



Discovery Learning Through Educandy: Its Effectiveness on Students' Critical Thinking Ability and Self-Confidence

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ABSTRAK

Matematika merupakan bidang ilmu yang mendorong pemikiran kritis, imajinatif, dan metodis sehingga menjadi bagian integral dari pendidikan di semua jenjang, mulai dari sekolah dasar hingga perguruan tinggi. Berpikir kritis dan self-confidence merupakan hal penting yang harus dikuasai siswa dalam pembelajaran matematika. Dengan model discovery learning menggunakan web educandy membuat belajar lebih manis. Penelitian ini bertujuan menganalisis keefektifan model pembelajaran discovery learning berbantuan web educandy terhadap kemampuan berpikir kritis dan self-confidence pada matematika kelas IV sekolah dasar. Jenis penelitian ini menggunakan penelitian kuantitatif. Metode yang digunakan dalam penelitian ini yaitu metode eksperimen semu (Quasi Experiment) dengan Posttest Only Control Group Design. Populasi penelitian ini berjumlah 40 peserta didik dengan sampel kelas IVA terdiri dari 20 peserta didik sebagai kelas eksperimen dan kelas IVB terdiri dari 20 peserta didik sebagai kelas kontrol. Data motivasi belajar diperoleh dari hasil angket, sedangkan data hasil belajar diperoleh dari hasil tes pilihan ganda. Teknik analisis menggunakan statistik deskriptif dan statistik inferensial atau uji-t. Hasil penelitian ini menunjukkan bahwa model discovery learning berbantuan educandy berpengaruh terhadap kemampuan berpikir kritis dan self-confidence siswa.

ABSTRACT

Mathematics is an area of knowledge that encourages critical, imaginative, and methodical thinking so that it becomes an integral part of education at all levels, from elementary school to university. Critical thinking and self-confidence are important things that must be mastered by students in learning mathematics. With the discovery learning model using the educandy web it makes learning sweeter. This study aims to analyze the effectiveness of the web-assisted discovery learning model of educandy on critical thinking skills and self-confidence in mathematics in grade IV elementary schools. This type of research uses quantitative research. The method used in this research is quasi-experimental method with Posttest Only Control Group Design. The population of this study consisted of 40 students with a sample of class IVA consisting of 20 students as the experimental class and class IVB consisting of 20 students as the control class. Data on learning motivation was obtained from questionnaire results, while data on learning outcomes was obtained from multiple choice test results. The analysis technique uses descriptive statistics and inferential statistics or t-test. The results of this study indicate that the educandy-assisted discovery learning model influences students' critical thinking skills and self-confidence.

1. INTRODUCTION

Mathematics is an area of knowledge that encourages critical, imaginative, and methodical thinking so that it becomes an integral part of education at all levels, from elementary school to university (Antara et al., 2020; Litke, 2020). The Ministry of Education and Culture emphasizes that learning Mathematics encourages students' logical, critical, analytical, systematic, and innovative thinking abilities, so the policymakers should include those aspects in the education curriculum in any level of education (Dare et al., 2018; Putri et al., 2019). Mathematics education plays an important role in shaping students' character and improving their ability to think critically and creatively (Tanjung & Aminah Nababan, 2019; Widodo & Kartikasari, 2017). According to the Ministry of Education and Culture, regarding emotional

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attitudes, students should present mathematical attitudes, such as thinking logically, being thorough, sincere, and responsible in dealing with problems, and not easily giving up (Ibama et al., 2018; Snegurenko et al., 2019). The attitudes highlight the importance of learning math concepts and developing good study habits. In achieving the goals of learning mathematics, it is important to use approaches, tactics, prototypes, and techniques related to characteristics (Amamah et al., 2016; Freeman et al., 2020). These characteristics must be exciting and motivating, delivering entertainment, challenge, and inspiration for actively participating students. The teachers must create collaborative situations and provide sufficient space for student initiative, creativity, and independence (Amiryousefi, 2017; Mamahit et al., 2020). In addition, these tactics must be responsive to individual student's talents, interests, abilities, and physical and psychological development (Junaid & Baharuddin, 2020; Zubaidah, 2018). In addition, teachers need to show creativity when combining various learning media (Antara et al., 2022; Antara & Dewantara, 2022). Utilizing the learning media must be easily accessible to students in their environment. According to the Ministry of Education and Culture regarding the 2013 Curriculum for primary school and Madrasah Ibtidaiyah (Islamic primary school), implementing learning activities requires various media and learning resources (Baiduri et al., 2019; Misri & Zhumni, 2013). Teachers may use electronic media such as software and document files, videos, films, the internet web, and games (Geni et al., 2020; Wahyuni et al., 2018). Furthermore, students' social environment can be used as a learning resource to develop their character and attitudes (Karta et al., 2022).

