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Learning Transformation 4.0 with Games-Based Interactive Multimedia: Its Effectiveness Towards Elementary School Students' Cognitive Skills

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Abstract

The purpose of this study was to determine the effectiveness of games-based interactive multimedia on the cognitive abilities of students in elementary school. This is quantitative research using an experimental method. The research used a quasi-experiment method with a nonequivalent control group design. The subjects of this research were 27 students in the experimental group, and 28 students in the control group. The instruments used were cognitive learning outcomes. The data collection technique was done using test. The data was analyzed using Independent Sample T-test. The requirements of the analysis test include, among others: normality test and homogeneity test. The hypothesis test result using independent sample t-test show that The result count of gain score shows that the tcount is 3.821 (>2.008 (ttabel)), so it can be concluded that H0 is rejected or there is a significant difference in the improvement of cognitive skills between the experimental class and control class. To understand the effectiveness of games-based interactive multimedia, the effect size is used to analyze the data. The result scored 1.40, therefore it belongs to the high category. Based on the result, it can be concluded that the student's cognitive skills with games-based interactive multimedia is better than the ones with conventional learning. Teachers are suggested to use games-based interactive multimedia because it is suitable for the students' environment where they like playing and can improve students' cognitive skills.

Keywords: Interactive multimedia, games, learning media, elementary school, education technology.

Introduction

The use of media in the teaching-learning process is essential for it can help the teachers to conduct the teaching-learning process smoothly. Learning media is a physical or non-physical object used by the teacher in delivering learning materials to the students so the materials can be understood effectively and efficiently by the students. Learning media supports the teaching process so the learning goals can be achieved well. Learning media that is applied correctly in the teaching-learning process will be a supportive tool that helps the teaching-learning process be more effective and efficient to reach the learning goals. The other purpose of learning media is to improve student's learning motivation (Puspitarini & Hanif, 2019). According to Triawang dan Kurniawan (2021) learning media is a medium or place that is used as a tool to convey information to students to achieve goals. Media is used to ease the students in understanding the material taught.

Learning media has significant benefits to build interest, to develop learning motivation, and to stimulate activities in the teaching-learning process. The use of learning media will help the effectiveness of the teaching-learning process, deliver the message and learning materials, help to improve understanding, present data in an interesting way, and facilitate data interpretation and information (Ariesta, 2019). Students feel motivated, physically and psychologically involved in using the media. Learning media can also maximize all students' senses in learning and create meaningful learning. The development of technology is not in line with its implementation in the education field to create Indonesia's golden generation, and to prepare students' competencies for the 21st century; i.e. critical thinking and problem solving,

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collaboration skills, creativity, and communication skills. The use of technology-based learning media will support these (Yalvenna Miaz, 2019). The development of technology in the globalization era creates industry revolution 4.0. It not only influences industrial production, but also human resources and the education system.

There is a shifting of learning meaning from academic numeric oriented. Learning should inspire millennials who are now studying to be motivated to improve self-management skills and manage their environment. Teachers should make a special reference and emphasize responsibility for the students (Hardika, 2020). Millennial generations are the generation who cannot be separated from technology in their daily life. The influence of technology especially the internet has already been a daily need. The rapid development of information technology and communication offer various facilities in learning and it can change learning orientation from guided learning to self-learning, from knowledge as possession becomes knowledge as construction. Technology has a significant role to advance the justification conception from learning as knowledge transferring becomes learning as guidance to master social culture knowledge.

There are a lot of kinds of learning media; one of them is interactive multimedia. "Multimedia refers to computer-based systems that use various types of content, such as text, audio, video, graphics, animation, and interactivity" (Constantinescu: 2007). Mayer (2005), states that learning achievement with interactive multimedia is more effective and efficient. Interactive multimedia teaching is better than other media. The use of learning media as a tool to deliver material cannot be separated from good learning outcomes (Siagian, 2014). Interactive multimedia that combines images and video on one screen has several advantages to attract students' attention; one of them is animation video. Oetomo (2007) suggests that without learning media, the teaching-learning process does not work well. Especially when doing a presentation, media becomes the best tool to be used. Multimedia not only consists of one media but also some combination using computers. Multimedia is defined as a combination or combination of the element of text, photo, graphics, sound, animation, and video that has been manipulated digitally (Aditya, 2021). Interactive learning media is expected to facilitate how the students absorb information fast and efficiently. The Source of information not only focuses on the textbook but also on a wider area. The better multimedia technology skill, the easier the students understand the information (Windiyani, 2019). Nowadays, Computer-based learning media has been developed and used as an alternative learning media. According to Roblyer, et al., (2013) computer-based learning is a computer program used to convey the teaching material. It is occupied with some features and supported accessories.

