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Comparing ICT-assisted take-and-give models with expository models in enhancing students' logical thinking

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Abstract

This research aimed to compare the effectiveness of the ICT-assisted Take and Give learning model with the Expository model in enhancing students' logical thinking skills in mathematics. The study addresses the challenges teachers face, including limited strategies and inadequate learning media, which hinder students' logical reasoning development. A quasi-experimental design with a non-equivalent Control Group was used, involving 59 students sampled purposively from a population of 354 at MIN 1 Sleman. Data were collected using validated logical thinking tests and analyzed with an Independent Sample T-test. The results revealed a significant difference, with the Take and Give model showing a higher average score. This indicates that the ICT-assisted Take and Give approach is more effective than the Expository model in improving students' logical thinking. This study contributes to educational research by highlighting the potential of ICT-supported interactive models to foster critical thinking in mathematics.

Keywords: Expository model; logical thinking; motivation; take and give model.

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1. INTRODUCTION

Mathematics is an abstract lesson that requires students to be able to think rationally and logically (Rosmala, 2021). In improving the learning system, a teacher should have creativity, especially in applying the mathematics subject (Yuniar et al., 2021). According to Siregar (2017), mathematics subject is a subject assumed as a horrifying and difficult subject to be understood by most students. However, on the side, mathematics is a subject that is closely related to daily life and is a skill support in the 21st Century.

The 21st century has seen the development of the 2013 curriculum, aimed at equipping students with critical thinking skills (Redhana, 2019). This curriculum emphasizes fostering high-level reasoning abilities, requiring students to develop higher-order thinking skills. These include understanding, analyzing, problem-solving, finding solutions, and effectively communicating their ideas with teachers and peers (Cao, 2022). Logical thinking is a key competency essential for students to successfully engage with the 2013 curriculum (Saraswati & Agustika, 2020).

In developing the logical thinking skill maximally teacher should apply an appropriate computation learning model, besides that learning should be supported by the learning media, so students do not feel bored in following the learning process (Ragonis et al., 2024; Aytekin & Topçu 2024). It means, that if students feel bored with the lesson, it will affect the learning result (Rimbarizki & Susilo 2017). However, according to the interview result with the homeroom teacher of MIN 1 Sleman on 20th September 2021 related to the student's logical thinking skills stated that most teachers did not apply the learning strategy acquiring students to learn actively in class, therefore students felt bored when following the learning process. The mathematic learning in MIN 1 Sleman applies an expository learning model. According to Ragin et al., (2020) expository learning is learning applied by delivering the material orally to students.

The second problem is most teachers are not accustomed to utilizing the learning media as a media that can be used to improve students learning motivation and logical thinking skills (Tazhenova et al., 2024; Mokmin et al., 2024; Yu et al., 2023). This case is due to the lack of learning media in MIN 1 Sleman. The homeroom teacher stated that students' will to learn is important in all subjects mainly in mathematics subject since internal motivation is very decisive in students' ability to think logically.

The logical thinking skills in learning mathematics, are one of the intelligences that should be owned by students. This statement is in line with the statements of Rachmantika & Wardono (2019), Santoso & Utomo, (2020), and Novitasari (2016) that learning mathematics is learning that requires students to be able to think logically since learning mathematics is the root of knowledge and a difficult and abstract subject. Therefore, mathematical logical intelligence in students could be improved if teachers could develop the students' logical thinking skills (Suhendri, 2011).

To be able to improve students' logical thinking skills, the teacher as an educator is acquired to give a new creativity in learning to make an interesting and comfortable learning. However, the real condition faced is still far from the expectation. Based on the interview result with the headmaster of MIN 1 Sleman, states that when the headmaster supervised the supervision in classroom, teachers applied the learning model gaming base in ones or twice, but it could not be done continuously since they were busy with the event or administration that must be done, besides that, the learning media related to the mathematics is still limited. Another statement was that if teachers only focus on the students, the maximal result could be obtained relating to prestige, motivation, ability logical, and critical thinking skills.

