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The Effect of the SSCS model assisted by quizizz on mathematical reasoning ability

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Abstract
This study examined the effect of implementing the Search, Solve, Create, and Share (SSCS) learning model supported by Quizizz on students' mathematical reasoning ability in exponential topics. A quantitative approach was employed using a quasi-experimental method with a Posttest-Only Control Group Design. The research involved 61 students, comprising 34 students in the experimental class and 27 students in the control class. Data were collected through an essay-based mathematical reasoning test that had met the required validity and reliability criteria. The data were analyzed using descriptive statistics, the Mann–Whitney U test, and effect size analysis. The findings revealed that the experimental class achieved a higher mean score (14.68) than the control class (12.93). However, the Mann–Whitney U test produced a significance value of 0.130 ($p > 0.05$), indicating no statistically significant difference between the two groups. Furthermore, the calculated effect size of 0.19 suggested that the implementation of the SSCS model assisted by Quizizz had only a small effect. Therefore, although students in the experimental class demonstrated a higher average level of mathematical reasoning, the SSCS learning model supported by Quizizz did not produce a statistically significant improvement in students' mathematical reasoning ability on exponential material.
Keywords: exponent, mathematical reasoning, quasi-experiment, Quizizz, SSCS

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Introduction

Mathematics education in the twenty-first century is no longer oriented solely toward conceptual and procedural mastery. Instead, it increasingly emphasizes the development of higher-order thinking skills that enable students to analyze, evaluate, and solve various problems logically and systematically. One key competency in mathematics education is mathematical reasoning, which enables students to connect concepts, construct arguments, formulate generalizations, and draw conclusions based on mathematical evidence. The importance of this competency is also reflected in international assessments, such as the PISA 2018 Assessment and Analytical Framework (2019), which emphasizes that students' achievement should be measured not only by their computational skills but also by their ability to reason when solving contextual problems (OECD, 2023). However, PISA results indicate that Indonesian students' mathematical proficiency remains an area requiring improvement, particularly in reasoning and problem-solving (*PISA 2018 Assessment and Analytical Framework*, 2019). This situation highlights the need to strengthen mathematical reasoning through effective mathematics instruction.

Mathematical reasoning refers to students' ability to connect information, identify patterns, formulate conjectures, justify solution procedures, evaluate the validity of arguments,

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and draw logical conclusions based on mathematical concepts (’Aisyah et al., 2021; Nurazizah et al., 2022). This competency helps students develop conceptual understanding and solve mathematical problems accurately tepat (Ardiansyah et al., 2022; Hawes & Ansari, 2020). Nevertheless, previous studies have reported that students’ mathematical reasoning abilities remain relatively low. Students often struggle to explain the reasoning behind their answers, connect mathematical concepts, select appropriate problem-solving strategies, and construct mathematical arguments systematically (’Aisyah et al., 2021; Anggraini et al., 2023; Asdarina & Ridha, 2020). These findings suggest that instructional processes need to be designed to provide meaningful learning experiences that encourage students to think, reason, and participate actively in discussions.

Similar problems were identified through preliminary observations at SMK Al-Ihya Selajambe. During mathematics instruction, some students experienced difficulties identifying known information and the questions being asked, selecting appropriate solution strategies, explaining the steps taken to solve problems, and drawing conclusions based on the mathematical concepts they had learned. These difficulties were particularly evident in the topic of exponents, which requires not only mastery of exponent rules and properties but also an understanding of relationships between concepts and the ability to justify each step in a solution. Satriani (2020) reported that students’ mathematical reasoning abilities in exponent-related topics remained relatively low, while Dores et al. (2023) found that difficulties in understanding exponent concepts affected students’ ability to solve problems logically. Thus, the preliminary observations at the school are consistent with previous findings indicating that developing mathematical reasoning in exponent-related instruction remains a challenge.