Learning in elementary schools today is still not optimizing the use of learning media. Teachers are too focused on delivering material without paying attention to the use of interesting and varied media. Based on observations in elementary schools, the media that are often used by teachers are in the form of printed media, namely textbooks. Teachers also sometimes use concrete media, image media, and LCD projectors to display power points or videos. The use of media that is less interesting and varied makes students bored with learning.

The development of elementary school students is currently surrounded by the digital world so it affects the way they respond to learning. Atsusi (2014: 11) argues that students today are not right if they carry out learning using traditional methods because many things have changed in students. These changes are due to the influence of TV, the internet, cell phones, and so on. The sophisticated technology is only used to play games and browse social media. The competition in the industrial revolution should be balanced with good skills and competence in managing and utilizing many sources of information. One of the efforts to build that skill is through reading activities (Pitoyo, 2020).

Based on previous research that applied computer games, the increase of knowledge from learning using applied computer games was statistically much higher than the learning using the traditional method Sanjose (2015: 51). Ahmad and Jafar (2012: 515) argue that the integration and implementation of computer games into the classroom can help students learn more enjoyably and effectively. In addition to enjoyment, students can gain cognitive and affective elements through problem-solving, making decisions, making conclusions, and working, and collaborating with their friends. The use of computer games also increases students' motivation and interest in learning Husni (2021: 98). Teachers as facilitators must be able to determine and manage methods, strategies, and motives in teaching so that they can increase motivation and interest in learning. Students need new learning media with criteria using computer technology, based on games, colorful displays (interface design), and active roles.

The advantage of using game-based interactive multimedia is that it helps improve student understanding. Learning media that have been proven effective can be developed into android-based so that they can be accessed by students easily because the learning process needs to present learning that is not monotonous (Suliyanah, 2021: 10). The use of game-based interactive multimedia has a significant effect on improving student learning outcomes both from

student cognitive results and student skillsNurpratiwiningsih & Didik (2018: 256). Cognitive and psychomotor learning outcomes in students can be said to increase with the existence of educational games. Other research was also conducted by Ramasyah (2015); Budiyanto, Widjanarko, and Pramono (2014) state that educational games can provide interesting, effective, and efficient learning alternatives so that students' cognitive abilities and skills will increase.

The use of computer games can be an alternative to keep up with the rapid advancement of technology in the 21st century. The growth of elementary school students is currently surrounded by the digital world so it affects the way they respond to learning. Atsusi (2014: 11) argues that students today are less suitable to be taught using traditional methods because many things have changed in students. These changes are due to the influence of TV, the internet, cell phones, and so on.

Based on some research above, it can be concluded that computer games give a positive impact if they are implemented in teaching. The use of computer games is one of the alternatives to follow the rapid change in 21st-century technology development. Digital technology now are surrounding elementary students so it influences how they respond the learning, Atsusi (2014: 11) states that nowadays, it does not suit to teach the students in conventional ways because many things have changed. The change has been caused by the influence of TV, the internet, smartphones, etc.

Based on the review of previous research, it was found that there was a research gap where previous researchers still did not focus on the use of interactive multimedia for elementary school students in terms of cognitive aspects in thematic learning. The objective of this study is to test the effectiveness of interactive multimedia based on games on the cognitive abilities of grade V elementary school students. This research is expected to provide benefits for elementary school teachers in examining the use of interemedia that is interesting and in accordance with technological developments.

Literature Review

The use of game-based audio-visual media makes learning more interesting, active, effective, and efficient. Edgar Dale's Cone of Experience (Sanaky, 2013, 47), describes that learning experiences with audio-visual media can convey teaching messages through iconic symbols. The symbols are in the form of sound and moving images that are used to present reality or actual situations. This can be seen in Edgar Dale's Cone of Experience in the following figure.

Edgar Dale (1970) emphasizes efficiency and explains the reasons for using audio-visual materials in the learning process.

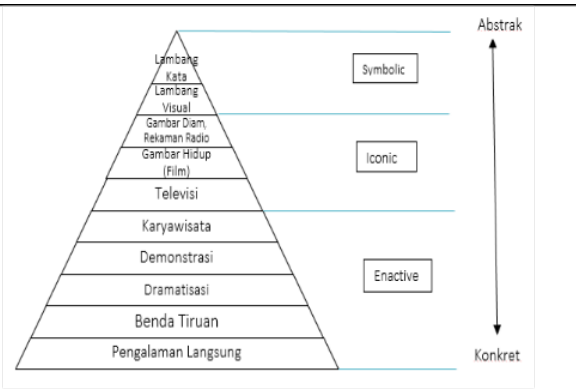

Image 1. The Edgar Dale's Cone of Experience (Source: Ken Mastersab (2013))

He points out that audio-visual-verbal materials can serve as more concrete experiences, which are "almost always skillfully integrated with the words themselves". Students are facilitated to move towards greater levels of applicable, clear, and useful symbolization and generalization as they abstract and generalize from video experiences at different levels of complexity. Images can present what cannot be explained easily or satisfactorily in words and help students learn how to draw and test conclusions by emphasizing process rather than a product.