Regarding the interview result, teachers are required to create innovation by applying an interesting, imaginative, and innovative learning model to be able to explore students to develop their knowledge and creativity. One learning method deemed effective and suitable for application during the COVID-19 pandemic is the Take and Give model supported by ICT simulation. This approach was selected based on its compatibility with government health protocols and its adaptability to pandemic-related constraints.

In this research, the Take and Give learning model assisted by ICT simulation is implemented in pairs while maintaining physical distancing. Each student is provided with a 15 x 10 cm card containing material previously

explained by the teacher using ICT tools such as an LCD, pen tablet, and mathematics learning media. The Take and Give model involve students working in pairs, where each is responsible for both receiving and sharing the material delivered by the teacher (Setiyawan & Yunianta, 2018; Theriana, 2019). This approach is expected to enhance students' logical thinking skills through interactive and collaborative learning.

The model was applied to fifth-grade students because the research material aligns with their curriculum, and the classroom is equipped with an LCD to support the implementation. According to Jean Piaget, children at this developmental stage demonstrate mature logical thinking skills when working with physical objects, although they may still struggle with abstract reasoning. Their egocentrism decreases, and they perform tasks more effectively in structured environments with tangible support (Jarvis, 2010). This makes fifth grade an ideal setting for applying the Take and Give learning model to develop logical thinking skills.

1.1. Purpose of study

Based on the description, the researcher is interested in conducting a quasi-experiment research by applying a take-and-give learning model assisted by ICT simulation on mathematics subjects in fifth grade. The simulation learning model can present something that cannot be presented, and it can be presented in an imitation form so that with the implementation of the take-and-give learning model assisted by information and communication technology simulation (ICT), learning becomes more interesting and fun.

2. METHOD AND MATERIALS

This research is quasi-experimental research involving two classes, such as experimental and control classes.

2.1. Purpose of study

The population of this research were all students of MIN 1 Sleman, the number population and sample are 354 and 59 students. The sample was taken by purposive sampling technique, where the sample was taken based on existing considerations, therefore the sample should be truly representative (Sugiyono, 2007a). The design used in this research is a non-equivalent control group design. This design provides the same material given in the control class and the experimental class, but the treatment given is different (Sugiyono, 2007b). In this research, the experimental class used the take-and-give learning model assisted by ICT simulation and the control class used expository learning.

2.2. Data collection tool

The data collection instrument in this research was a test instrument in the form of 20 multiple-choice questions. The test instruments were in the form of pre-test and post-test questions that have been tested and validated by several material experts and content experts. The learning instruments used were lesson plans and teaching materials.

2.3. Data analysis

The analysis of the test instruments consisted of validity analysis, reliability analysis, difficulty level analysis, and discriminatory power analysis. Validity analysis consists of content and construct validity. Data analysis in this research used an independent sample t-test where the test required prerequisite tests, such as normality and homogeneity tests. When the prerequisite test is met, the data can be analyzed by using the independent sample t-test.

3. RESULT

3.1. The data on students' early logical thinking skill

Data on students' early skills was obtained from pre-test score which is students' skill before being given treatment. The average score for the experimental class was 68.55, higher than the control class's average score of 62.50. The normality test results showed that the pre-test scores in both classes were normally distributed, with significant probability values in the Kolmogorov-Smirnov test of 0.200 > 0.05 for the

experimental class and 0.179 > 0.05 for the control class. Additionally, the homogeneity test yielded a significant value of 0.393 > 0.05, indicating that the pre-test scores in both classes had homogeneous variance.

Since the pre-test data were both normally distributed and homogenous, a T-test was conducted to determine the equivalence of the average scores before treatment. The T-test resulted in a significant value of 0.125 > 0.05, confirming that the experimental and control classes had similar initial skill levels prior to the intervention. More explanation can be viewed in Table 1 below.