One instructional alternative that may support the development of mathematical reasoning is the Search, Solve, Create, and Share (SSCS) learning model. This model is designed to encourage students to construct knowledge through inquiry, problem-solving, solution development, and the communication of their ideas. The search stage guides students in identifying relevant information and understanding problems. The solve stage helps students formulate appropriate solution strategies. The create stage encourages them to develop solutions systematically, while the share stage provides opportunities to communicate their reasoning and receive feedback through discussion (Yasin et al., 2020; Yusnaeni et al., 2017). These characteristics make SSCS a promising approach for developing mathematical reasoning because students are expected not only to obtain correct answers but also to explain their reasoning, evaluate strategies, and defend mathematical arguments (Basir, 2025; Meilindawati et al., 2021)

To support the implementation of the SSCS model, this study employs Quizizz as a digital learning platform incorporating gamification. Gamification involves integrating game elements into learning activities to enhance students’ motivation, engagement, and learning experiences (Deterding et al., 2011; Hamari et al., 2014; Kapp, 2012). Quizizz provides various features, including interactive quizzes, immediate feedback, leaderboards, and point-based systems, which can encourage student participation during instruction (Lim & Yunus, 2021). Previous studies have also reported that Quizizz can influence learning motivation, increase student activity, and create a more engaging learning environment, thereby supporting the achievement of mathematics learning objectives (Husna et al., 2023; Setiyani et al., 2020). Therefore,

integrating SSCS with Quizizz is expected to create a more interactive learning process and provide students with broader opportunities to develop their mathematical reasoning abilities.

Previous studies have demonstrated the potential of the Search, Solve, Create, and Share (SSCS) model to support the development of students' mathematical competencies. Rafianti et al. (2020) found that SSCS could improve students' understanding of mathematical concepts, while Meilindawati et al. (2021) and Elistinawati (2023) reported that implementing SSCS could support mathematical reasoning abilities. However, these studies examined SSCS in different contexts, including variations in student characteristics and instructional approaches. Meanwhile, Quizizz has been used as a supporting medium in mathematics education. For example, Dwi Raka Adnyani et al. (2026) integrated Quizizz with the Experience, Language, Pictorial, Symbol, and Application (ELPSA) learning framework to develop mathematical reasoning abilities. Thus, previous research has provided empirical evidence of the potential contributions of SSCS and Quizizz to mathematics learning. However, research integrating SSCS with Quizizz as a supporting medium, particularly to develop mathematical reasoning in exponent-related topics at the vocational high school level, remains limited.

Accordingly, a research gap remains concerning the implementation of the SSCS model specifically supported by Quizizz to develop students' mathematical reasoning abilities. This gap is particularly relevant to exponent-related topics and vocational high school students, whose instructional contexts may differ from those examined in previous studies. Therefore, this study focuses on integrating SSCS with Quizizz to obtain empirical evidence regarding students' mathematical reasoning abilities in learning exponents.

Based on this discussion, students' difficulties in mathematical reasoning need to be addressed through learning opportunities that encourage them to think critically, discuss ideas, justify their reasoning, and actively evaluate their solutions. The SSCS model, combined with the Quizizz digital gamification platform, offers a potential instructional alternative because both provide features that can support student engagement in the learning process. Therefore, this study aims to investigate the effect of the SSCS learning model assisted by Quizizz on students' mathematical reasoning abilities in learning exponents.

Method

This study employed a quantitative approach using a quasi-experimental method with a *Posttest-Only Control Group Design*. This design was selected because the study was conducted in pre-existing classes, making it impractical for the researchers to randomly assign individual participants to the experimental and control groups. Using this design, students' mathematical reasoning abilities in the experimental and control classes were compared after each class received a different instructional treatment (Creswell & Creswell, 2018). The research design is presented in Table 1.

Table 1. Posttest-Only Control Group Design

Group	Treatment	Posttest
Experimental	X	O
Control	–	O

Note:
X = Instruction using the SSCS learning model assisted by Quizizz.
O = Posttest measuring students' mathematical reasoning abilities.

The population of this study comprised all eleventh-grade students at SMK Al-Ihya Selajambe in the 2025/2026 academic year who had studied exponents. The sample was selected using *purposive sampling*, a sampling technique in which participants are selected based on specific considerations relevant to the research objectives (Sugiyono, 2022). The selection criteria included the similarity of the learning material, the compatibility of instructional schedules, and recommendations from the mathematics teacher. Based on these criteria, two classes were selected: Class XI TKJ, consisting of 34 students, as the experimental group, and Class XI MP, consisting of 27 students, as the control group. The experimental group received instruction using the SSCS learning model assisted by Quizizz, whereas the control group received conventional instruction. The study was conducted at SMK Al-Ihya Selajambe, Kuningan Regency, West Java, during the second semester of the 2025/2026 academic year.