Teaching mathematics has two purposes. It provides knowledge of mathematical concepts and encourages students' critical, logical, and accurate problem-solving skills (Kamid et al., 2020; Nofrion & Wijayanto, 2018). Mathematics education does not only involve the presentation of formulas and concepts but also their practical application in daily life, providing students with information relevant to their daily lives. Therefore, students are expected to be actively involved with mathematical concepts and think creatively and critically in their application (Indarti & Pramudya, 2018; Trimahesri et al., 2019). In contemporary education, it is crucial to consider the diverse characteristics of students in teaching and learning activities. Thus, schools must adapt their pedagogical approach to suit each student's unique learning style, intelligence, and characteristics. This is because students are the fundamental goal of all educational activities, and failure to account for individual disparities can lead to misunderstandings (Dare et al., 2018; Kusumah et al., 2020).

The researcher found problems in the learning process at Muhammadiyah Bekonang Primary School. The teacher uses different learning models from students' characteristics, environment, and teaching materials. In this case, the teaching approach is still teacher-centered, with less proactive and creative involvement of students in learning mathematics and overly reliant on traditional teaching and assessment methods. As a result, students are less enthusiastic in class and even fall asleep. Interviews with teachers revealed that using instructional media, especially IT-based media, could have been more optimal due to limited school facilities and infrastructure and the teacher's lack of knowledge in this field. These issues may be apparent in the classroom, as some students are not paying attention or engaged in off-topic talks, leading to unfavorable impressions of mathematics learning and boredom.

Critical thinking skills are essential for students and enable them to solve various academic and daily problems (Ramdani et al., 2021; Sagala & Effiyanti, 2019). Students who develop critical thinking skills are more likely to succeed in solving complex problems (Syafuruddin & Pujiastuti, 2020). Critical thinking skills are also important for students in mathematics classes (Purwati et al., 2016; Zulkarnain et al., 2021). However, many students struggle with understanding and learning mathematics. This can be seen from a survey conducted on eight grade IV students at Muhammadiyah Bekonang Primary School, in which six students had difficulty learning mathematics. Student learning outcomes, as measured by the Minimum Integrity Standards (KKM) 68 set by schools, are also low. The test results show that 55% of the students fail to complete their studies. This indicates the need for improvement in the learning process. A course is considered successful if more than 85% of its students pass.

Educandy Web Media is a web-based application that aims to "sweeten learning." With Web Educandy, you can create fun online educational games. Games created using Web Educandy are educational and engaging, making learning fun. This program offers a basic UI that even inexperienced users may comprehend. Teachers use Web Educandy to design and create a series of questions related to the taught material during the learning process, which they can reuse when assessing quizzes and tasks. Engaging in interactive assessments helps students develop interest and enthusiasm for answering questions. According to the aforementioned background, this study aims to analyze the effectiveness of the web-assisted discovery learning model of educandy on critical thinking skills and self-confidence in mathematics in grade IV elementary schools.

2. METHOD

The research was conducted at Muhammadiyah Bekonang Primary School, Sukoharjo Regency. The researcher employed quantitative research through quasi-experimental methods. The experimental group received was included, and the control group did not. This research utilized a posttest-only control group design within a quasi-experimental framework. The research population comprised 40 fourth-grade students, with a saturated sample covering all population members. The experimental class consisted of 20 students of class IV.A, while the control class consisted of 20 students of class IV.B. Data collection techniques involved written assessments and surveys. Moreover, written tests assess student learning outcomes, and opinion polls measure student motivation. Descriptive statistical analysis was executed, including calculating the mean, median, mode, standard deviation, variance, minimum and maximum. Statistical inference analysis using a t-test, preceded by a normality test and homogeneity test (Psaradakis & Vávra, 2020).

3. RESULT AND DISCUSSION

Result

The research was carried out at Muhammadiyah Bekonang Primary School, located in Sukoharjo Regency. This research was quantitative research with quasi-experimental methods. The research object included the experimental group, while the control group was not included. A posttest-only control group design is the type of quasi-experimental design used. The research population consisted of only 40 fourth graders, and the researcher used a saturated sample that included all population members. The experimental class consisted of 20 students from IV. A class, while the control class consisted of 20 students from IV.B class. Written assessments and surveys were utilized in this study to obtain data. The researcher used written exams to evaluate student learning outcomes, while surveys were used to determine student motivation. Descriptive statistical analysis and inferential statistics were employed as data analysis techniques in this study. Descriptive statistical analysis calculates the mean, median, mode, standard deviation, variance, minimum, and maximum.