Table 1

Data on students' early skill

Mean		Normality Test		Homogeneity Test	T-Test
Experiment	Control	Experiment	Control		
68,55	62,50	0,200	0,179	0,393	0,125

3.2. Data on students' final logical thinking skill

Post-test data, representing students' skills after the treatment, revealed an average score of 83.87 for the experimental class, significantly higher than the control class's average score of 73.21. The normality test results for both classes indicated that the post-test scores were normally distributed, with Kolmogorov-Smirnov significance values of 0.200 > 0.05 for both classes. The homogeneity test yielded a significant value of 0.213 > 0.05, confirming that the post-test scores of both classes had homogeneous variance.

Given that the post-test data were both normally distributed and homogenous, a T-test was performed to compare the average scores after the treatment. The T-test resulted in a significant value of 0.002 < 0.05, indicating a statistically significant difference in the final skills of the experimental and control classes. Detailed data and comparisons are presented in Table 2.

Table 2

Data on students' final skill

Mean		Normality Test		Homogeneity Test	T-Test
Experiment	Control	Experiment	Control		
83,87	73,21	0,200	0,200	0,213	0,002

3.3. Data of normal gain test result of logical thinking of experimental and control class

The analysis in this research utilized the normalized gain score, calculated as the difference between the post-test and pre-test scores, divided by the difference between the maximum possible score and the pre-test score. Prior to conducting a comparative analysis of the average discrimination, preconditions for the final logical thinking test were examined. If the normalized gain scores are both normal and homogenous, an Independent Sample T-test is employed to test the research hypothesis. However, if the scores are not normal or homogeneous, the Mann-Whitney U-test is applied as an alternative. The normalized gain data for the logical thinking skills of the experimental and control classes are presented in the following section.

Table 3

Normal data of logical thinking gain test

Mean		Normality Test		Homogeneity Test
Experiment	Control	Experiment	Control	
0,50	0,31	0,06	0,06	0,155

Based on Table 3, the average score of the normal gain result of logical thinking is 0.50 for the experimental class and 0.31 for the control class. The average score shows that the experimental class is higher than the control class with a difference of 0.19. the significant probability score in column Kolmogorov Smirnov = 0.06 > 0.05, and the significant score for the control class is 0.06 > 0.05, indicating that the data is distributed normally. Meanwhile, the inhomogeneity test using a 95 percent confidence level shows the significant score is 0.155 > 0.05; so, the data has the same variance or homogenous.

3.4. Research hypothesis examination

Hypothesis testing was conducted by using a two-sample unpaired discrimination test or independent sample t-test after fulfilling the assumption test regarding which one is more effective between take and give learning model with ICT simulation-assisted learning compared with mathematics learning using expository learning to improve students' logical thinking skills. The result of the t-test shows that in the independent sample test table, the assumption of homogeneous variance (fulfilled), then the value used in the hypothesis test is the value in the first row (equal variances assumed). The following table shows the results of the hypothesis test on the normal gain test value of logical thinking:

Table 4

The result of students' logical thinking skills normal gain T-test

Statistic *(T*)*	***Mean difference***	***Sig.(2-tailed)***
3,348	0,197	0,00

Based in Table 4, the statistical value and mean difference respectively are 3.348 and 0.197, meanwhile, the significance value is 0.00 0.05. Therefore, based on this significant value it can be stated that H0 is rejected, and Ha is accepted. It can be observed from the value of sig.2 tailed on the line (equal variance assumed) = 0.00 0.05. So, it can be concluded that at the 95 percent confidence level, the average normal gain in logical thinking skills of students by using the take-and-give learning model assisted by ICT simulations is higher than the average normal gain in logical thinking skills of using expository learning.

4. DISCUSSION

From the description of pre-test data of students' logical thinking skills, it can be observed that both of experimental and control class has the same logical thinking skills. This case can be observed based on the conclusion of the T-test result stating that the pre-test average score of students' logical thinking is the same. Based on the T-test result of the post-test of logical thinking, it can be concluded that the average score of students' logical thinking is different. This case can be observed from the average score of logical thinking skill of the experimental class is higher than control class.

