and the final data on the reasoning skills of students. The homogeneity test uses the Levene test, the criterion for homogeneity data if the significance value is larger than 0.05. The normality test uses the parameters for Kolmogorov-Smirnov with data normally distributed if the significance value reaches 0.05. The assumption tests that need to be completed are the homogeneity and normality test of the post-test learning achievement data and the final data on the thinking skills of students. When the significance value is more than 0.05, the homogeneity test uses the Levene test with homogeneous data parameters. The normality test uses the parameters for Kolmogorov-Smirnov with data normally distributed if the significance value reaches 0.05.

Research Objectives and Types

This study utilizes a pre-experimental design with a One-Group pre-test and post-test design with a pre-test before being given treatment. This study's main objective is to answer the research question of what the effect of collaborative mobile borderless learning applications on students' critical thinking is.

Samples and Instruments

Multimedia Learning Methods in Distance education were tested on 30 early childhood children. The sample was selected using a purposive sampling method by considering early childhood who have adequate internet and computer access facilities. The elements of critical thinking used the test based on Facione's (1990) cognitive levels.

Table 3. Number of Questions

Construct	Cognitive Level	Item No.	Total of Items
Critical thinking elements (Facione, 1990)	Interpretation	1, 2, 3	3
	Analyzing	4, 5, 6,	3
	Evaluating	7, 8, 9	3
	Inference	10, 11, 12	3
	Explanation	13, 14, 15	3
	Self-Regulation	16, 17, 18	3
Total			18

Table 4. Result of Validity and Reliability Test

Cognitive Level	Item No.	Total Correlation item	Cronbach's Alpha
Interpretation	1, 2, 3	0.719-0.884	0.894
Analyzing	4, 5, 6,	0.662-0.851	0.866
Evaluating	7, 8, 9	0.765-0.815	0.887
Inference	10, 11, 12	0.735-0.919	0.937
Explanation	13, 14, 15	0.688-0.735	0.815
Self-Regulation	16, 17, 18	0.726-0.804	0.869

The normality test is carried out to test whether the study sample is of the normal distribution type or not. The way to detect whether the residuals are normally distributed or not is by using graph analysis. The data normality test in this study used the Kolmogorov Smirnov test and was tested using SPSS. $P < 0.05$ is not normal; $P > 0.05$ is normal.

Hypothesis testing in this study uses a paired sample t-test. A paired sample t-test was used if the data were normally distributed. Independent sample t-test is one of the testing methods used to assess pre-test and post-test treatment effectiveness. The basis for deciding to accept or reject H_0 in the paired sample t-test is as follows. If the probability (Sig) < 0.05 , then H_0 is rejected, and H_a is accepted. If the probability (Sig) > 0.05 , then H_0 is accepted and H_a is rejected.

Results and Discussion

Table 5. Results of the pre-test and post-test

Level	Range of Marks (%)	Number of Students	
		Pre-test	Posttest
Excellent	80-100	1	18
Good	60-79	17	11

Moderate	40-59	8	1
Weak	20-39	4	0
Very Weak	0-19	0	0
Average		60.1	83.7
Minimum		22	59
Maximum		86	98
Standard Deviation		17.7	10.8

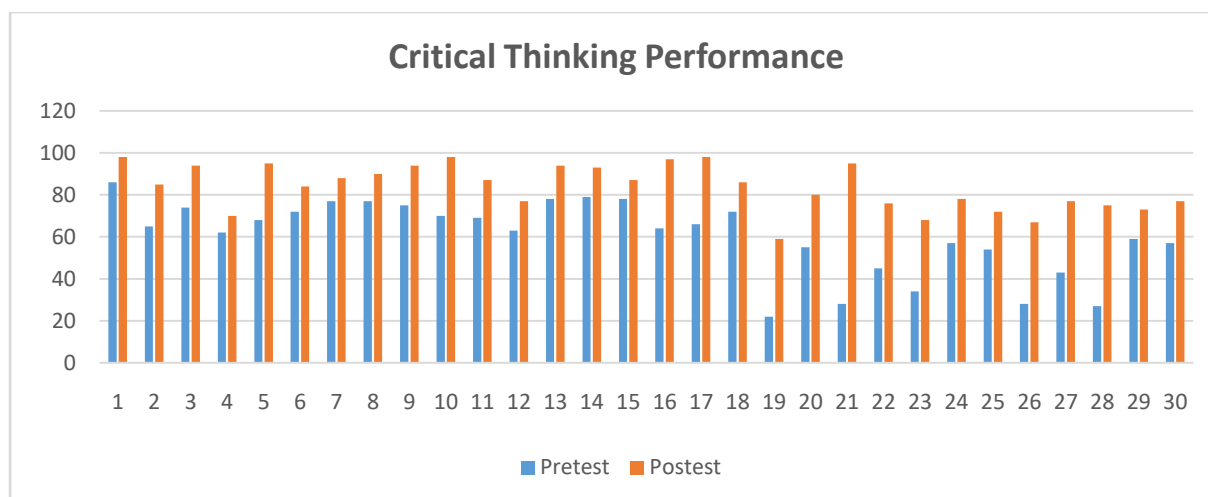


Figure 1. Critical Thinking Performances

Based on table 6, it can be seen that the lowest pre-test score is 22, the highest score is 86, with an average value is 60.1. Post-test data were obtained from learning outcomes after all learning materials were delivered. The post-test score of 30 students was seen with the lowest score of 59; the highest score was 98, with the average score was 83.7.