The t-test was used for statistical inference analysis, but before carrying out the t-test, the researcher conducted a normality test and homogeneity test. Based on the analysis results using SPSS Statistics 28.00 for Windows by looking at the Shapiro-Wilk statistical test at a significance level of 0.05, the results are shown in Table 1.

Table 1. Normality Test Calculation Results

| Category | | Kolmogorov-Smirnov | | | Shapiro Wilk | | |
|------------|------------|--------------------|----|-------|--------------|----|-------|
| | | Statistic | Df | Sig. | Statistic | Df | Sig. |
| Critical | Control | 0.101 | 20 | 0.200 | 0.956 | 20 | 0.469 |
| Thinking | Experiment | 0.163 | 20 | 0.170 | 0.926 | 20 | 0.127 |
| Self- | Control | 0.150 | 20 | 0.200 | 0.930 | 20 | 0.156 |
| Confidence | Experiment | 0.206 | 20 | 0.026 | 0.920 | 20 | 0.097 |

Table 1 proves that Sig. 's value of the Shapiro-Wilk variable for both learning motivation and learning outcomes is greater than 0.05 for all groups. The evidence indicates that the null hypothesis (H0) is accepted, while the alternative hypothesis (H1) is rejected. Therefore, all data sets follow a normal distribution. After the normality assumption is confirmed, the homogeneity test can be performed. The researcher utilizes SPSS Statistics 28.00 for Windows to assess dispersion uniformity. Based on the findings using SPSS Statistics 28.00 for Windows, the following results are obtained as shown in Table 2.

Table 2. Homogeneity Test Calculations Results

| Statistic | | Levene Statistic | df1 | df2 | Sig. |
|------------|---------------------------------|------------------|-----|--------|-------|
| Critical | Based on Mean | 3.351 | 1 | 38 | 0.075 |
| Thinking | Based on Median | 1.866 | 1 | 38 | 0.180 |
| | Based on Median and adjusted df | 1.866 | 1 | 37.178 | 0.180 |
| | Based on trimmed mean | 3.330 | 1 | 38 | 0.076 |
| Self- | Based on Mean | 1.625 | 1 | 38 | 0.210 |
| Confidence | Based on Median | 1.896 | 1 | 38 | 0.177 |
| | Based Median and | 1.896 | 1 | 37.940 | 0.177 |

| Statistic | Levene Statistic | df1 | df2 | Sig. |
|--------------------------------------|------------------|-----|-----|-------|
| adjusted df Based on trimmed mean | 1.757 | 1 | 38 | 0.193 |

Table 2 depicts that Sig. Learning Motivation has a value of 0.075, while Sig. Learning Outcomes have a value of 0.210. This shows that Sig. Thus, there is consistency in data on motivation and learning achievement scores between the experimental and control groups. The prerequisite test results reveal that the study data are normally distributed and homogeneous, allowing us to proceed with the t-test. Table 3 displays the results.

Table 3. Calculation results of the t-test on Critical Thinking Variables

| Variable | Sample | N | Mean | Standard Deviation | df | T-count | T-table |
|-----------------|------------|----|-------|--------------------|----|---------|---------|
| Self-Confidence | Control | 20 | 70.66 | 5.43 | 38 | 5.551 | 2.0243 |
| | Experiment | 20 | 81.32 | 6.66 | | | |

Referring to Table 3, students who were given the Educandy Web software had an average score of 81.32 in critical thinking when learning mathematics. In contrast, students who were not given an application had an average score of 70.66 in mathematics learning motivations. This shows that the group that received the Educandy application had a higher average mathematical critical thinking ability than the group that did not. The results of the hypothesis test show that the value of the t-count is |5.551|, and the t-table is 2.0243 with $df = 38$, with a significance level of 5%. Based on these calculations, it can be concluded that $t\text{-count} > t\text{-table}$ at a significance level of 5%, thereby rejecting H_0 and accepting H_a 's statement that "there is a significant difference between groups of students treated with the Educandy application and groups of students who were not processed by the Educandy Web application." Thus it can be concluded that the use of Web Educandy has a significant effect on the motivation of fourth-grade students at Muhammadiyah Bekonang Primary School to learn mathematics. Table 4 summarizes the t-test findings for the trust variable.