The reason is clearly stated by Edgar Dale (1970), who believes that audio-visual teaching methods can reduce forgetting and make learning more permanent. Images can increase the understanding, significance, and frequency of the material used that students need to learn. With concrete images, students can be helped to see what may remain abstract. Images make events seem more real and therefore more important, images connect things learned in the classroom with real experiences of real people in everyday life, tying the old with the new, the known with the unknown (Dai & Cui, 2018).

The level of involvement of Edgar Dale's theory starts from verbal, visual, involved, and doing. Learning activities with interactive multimedia such as audio-visual media, students can learn well from 50% of what they see and hear through audio-visual media, and on learning evaluations by doing real things students can learn well by 90% of what they do when using the game media.

Interactive multimedia is one of the learning media that allows the students to actively interact with the learning media. Ariani & Hartanto (2010:25) states that multimedia is a media that is integrated and combines two or more media consisting of graphics text, image, pictures, audio, video, and animation. It is explained by Daryanto (2015:51) who presents that interactive media is media completed with a controller so the user can interact and choose the menus.

Interactive multimedia is one of the alternative media integrated with ICT. This media can be operated through computers. The components of interactive multimedia are text, images, video, animation, and other interactive elements which involve and influence the students during the teaching-learning process. On the other hand, teaching multimedia is considered to create an active learning environment and informed and can be a reference for teaching activities besides the teacher (Budiarto, 2021).

Sanjaya (2014: 225-226) states that interactive multimedia is not linear, but the students can choose the menus offered. Interactive multimedia has a controller tool called graphical user interface (GUI) in form of an icon, button, scroll, etc. Students can select the menu or icon based on their interest to find information. Indriana (2011: 116) suggests that interactive multimedia is interactive media and is multimedia completed by some elements such as sound, animation, video, text, and graphics.

According to Edwards & Wilson (2017), and Moeliono (2003), interactive multimedia is one learning media that presents the material in for of audiovisual and allow the interaction between the students and the media. The use of interactive multimedia as a variation in learning media creates an effective communication process between teachers and students during learning. Effective communication is related to communication and communicant skills. Skill is competence and an effort done by someone. One of the advantages of multimedia in teaching, according to Munir (2012), can attract students' interest and improve their motivation and interest in study, activities, and creativity. Interactive multimedia is operated using a smartphone because it has high flexibility and portability, so it enhances the interaction between the students and the materials (Mochamad Kamil Budiarto Wibawanto, 2020).

The use of interactive media in education has brought benefits. When learning media is applied and utilized correctly, it will bring a better teaching-learning process. Nowadays, almost all schools and educational institutions use interactive multimedia because of its advantages and effectiveness. The resources can be employed effectively. Interactive multimedia has more positive impacts. One of the good impacts is facilitating students to understand and memorize the teaching materials easily (Gouhar & Mahapatra, 2016; Kadafi, et. al. 2021).

Purnomo (2013: 31) states that there are several types of games, and they are electronic games, traditional games, storytelling, imaging games, guidance, and activities from some games. Whereas Freeman and Munandar (2000: 265-266) present that there are 4 types of games, are (1) explorative game, it is a game that allows the children to explore themselves, explore the environment, or explore someone; (2) constructive games where the children follow material exploration process. The children involve creating and combining some objects like experimenting with different size wooden puzzle and shapes; (3) destructive game is where the children play and treat the objects in a destructive way like throwing, breaking, kicking, shredding, or slamming the objects; (4) creative game is when the children follow experiment stage with the materials to create objects and use their imagination to create something or make a new combination from the games tools components.

Ismail (2006: 105-111) states that there are two types of games based on their shapes and skills; they are traditional games and modern games. Traditional games are the games containing heritage and values that the existence must be preserved. Modern games are the games that are produced using sophisticated technology and they are analogous to electronic games.

"Game" is a term used to describe the game-based object and focuses more on the main purpose rather than as entertainment it is designed as a game with an educational purpose and the learning material to create student-centered learning, interesting, fun, enjoyable, and more effective and efficient. Digital games are widely used in education and other industries. Kinzie and Joseph (2018) define a game as a "deep activity, voluntary, and fun" that aims to challenge based on the rules agreed upon. Education games are considered new whereas serious games have been applied. Education games can be considered as tools and instructional computer techniques, where the skills and opportunities are combined and implemented on the information and experience obtained. Maragos and Grigoriadou (2005) quote that an educational game is a game that promotes logical development and skills and gains knowledge in a fun and interesting ways. In addition, they allow the students to learn a new thing while at the same time they enjoy the situation (Anastasiadis., 2018).