The research instrument was a mathematical reasoning test consisting of open-ended questions developed based on indicators of mathematical reasoning in the topic of exponents. Before being used in the study, the instrument underwent expert judgment to assess its content validity, construct validity, and language appropriateness. The instrument was subsequently piloted with 25 students who had previously studied exponents to obtain information on the validity, reliability, difficulty level, and discrimination index of each item. This process was intended to ensure that the instrument was suitable for data collection. In addition to the test, the study employed a classroom observation sheet to assess the implementation of the learning process and documentation as supporting data throughout the research.

The data were analyzed using descriptive and inferential statistics with the assistance of IBM SPSS Statistics version 22 at a significance level of 5% ((\alpha = 0.05)). Descriptive statistics were used to summarize the characteristics of the data, including the mean, standard deviation, minimum, and maximum values. The Shapiro–Wilk test for normality and Levene's test for homogeneity of variance were then conducted as preliminary tests to assess the assumptions for statistical analysis. Hypothesis testing was subsequently performed using an appropriate statistical procedure based on the results of these assumption tests. In addition, the effect size was calculated to determine the magnitude of the effect of implementing the SSCS learning model assisted by Quizizz on students' mathematical reasoning abilities.

Results and Discussion

This study aimed to investigate the effect of the SSCS learning model assisted by Quizizz on students' mathematical reasoning abilities. The results are presented through descriptive statistics, followed by assumption testing, hypothesis testing, and effect size analysis.

Table 2. Descriptive Statistics of Posttest Results

Statistic	Experimental Group	Control Group
Number of students	34	27
Minimum score	7	5
Maximum score	22	23
Mean	14.68	12.93
Standard deviation	4.78	4.51

As shown in Table 2, the mean mathematical reasoning score of the experimental group was 14.68, compared with 12.93 in the control group. The minimum score in the experimental group was also higher than that in the control group, whereas the maximum scores of the two groups were relatively similar. Descriptively, these results indicate that students in the experimental group tended to achieve higher mathematical reasoning scores than those in the control group, which received conventional instruction.

Subsequently, preliminary assumption tests were conducted, including tests of normality and homogeneity of variance, to determine the appropriate statistical procedures for the subsequent analysis.

Table 3. Results of the Normality Test

Class	N	Significance (Shapiro–Wilk)	Interpretation
Experimental	34	0.023	Not normally distributed
Control	27	0.365	Normally distributed

The normality test results indicate that the posttest scores in the experimental class were not normally distributed, as the significance value was 0.023, which is below the 0.05 threshold. In contrast, the control class data were normally distributed, with a significance value of 0.365, exceeding 0.05.

Table 4. Results of the Homogeneity Test

Levene Statistic	df1	df2	Significance	Interpretation
0.516	1	59	0.475	Homogeneous

The homogeneity test yielded a significance value of 0.475, which exceeds 0.05. Therefore, the variances of the two groups can be considered homogeneous. However, because the experimental group did not satisfy the normality assumption, the Mann–Whitney U test was used for hypothesis testing.

Table 5. Results of the Mann–Whitney U Test

Statistic	Value
Mann–Whitney U	355.000
Z	−1.515
Significance (two-tailed)	0.130

The Mann-Whitney U test produced a two-tailed significance value of 0.130. Since this value exceeds the significance threshold of 0.05, the null hypothesis cannot be rejected. Thus, the analysis did not identify a statistically significant difference in mathematical reasoning abilities between students who received instruction using the SSCS model assisted by Quizizz and those who received conventional instruction.

To determine the magnitude of the observed effect, an effect size analysis was conducted based on the Mann–Whitney U test results.

Table 6. Effect Size

Indicator	Value
Effect size (r)	0.19
Interpretation	Small

The effect size of 0.19 indicates a small observed effect of the SSCS learning model assisted by Quizizz on students' mathematical reasoning abilities. Although the experimental

group achieved a higher mean posttest score than the control group, the inferential analysis did not establish a statistically significant difference at the 5% significance level. Therefore, the descriptive difference should be interpreted cautiously, and further research with a larger sample and improved instructional implementation may be needed to clarify the potential benefits of this approach.