After assessing the initial conditions of both the experimental and control classes, treatments were applied. Class VA served as the experimental group, utilizing the Take and Give learning model assisted by ICT simulation, while class VB functioned as the control group, employing the expository learning model. Both approaches aimed to enhance students' logical thinking skills with the support of learning media. In both classes, the learning media included transparent simulation tools for 3D geometric shapes. For the experimental class, the material on 3D geometry was presented using PowerPoint slides displayed on an LCD projector, supplemented with interactive media to support the content. This approach helped students visualize the material more clearly, promoting realistic and logical thinking.

Learning activities in the experimental class are carried out in groups of two students or pairs. Teaching and learning formats carried out in small groups encourage teachers to reduce one-way communication. Learning in small groups encourages the creation of a greater possibility for communication, two-way and multi-way educational interactions are more visible to students compared to lecture learning, where the teacher tends to be the center of the teaching and learning process.

The material that has been memorized by students in the experimental class from take-and-give cards will be asked by the teacher to find out how far students have mastered the material that has been given. The teacher randomly asked some students due to the limited time and the learning process was quite slow in adjusting the applied learning model. The role of the teacher in managing the class properly is quite important so that students can be more active in learning and follow the learning process according to the procedures that have been planned in the lesson plan. In its application, the take-and-give learning model assisted by ICT

simulation requires the readiness of teachers and students to collaborate well. Teachers should be ready to become mentors as well as tutors for students so that they can provide encouragement and assist in mastering students' logical thinking skills in working on multiple-choice questions by referring to the logical thinking indicators.

The material provided by the teacher intake and give learning group learning model based on ICT simulations can help students participate more in learning, especially in learning mathematics by asking the teacher a lot of material that they do not understand, practicing applying the material obtained in building media, understanding material, and memorize the material given by the teacher.

Some of the limitations in implementing a take-and-give learning model assisted by ICT simulation are a different atmosphere and it is quite new for students, so it is necessary to adjust the time and situation. Another thing that needs to be carefully planned is timing; during the implementation of this learning model, some students are quite noisy so the practice questions given are not adequate.

In testing the hypothesis using normal gain data score of logical thinking has been obtained. Based on the results of the independent sample t-test on normal gain data of logical thinking, the value of sig (2. tailed) = 0.00 < 0.05, which means that Ho is rejected, and Ha is accepted. Based on the data obtained, it can be concluded that at the 95 percent confidence level, in general, the average normal gain of students' logical thinking skills using take and give learning model assisted by ICT simulation is higher than the normal gain average of students' logical thinking skills using expository learning, and it means that take and give learning model assisted by ICT simulation is more effective in improving students' mathematical logical thinking skills than using expository learning.

Learning mathematics using the take-and-give learning model assisted by ICT simulations is more effective since the experimental class students learn not only centered on the teacher but students also get the opportunity to memorize the material that has been given on the take-and-give cards that they get themselves and obtained by their partners. Therefore, students are free to look for other pairs with different materials to memorize and strengthen the material that has been obtained previously. The learning process by presenting media related to the material being taught will encourage the potential to carry out mathematical activities to a higher level of thinking, one of which is logical thinking.

In the control class, students do not have the same opportunities as experimental class students in other words, students in the control class have fewer opportunities to interact as students learn by using expository learning. In expository learning, the teacher conveys the material with the help of learning media as it was carried out in the experimental class, providing examples and practice questions. The improvement in students' logical thinking in the experimental class occurred because learning with the take-and-give learning model assisted by ICT simulations allowed students to help each other in learning to get a fun learning experience.

5. CONCLUSION

Based on the research result and analysis of the hypothesis testing conducted, it can be concluded that take and give learning model assisted by ICT simulation is more effective than expository learning in improving students' logical thinking skills. It can be observed from the results of the T-test obtained sig value. 0.00 < 0.05 then it can be interpreted that Ho is rejected and Ha is accepted.

Based on the data obtained, it can be concluded that in general, at the 95 percent level of confidence, the average normal gain of students' logical thinking skills using the take-and-give learning model assisted by ICT simulations is higher than the average normal gain of students' logical thinking skills using mathematics learning by expository learning. It means that the take-and-give learning model assisted by ICT simulation is more effective in improving students' mathematical logical thinking skills than using expository learning.

Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: The study adheres to the ethical guidelines for conducting research.

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