The students can use games during the learning process for experimental learning to develop skills, decision-making, and problem-solving in their dynamic environment. Instead of having traditional assessment methods (such as tests and quizzes), the students can directly get feedback to get the answer. In addition, some educational games help the students to reduce their limitations, including time and places, because the portable devices enable the students to learn anywhere and anytime. The simple device helps the students to understand and memorize difficult subjects (Cheung & Ng, 2021).

Human is seen as a social creature who has always tried to understand their environment, and are also known as thinking creature. Cognitive skills actively collect experiences

from senses by managing, creating, organizing, interpreting, distorting, and finding meaning to produce a new information product (Arumwardhani, 2011: 50).

Cognitive terminology comes from the word cognition or knowing. It can be said that cognition is gaining, managing, and using knowledge. Cognitive skills are drawn on the learning outcomes and measured with a test. The test produces a score and draws the difference between an individual's cognitive skills (Uno, 2008: 10-11).

Cognitive theory covers conscious mental activities such as thinking, knowing, understanding, and conceptual mental activities such as behavior, confidence, and expectation which later become the deciding factor to behave. Cognitive theory has one strong point in answering or responding to reticent behavior. The cognitive theory states that someone's behavior is caused by one stimulus; it is a physical object which influences someone in many ways. The cognitive theory tries to see what is happening between the stimulus and someone's answer to that stimulus. The cognitive theory sees how the stimulus is being preceded in someone.

Cognitive skills have an effect to acknowledge whether an adolescent can achieve academic success or not. Cognitive skills refer to the human brain's abilities to process, save, and extract information, including attention, memories, and reasoning. Those skills are the key o psychological elements for someone to accomplish an activity. According to Stadler (2016), nowadays, cognitive skill is one of the significant things in academic work which is being reached and stable. If all or certain cognitive skills are low, some information will be missing during processing information, reducing effective information output, and creating lower academic performance. Cognitive performance is essential in the learning process and has the benefit to be applied on higher and wider levels (Shi & Qu, 2021).

Cognitive skills are students' ability to think widely and conduct reasoning activities, and problems solving. Cognitive skills will influence knowledge mastery. Students' cognitive skills will help them to run the function in the learning process or wider area. The cognitive function focuses on the awareness of the process and gaining information. One of the cognitive variables that have not been explored yet is the teacher's cognitive style which is considered to have important potential in learning the second language. The creativity in written assessment has covered the combination of what has been learned from the cognitive point of view and instructional writing and brings advantages to the teachers, students, and policymakers, without being aggressive. Historically, academic writing teaching focuses on an object (such as exposition, descriptive, narrative, argumentative, and persuasive) and especially on writing and exposition argumentation.

Method

Research Design This is experimental research. The research design used a quasi-experiment design with a nonequivalent control group design. The subjects of this research were 27 students in the experiment group, and 28 students in the control group. The data collection techniques used test. The instruments in this research were adjusted to the data collection techniques. The technique is a test consisting of some questions to obtain students' cognitive skills.

The test used was a multiple-choice test consisting of 40 questions. Before the questions were used as research instruments, they had been validated by experts. The instrument was validated by 3 experts in the field of cognitive instruments and 5 practitioners in elementary schools who have a minimum educational background of a Master's Degree. After the question instrument was revised, according to the validator's suggestion, it was tested to determine the validity, reliability, difficulty level, and differentiation of the questions made. The analysis process used is ITEMAN (Item And Test Analysis) analysis. The results of the instrument validity test were analyzed using the ITEMAN application program.

The results of the analysis of the level of difficulty of the instrument questions using the ITEMAN application program can be seen in Table 1.

Based on the Table 1, it can be concluded that there are 12 question items which have easy level of difficulty, namely question items 1, 2, 10, 18, 20, 22, 25, 26, 33, 35, 37, and 39. 19 question items that have a medium level of difficulty are question items 3, 4, 5, 6, 8, 11, 12, 13, 14, 17, 19, 21, 23, 24, 27, 28, 29, 31, dan 36.; and 9. Question items that are difficult are question items 7, 9, 15, 16, 30, 32, 34, 38, dan 40.

The results of the instrument trial regarding the differential power analyzed using the ITEMAN application program can be seen in Table 2.