Table 4. T-test Calculation Results on Self-Confidence Variables

| Variable | Sample | N | Mean | Standard Deviation | df | T-count | T-table |
|-----------------|------------|----|-------|--------------------|----|---------|---------|
| Self-Confidence | Control | 20 | 57,20 | 17,60 | 38 | 3,328 | 2,0243 |
| | Experiment | 20 | 74,00 | 14,20 | | | |

According to Table 4, the students who were taught through the Educandy Web software achieved an average math score of 74.00. In contrast, another group of students who did not use the Educandy Web application acquired an average score of 57, with 20 examples of academic falsehood. This shows that the average mathematics learning outcomes of the education group outperformed the non-educational group. Based on hypothesis testing, the $t\text{-count} = |3.328|$ and $t\text{-table} = 2.0243$ for $df = 38$ at a significance level of 5%. This calculation at a significance level of 5% indicates that $t\text{-count} > t\text{-table}$. As a result, there is a significant disparity in mathematics learning outcomes between the education and non-education groups. Therefore it can be concluded that the application of Web Educandy has a significant effect on the results of learning mathematics at Muhammadiyah Bekonang Primary School Grade IV.

Discussion

Students succeed because of the very influential role of the teacher. Teaching and learning activities can be considered inefficient if the teacher does not have good teaching skills in the learning process (Nurjanah et al., 2020; Susanto et al., 2020). The method employed by the teacher to deliver material in class substantially influences students' motivation to study certain courses. Therefore highly motivated students will achieve excellent learning outcomes (Iba et al., 2021; Sulfemi & Mayasari, 2019). Apart from that, using media is important in learning to achieve the desired goals (Moustapha et al., 2022; Panjaitan et al., 2020). The results of the initial hypothesis test explained that the use of Edcandy aims to increase learning motivation. This shows that students who use Educandy are better at thinking critically than students who do not use Educandy. The results of this study are also compatible with research findings that students' motivation to use their Educandy application in the learning process is in the excellent category (Nurhabibah et al., 2021). There are differences in mathematics learning outcomes between the groups that use the Educandy Web application and those that do not use the Educandy Web.

Students who use the Educandy Web application have an average score higher than those who do not use the Educandy Web application. This research is supported by other researchers who prove that the learning process increases using Web Educandy. The Educandy Web application offers various games students can use (Abidin et al., 2022; Fadhilah, 2022). The Educandy Web Application is designed to deliver learning resources and encourage students to actively participate in the learning process. Students enter a contest to answer questions correctly while studying. In addition, teachers can assess students' initial abilities concerning the taught subjects. Interactive learning in the classroom influences students' perceptions of learning outcomes (Nurhabibah et al., 2021; Nurhikmah et al., 2023).

Critical thinking is essential for understanding and solving mathematical problems that require thinking, analysis, evaluation, and interpretation (Ata & Yildirim, 2019; Erdogan, 2019). Applying critical thinking to mathematics can help minimize problem-solving errors and generate correct conclusions. Critical thinking in mathematics relies on prior knowledge, mathematical reasoning abilities, and cognitive strategies to generalize, prove, and assess mathematical situations reflexively (Erdogan, 2019; Yulianto et al., 2019). Apart from critical thinking skills, psychological aspects such as self-confidence also play an important role in helping students succeed in mathematics. Self-confidence is vital for students to understand mathematics. The existence of self-confidence makes learning mathematics more enjoyable for students, and this triggers their enthusiasm and motivation (Mujtaba et al., 2018; Rahmatiya & Miatun, 2020). Confident students perform better in mathematics and ultimately optimize their mathematics learning. The students' success and failure depend on their encouragement, self-confidence, and belief in learning mathematics. Adjusting the provided material, the students' condition and level of competence, and the accessible facilities can increase critical thinking and self-confidence (Le'ger, 2009; Son et al., 2017). The selected learning model is crucial since it has its own uniqueness. Therefore, the suggested learning model to improve critical thinking is the discovery learning model.

The discovery learning model demands active student participation and evaluates learning based on the learning process, apart from results. The discovery learning model encourages students to develop their learning through self-discovery, and the results obtained are not easily forgotten (Ali & Setiani, 2018; Ulumi et al., 2015). Discovery learning is a learning model that involves discovering meaningful things while learning. Learning activities that allow students to have new experiences are beneficial in improving their learning outcomes. Discovery learning trains students to learn independently by experimenting and solving their problems, which helps build their self-confidence (Sukmasari & Rosana, 2017). The discovery learning model is a learning activity that requires each student to seek and find something (objects, people, or events) systematically, critically, logically, and analytically. This model helps students gain unique insights with confidence.

4. CONCLUSION

According to the findings, the research proves that using applications from Educandy in mathematics learning subjects effectively improves students' abilities to think critically and become more confident for fourth-grade elementary school. This certainly can push students to be involved in learning activities and achieve the expected learning outcomes. The discovery learning model is a learning activity that requires each student to seek and find something (objects, people, or events) systematically, critically, logically, and analytically. This model helps students gain unique insights with confidence.

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