Table 6. Normality Test

One-Sample Kolmogorov-Smirnov Test	Pre-test	Posttest
N	30	30
Mean	60.1	83.7
Std. Deviation	17.7	10.8
Statistical Test	0.127	0.146
Asymp. Sig. (2 tailed)	0.202	0.093

After learning is carried out using multimedia learning methods in distance education. The next step is to test the hypothesis of whether there is a difference between the pre-test and post-test. Paired sample t-tests were analyzed through SPSS 24.0 for Windows using paired sample t-tests with a significance level of 0.05.

Table 7. Test Hypotheses with the T-Test

Cognitive Level	t	Sig. (2-tailed)	Explanation
Interpretation	5,131	0.000	Significant
Analyzing	5,674	0.000	Significant
Evaluating	3,417	0.000	Significant
Inference	2,819	0.000	Significant
Explanation	2,434	0.000	Significant
Self-Regulation	2,849	0.000	Significant
Critical Thinking Performances	15,750	0.000	Significant

A significant difference ($p = 0.000$, $t(30) = 15.750$, <0.05) between the pre-test scores (mean = 60.1, SD = 17.7) and post-test scores (mean = 83.7, SD = 10.8) was observed in the study of the paired sample t-test of critical thinking abilities. The findings also showed that the 6 Elements of Critical Thinking (Interpretation, Analyzing, Evaluating, Inference, Explanation, and Self-Regulation) had significant differences ($p = 0.000$) pre-tests. This study proves how multimedia-based learning can influence distance education.

The existence of multimedia-based learning can handle distance learning problems where teachers and children have limitations in face-to-face interactions. Multimedia-based learning is delivered in an interactive and integrated manner, including texts, images, sounds, videos, or animations, to stimulate children's interest in participating in a series of distance learning. The Covid pandemic that has hit Indonesia, and even throughout the world, has made distance learning the only solution used to keep the education process going. The application of distance learning in early childhood in Indonesia often uses several platforms such as the WA Group, Zoom, Google Meet, Google Classroom, and several others (Luh et al., 2020). Distance learning applied to early childhood is not just a task given by the teacher, then completed and collected by parents. Cooperation between teachers and parents is the main thing that affects the implementation of distance learning (Jaramillo, 2020). The needs of the 21st century and the Industrial Revolution era 4.0 for increasing human resources want the education sector to create a generation that suits one's needs. Reorientation of Education hopes that learning can develop higher-order thinking skills as one of the demands for the 21st-century generation.

Santrock revealed that to think critically, the children must take an active role in the learning process. In distance learning, children's participation can be stimulated by the use of multimedia-based learning media (Nusir et al., 2013). Especially now that technology is increasingly accessible and accessible to all groups. Teachers provide multimedia in distance learning in early childhood in videos, interactive PowerPoints, flipbooks, etc. This treatment provides benefits for children considering face-to-face interactions in learning are not yet possible to implement. Distance learning by utilizing multimedia can create meaningful learning, even though, it is carried out in different times and spaces. Early childhood in the pre-operational phase needs stimulants to think in ways that make sense to understand the world using multimedia. It is in line with Lai's (2011) opinion that the critical thinking process includes the process of combining, not just mixing. Lai added that critical thinking is an investigation that aims to explore a situation, event, question, or problem to arrive at a hypothesis or conclusion about it that combines all available information and can make decisions. As a guide to beliefs and behavior, Mulnix (2012) notes that critical thinking is an analytical disciplinary method to actively and skillfully conceptualize, apply, interpret, synthesize, and assess knowledge gathered from, or generated by, observation, experience, thought, reasoning, or communication. Alternatively, problems come to a theory or inference that incorporates all the facts and decisions available.

The learning process in distance learning often makes children bored due to the high assignment through children's worksheets. Through the application of multimedia in distance learning, learning can be packaged to be more attractive. Themes can be explained more clearly to facilitate the completion of learning objectives (Ambarini, 2018; Lieberman et al., 2009). Distance learning in early childhood by applying multimedia places the teacher as a facilitator so that the creation of a student-centered learning process is not teacher-centered. Practical and easy multimedia for use in distance learning makes this media capable of being used independently and in classical forms. It can be said that multimedia can create practical and efficient learning.

Multimedia has the potential to create a multi-sensory environment that supports the specific learning styles of students. According to (Marsh et al., 2018; Yafie, Samah, et al., 2020) The existence of multimedia can improve children's creative thinking and critical thinking skills with presentations that attract children's interests and strengths in overcoming their limited experiences. Multimedia in distance learning for early childhood can create more interactive learning atmospheres, reducing teacher verbalizes explanations, and making children more independent through the brain's exploration process. Through multimedia, early childhood can explore whatever is around them, thus, they can gain various knowledge. If the children can think critically, then the child will have no difficulty in dealing with problems, for example, is in facing learning difficulties, which will increase their reasoning skills and learning achievement. It is interlinked with an opinion (Alfrey & Durell, 2013; Yafie, Nirmala, et al., 2020) that children's competence and learning outcomes in the cognitive aspects are children who can think logically, think critically, provide reasons, and solve problems at hand.

Conclusion

The final result concluded in this research is that multimedia learning is an effective method to do in distance education during the COVID-19 pandemic to develop children's critical thinking skills. It is motivated by the rapid advancement of technology to support easy access to learning materials, which are then synchronized with learning activities. Based on the cognitive level's six aspects, critical thinking shows an increase in all aspects significantly.

Recommendations

The aspects involved are interpretation, analysis, evaluation, inference, explanation, and self-regulation. However, since the current research only covers the development of critical thinking skills during distance education, the researchers suggest future researchers focus on other skills or even cover the negative effect of distance education on children.

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