Table 1: Recapitulation of the Level of Difficulty of the Instrument Trial Results

No.	*Criteria*	*Question Number*	*Total*
1.	Easy	1, 2, 10, 18, 20, 22, 25, 26, 33, 35, 37, and 39.	12 questions
2.	Medium	3, 4, 5, 6, 8, 11, 1w2, 13, 14, 17, 19, 21, 23, 24, 27, 28, 29, 31, and 36.	19 questions
3.	Hard	7, 9, 15, 16, 30, 32, 34, 38, and 40.	9 questions

Table 2: Recapitulation of Differentiated Power of the Instrument Trial Results

No	*Criteria*	*Question Number*	*Total*
1.	Poor	8, 19, 21, 31, dan 33.	5 Questions
2.	Fair	3, 20, and 25.	3 soal
3.	Good	1, 2, 4, 5, 6, 7, 9, 10, 12, 13, 14, 15, 16, 17, 18, 22, 23, 24, 26, 27, 28, 29, 30, 32, 34, 35, 36, 37, 38, 39, and 40.	31 Questions
4.	Very Good	11	1 Questions

Based on the analysis of instruments regarding the differentiating power, it can be concluded that there are 5 questions in the poor category, 3 questions in the fair category, 31 questions in the good category, and 1 question in the very good category.

The conclusion from the data analysis above is that 35 test instruments meet the requirements of validity, reliability, difficulty level, and appropriate differentiation, so the researchers decided that 35 questions were used for the pretest and posttest questions. The questions used consisted of 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 35, 36, 37, 38, 39, 40. The pretest question was used to measure students' initial abilities before being given treatment. Posttest questions were used to determine student learning outcomes after using game-based interactive multimedia. Furthermore, researchers conducted a reliability test using Cronbach's Alpha. Based on the results of the ITEMAN analysis, the reliability of the instrument is 0.900 (>0.6) so it can be concluded that the instrument has good reliability.

Data analysis to test the hypothesis in this study used the t-test. However, previously a prerequisite test was carried out which began by using the analysis prerequisite test, namely the normality test and homogeneity test. The data used for the t-test is in the form of gain score results. A Gain score is an increase in value that can be known by using the difference between the posttest value minus the pretest value. Researchers used SPSS version 20 to go through the Independent Sample T-test.

Based on testing using the t-test, it will be known the difference in the average sample value in the experimental class compared to the average sample value in the control class. The hypothesis for the t-test is:

H_0 : There is no average difference between classes that use game-based interactive multimedia and classes that do not use game-based interactive multimedia.

H_i: There is an average difference between classes that use game-based interactive multimedia and classes that do not use game-based interactive multimedia.

Decision-making is done if $-t_{table} \leq t_{count} \leq t_{table}$, then H_0 is accepted, meaning that the cognitive abilities of experimental class students are not better than the control class. If -count < $-t_{table}$ or $t_{count} > t_{table}$, then H0 is rejected, meaning that the cognitive abilities of experimental class students are better than the control class.

The effect size calculation aims to determine the size of the effect of game-based interactive multimedia on the cognitive abilities of grade V elementary school students. Calculating the effect size using Cohen's d formula as follows:

$$d = \frac{x_1 - x_2}{S_{gab}}$$

with

$$S_{gab} = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_1 - 2}}$$

Description:
= average of experimental group
= average of control group
= total sample of experimental group
= total sample of control group
= variant of experimental group
= variant of control group (Thalheimer & Cook, 2002: 4).

The results of the effect size calculatio n are interpreted with the effect category can be seen in Table 3.4 as follows.

If the effect seen is 0 (d = 0), it is concluded that there is no effect given by one variable to another. In addition, if the d obtained is negative (-), then the variable has a bad effect on other variables (Lakens, 2013: 3).

Findings

The table below describes the 5th-grade elementary school theme 4 sub-theme 1 "*Peredaran Darahku Sehat*" learning outcomes in the experimental and control class.

Table 3: Size Effect Classification

The Size d	*Size Effect*
d ≥ 0,81	High
0,51 ≤ *d* ≤0,80	Medium
0,20 ≤ *d* ≤ 0,50	Low
0,01 ≤ *d* ≤ 0,19	Very Low

(Sawilowsky, 2009: 597-599)

The product test was done to know the effectiveness of games-based interactive multimedia implemented in the 5th grade of elementary school. The subjects are 27 students in the experimental group and 28 students in the control group. The data is the result of cognitive skills before and after games-based interactive multimedia was implemented in the experimental class and control class. Pretest data of cognitive skills in the experimental class using games-based interactive multimedia can be seen in this table.

Table 4 displays students' cognitive skills data before and after the implementation of games-based interactive multimedia in an experimental class. Before games-based interactive multimedia was implemented, 27 students in experimental class had a 51.96 average score; a standard deviation of 10.967; a minimum score of 34; and a maximum score of 71. After the students used games-based interactive multimedia, they got an 83.44 average score; a standard deviation of 7.832; a minimum score of 66; and a maximum score of 94. Generally, pretest and posttest cognitive skills in the control class can be seen in table 5.

Table 5 presents the pretest and posttest of cognitive skills in the control class. Pretest data from 28 students got a 51.61 average score; deviation standard of 9.953; minimum score of 34; and a maximum score of 71. Posttest data obtained an average score of 74.14; deviation standard of 5.804; minimum score of 60; and maximum score of 86.

There is an improvement in cognitive skills in both experimental class and control class seen from average score students pretest and posttest improvement.

The effectiveness test was done using the normality and homogeneity test, and balanced test. The student's cognitive skills analysis result on the effectiveness test is shown in Table 7.

Based on data analysis of cognitive skills proceed by SPSS ver. 20, it can be obtained that data normality tested by Kolmogorov-Smirnov, significant level pretest score result is 0.200 for experimental class and 0.200 for control class. Therefore, the data is normally distributed. The significant level of posttest score is 0.164 for the experimental class and 0.92 for the control class. Thus, the data is normally distributed. Homogeneity pretest data tested using Levene's test generates a significant level score of 0.506, so it can be concluded that pretest data of experimental class and control class come from homogenous variants. After the normality test and homogeneity test had been conducted, the balance test pretest score was held and it was obtained a significant 0.126, then it can be concluded that the data come from two balanced populations. Posttest homogeneity data produce a significant level score of 0.085. As a result, both variants are homogenous groups. The significance of the post hoc test was the t-test using Independent Sample T-test. The analysis result using SPSS shows that the t count is 5.205 (>2.008) so it can be concluded that H_0 is rejected or there is a significant cognitive skills difference between the experimental class and the control class.

The data obtained from the pretest and posttests in the two classes were analyzed using the gain score. Gain score analysis aims to know the students' cognitive skills improvement in the experimental and control classes. The result of gain score analysis in experimental and control classes can be seen in table 8

Based on the data in table 4.33 it can be seen that the minimum score, maximum score, and average gain score of

Table 4: Pretest and Posttest Result of Cognitive Skills in Experimental Class

Types of Tests	N	Minimum	Maximum	Mean	Deviation Standard
Pretest	27	34	71	51.96	10.967
Posttest	27	66	94	83.44	7.832

Table 5: Pretest and Posttest Result of Cognitive Skills in Control Class

Types of Tests	*N*	*Minimum*	*Maximum*	*Mean*	*Deviation Standard*
Pretest	28	34	71	51.61	9.953
Posttest	28	60	86	74.14	5.804

Table 6: Score Improvement in Experimental Class and Control Class

		Average Score		
No	*Student Group*	*Pretest*	*Posttest*	*Improvement*
1.	Experimental	51.96	83.44	61%
2.	Control	51.61	74.14	44%

Table 9: Gain Score Data Analysis

Test	Type of Test	Sig.	Result	Conclusion
Normality	*Kolmogorov Smirnov*	Experiment = 0,200	H0 accepted	Data Normal
		Control = 0,073	H0 accepted	Data Normal
Homogeneity	*Levene's test*	Sig. = 0,391	H0 accepted	Data Homogen
Difference	*Independent Sample t-test*	Sig. = 0.000 Tcount.= 3,821	H0 rejected	There is difference

the experimental class are higher than the control class' score. The minimum score of the experimental class is 14, while the minimum score in the control class is 6. The maximum score in the experimental class is 46, while the maximum score in the control class is 43. The average gain score in the experimental class is 31.48, while the average gain score in the control class is 22.53. Based on the results, the average of the experimental class is higher than the average of the control class. Then, it can be concluded that the gain score in the experimental class is higher than the gain score in the control class.

Gain score data of control class and experimental class are being analyzed using normality test, homogeneity test, and t-test. The result of the gain score analysis is presented in Table 9.

Based on gain score data analysis proceeded by SPSS Ver. 20, normality data can be obtained by Kolmogorov-Smirnov, the significant lever is 0.200 for experimental class can 0.073 for control class, so it can be concluded that distribution data is normal. Gain score homogeneity data tested by Levene's test show a significant level of 0.391, so it can be concluded that gain score data in the experimental class and control class is homogeny. After the normality test and homogeneity test had been done, the post hoc test was done which was a t-test using Independent Sample T-test. The result shows that the t_{count} is 3.821 (>2.008), so it can be concluded that H_0 is rejected or there is a significant difference in the improvement of cognitive skills between the experimental class and control class.

Based on the data analysis result above, it can be concluded that games-based interactive multimedia influence students" cognitive skills. To understand the effectiveness of games-based interactive multimedia, the effect size is used to analyze the data. The result scored 1.40, therefore it belongs to the high category. It shows that games-based interactive multimedia is effective to be applied with high category effectiveness in the topic "*Peredaran Darahku Sehat*" (My Healthy Blood Circulatory) in the 5th grade of school in Surakarta city.

The requisite test was conducted by giving pretest questions to both groups. The prerequisite test result shows that the data distribution on the two classes is normal and the variant is homogeny. The students in the experimental class studied using games-based interactive multimedia, while the students in the control class did not use games-based interactive multimedia. After one sub-theme material was delivered, the students in the two groups did posttest questions.

The posttest outcomes show that there is a difference in cognitive skills between the experimental class and the control class. The class using games-based interactive multimedia has a higher average than the control class. Before the t-test was conducted, a gain score test had been done. The gain test calculation shows that there is cognitive skills improvement in the experimental class and it is higher than in the control class.

Discussion

Games-based interactive multimedia is effective to be applied to the 5th-grade elementary school theme 4 sub-theme 1 *"Peredaran Darahku Sehat"*. This finding is in line with the research result that video games can improve cognitive skills like memorizing ability (Adkins, 2014). Another research also presents the same result that computer-based games can improve students; achievement in cognitive skills process (Chuang & Chen, 2009). The game content in interactive multimedia not only brings benefits but also entertains the students because it makes learning media more effective.

The effectiveness of learning media is also known from effect size calculation which shows that games-based interactive multimedia has high category effectiveness to improve elementary school students' cognitive skills. Interactive multimedia eases the students' studying because it displays pictures so the material is seen clearer. It supports the research done by Ebata (2008) that the students prefer visual aid to obtain new knowledge and memorize so they understand the material better.

Interactive multimedia used by the students also makes the students study actively. Evan & Gibbons (2007) has done the research and results that an interactive system facilitates deep learning and makes students active during the teaching-learning process. The interactive system also provides opportunities for students to study independently.

The use of various learning media has made students enthusiastic about studying. Interactive multimedia not only show texts but also shows images and videos. This is following research that shows the more various learning media used, the more information gaps by the students and it improves students learning outcomes (Babiker, 2015).

Teaching with games-based interactive multimedia makes learning fun for the students. It corresponds with the research done by Ahmad and Jafaar (2012) that integration and implementation of computer games in the class help the student students study effectively and fun. The students enjoy learning with technology because they see technology as something interesting and entertaining (Heafner, 2004). This theory is supported by the research which proves that educational games computer-based makes the students happy and enjoy learning, therefore students feel motivated and willing to study hard (Jong, et al, 2008).

Integrated interactive multimedia in learning facilitates the teachers to reach teaching goals. It happens because the use of multimedia is proven effective to be implemented in the educational field so the teachers need to develop multimedia as learning media. Integrating technology in the class also brings benefits to preparing the students for the future. The teachers and policymakers makers of education are suggested to integrate technology into the teaching-learning process.

The use of game media makes it easier for teachers to convey material. Media can help students in understanding the material, as well as help teachers to convey information to students from abstract to more concrete. This is in line with Piaget's theory (Franzoi, 2011) which states that the age of learners 7-11 years is included in the concrete operational stage. Piaget said that cognitive development is a continuous process and all children, even in the context of different environments and cultural diversity around the world, have the same sequence of cognitive development (Hockenbury & Hockenbury, 2011). The games that teachers apply to learn produce concrete experiences for learners, learners can construct knowledge by developing their ideas.

The impact of learning media in receiving information from students is that the information conveyed through audio-visual media provides a meaningful and memorable learning experience for students. This is in line with Brunner's Theory stated by Hawa (2012) that audio-visual media is included in the iconic stage. This iconic stage is based on internal thoughts, namely, knowledge is presented through a series of images or graphics performed by children so media is needed in learning. Based on this, learning with game media is included in the iconic stage, because the knowledge gained by students can be realized in visual form through concrete situations.

The use of this media is a novelty that teachers apply so that the thematic learning process is more meaningful than previous learning. This is in line with neuroscience theory in cognitive neuroscience research which states that various environmental factors can arouse and maintain students' attention. These factors include importance, novelty, intensity, and movement. Teachers in learning can determine how to build these factors into learning activities that learners do (Schunk, 2012). The teacher in applying Neuroscience Theory is providing a game-based learning media. Learners must try to complete the game according to their level.

Fun learning by using game media also affects students' interest in learning. Learning interest is obtained by the presence of challenges at each level of material so that students can receive information easily during learning. In line with this, Schunk (2012: 586) explains that willingness or interest is used to carry out intended actions by activating mental perceptions that function as behavioral direction.

Based on these findings, teachers need to implement games-based interactive multimedia to improve teaching quality. Games-based interactive learning media makes studying interesting and fun for the students. The displays on interactive multimedia consist of text, audio, images, and videos to make the students understand the materials better and the games on the interactive multimedia help the students learn actively. The teachers are recommended to use games-based interactive multimedia to the students can give better responses and the learning goals can be achieved well.

Hew and Brush (2007) explain the integration of technology in educational fields as the use of all kinds of technology by the teacher in the teaching-learning process to improve students' achievement. They believe that technology integration has contributed to the teaching-learning process being widely spread. Moreover, there are some mechanism factors to accept and decide to use technology individually.

Çankaya & Karamete (2009) has researched the use of mathematics computer games towards students' behavior. The result of that research shows that students' behavior towards mathematics and students' behavior toward educational computer games has a positive value. Demirbilek & Tamer (2010: 714) researched teachers' perceptions of teaching mathematics based on the computer game. The result of this research shows that computer games directly contribute to teach mathematics. The uses of computer games allow the students to understand mathematics. Eow et al., (2010: 106) researched the development of computer games with an appreciative teaching approach. The result shows that computer games and the approach give big opportunities for the students to improve their creative perspective. Chen and Sun (2012: 1273) present a result where video-based

multimedia produces the best teaching and influences positive emotion. Moreover, dynamic multimedia material containing video and animation suits the visualizer more than the static multimedia picture. Navvarete (2013: 331) has carried out research and resulted that students experience positive involvement in creative thinking and synthesizing social problems to build their understanding of digital interactive educative creating games. Sun, et al., (2015: 559) stated that material implementation in interactive multimedia can improve students' concentration during English lessons, improve interaction with the teachers, build students' ability to express themselves, and increase students" learning motivation. Vasalou et al., (2017: 175) researched perception in constructing social relationships towards digital games based. The result shows that the implementation of digital games on dyslexia students gives influences, where the children spontaneously involve in "speaking game: related to game, content, behavior, and experience.

Interactive multimedia learning media is an integrated digital media combined with visual, audio, moving pictures, and graphics in digital computerization which allows other people to connect and communicate with the data for the correct aims. Interactive multimedia learning media is a teaching medium that attracts student interests and enhances students learning motivation during the teaching-learning process. The students become more active and solve problems easier, analyze and define a problem using interactive multimedia-based learning media. Students not only memorize the materials but also develop critical thinking and creative thinking (Chasanah, 2019).

The hypothesis was tested to know the effectiveness of games-based interactive multimedia applied to the 5th grade of elementary school. The data obtained from the cognitive skills pretest result in the experimental class got an average of 51.96, and the average posttest of cognitive skills in the experimental class is 83.44. The improvement in pretest and posttest is 61%, while the average cognitive skill pretest of the control class is 51.61, and the average cognitive skills posttest of the control class is 74.14. The average improvement of the pretest and posttest in the control class is 44%.

The data obtained from the pretest and posttests from both classes were analyzed using the gain score. Gain score analysis aims to know the students' cognitive skills improvement in experimental class and control class. Gain score analysis results from both classes show that the average for the experimental class is 31.48 and the average for the control class is 22.53. Therefore, it can be concluded that the gain score of the experimental class is higher than the gain score of the control class. It can interfere that the use of interactive multimedia in the teaching-learning process will improve students learning interest and motivation than only using a monotonous teaching method.

The research done by Holila Pulungan in 2021 entitled The Use of Interactive Learning Media for Teachers in Rural Areas. The result of this research shows that interactive learning is learning media used and developed by teachers during the teaching-learning process. Interactive multimedia learning media can enhance students' interest and motivation and influence the students' learning quality and make students learning competence better.

Another research done by Suhardi et al., in (2020) entitled The Effectiveness of Science Multimedia Interactive Based on Aurora 3D Presentation on Student Learning Outcomes. The result of the research shows the use of Aurora 3D Presentation-based interactive multimedia and conventional learning on the students on environment pollution material. Aurora 3D Presentation-based interactive multimedia is effective in the teaching-learning process because it increases the students' outcomes and motivates students to study.

Conclusion

The hypothesis test result using independent sample t-test show that The result count of gain score shows that the t_{count} is 3.821 (>2.008), so it can be concluded that H_0 is rejected or there is a significant difference in the improvement of cognitive skills between the experimental class and control class. To understand the effectiveness of games-based interactive multimedia, the effect size is used to analyze the data. The result scored 1.40, therefore it belongs to the high category. It shows that games-based interactive multimedia is effective to be applied with high category effectiveness in the topic "*Peredaran Darahku Sehat*" (My Healthy Blood Circulatory) in the 5th grade of school in Surakarta city. Teachers are suggested to use games-based interactive multimedia because it is suitable for the students' environment where they like playing and can improve students' cognitive skills.

Nevertheless, there is some limitation in conducting this research; they are: (1) games-based interactive multimedia is only developed on theme 4 sub-theme 1 "*Peredaran Darahku Sehat*", (2) learning outcomes in this research only focuses on the cognitive aspect, (3) the implementation of preliminary field testing had to copy the file manually to the computer because the school has not got server computer which can distribute the file automatically, (4) this research cannot control another variable which influences to the student's cognitive skills improvement such as teacher teaching skill, studying frequency at home, and other factors influencing students' cognitive skills.

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