The results showed that the mean mathematical reasoning score of students in the experimental class, which received instruction using the SSCS learning model assisted by Quizizz, was 14.68, compared with 12.93 in the control class, which received conventional instruction. Descriptively, these findings indicate that the experimental class achieved higher mathematical reasoning scores than the control class. However, the Mann–Whitney U test yielded a significance value of 0.130 (> 0.05), indicating that the observed difference was not statistically significant. This finding is further supported by an effect size of 0.19, which falls within the small-effect category. Therefore, the implementation of the SSCS learning model assisted by Quizizz showed a tendency toward higher achievement in the experimental class, but the results did not provide sufficient evidence that the intervention produced a statistically significant difference in students' mathematical reasoning abilities.

These findings differ from those of several previous studies that reported positive outcomes from implementing SSCS and using Quizizz in mathematics education. Rafianti et al. (2020) found that SSCS could improve students' understanding of mathematical concepts, while Meilindawati et al. (2021) and Elistinawati (2023) reported an influence of SSCS on mathematical reasoning abilities. Similarly, Dwi Raka Adnyani et al. (2026) reported that integrating Quizizz with the ELPSA learning model had a positive effect on mathematical reasoning abilities. In contrast, the present study did not identify a statistically significant difference between students who received SSCS instruction assisted by Quizizz and those who received conventional instruction, although the mean mathematical reasoning score in the experimental class (14.68) was higher than that in the control class (12.93). The Mann–Whitney U test result of 0.130 and the effect size of 0.19 indicate that the observed difference was relatively small. Thus, the findings do not directly corroborate the positive results of previous studies. Instead, they provide additional empirical evidence that the outcomes of implementing SSCS or Quizizz may vary when these approaches are integrated and applied in different student populations, subject matter, and instructional contexts.

The differences in findings may be associated with the characteristics of the intervention and the learning context. Implementing SSCS requires students to participate actively through the *Search, Solve, Create, and Share* stages, which may require them to adjust to a different instructional approach. Furthermore, mathematical reasoning develops through sustained practice and learning experiences. Therefore, a limited intervention period may not provide sufficient opportunities for students to adapt to the model and develop their reasoning abilities fully. Differences in student characteristics, learning materials, and instructional conditions may also help explain the variation between the present findings and those of previous studies

Theoretically, the SSCS learning model is designed to encourage students to construct knowledge through a sequence of identifying problems (*search*), designing solution strategies (*solve*), developing solutions (*create*), and communicating their findings (*share*). These stages provide opportunities for students to engage in reasoning, establish connections between concepts, and provide logical justifications for their solutions. Previous research has also

indicated that implementing SSCS can improve mathematical problem-solving skills when students have sufficient time to adapt to each stage of the learning process (Hansuk et al., 2024; Yasin et al., 2020).

The use of Quizizz as a supporting learning medium also provides an interactive learning experience through game-based questions, immediate feedback, and a more engaging learning environment. These features may increase student engagement and motivation during the learning process. Several studies have also reported that Quizizz contributes to improved learning activity and mathematical competencies, although the magnitude of its effects may vary depending on the instructional model, subject matter, and student characteristics (Husna et al., 2023; Setiyani et al., 2020).

The absence of a statistically significant difference in this study may be associated with several conditions during the implementation of the intervention. First, students may have needed time to adapt to the SSCS stages, which require active participation in identifying information, designing solution strategies, developing solutions, and communicating their reasoning. This process differs from more conventional instruction, meaning that students may need time to develop learning habits consistent with the characteristics of SSCS. Second, the intervention period in this study was relatively limited. Mathematical reasoning is a competency that develops through sustained practice and continuous learning experiences. Consequently, a short implementation period may have limited the extent to which the instructional effects could emerge. Third, variations in students' initial abilities may have contributed to differences in individual achievement, meaning that the higher mean score in the experimental class was not sufficient to establish a statistically significant difference. Previous studies have shown that the outcomes of SSCS implementation may vary according to instructional characteristics and learning contexts (Meilindawati et al., 2021; Yasin et al., 2020). These findings provide a useful perspective for interpreting the present results, particularly because implementing SSCS assisted by Quizizz did not produce a statistically significant difference in this study.

The findings suggest that the absence of statistical significance does not necessarily demonstrate that the SSCS model assisted by Quizizz offers no educational benefit. The experimental class still achieved a higher mean posttest score than the control class, although the observed difference was not statistically significant. Therefore, the results are best interpreted as preliminary evidence that SSCS assisted by Quizizz may support the development of mathematical reasoning abilities, while its effectiveness may depend on various instructional and implementation factors. Further studies involving longer intervention periods, larger samples, and more detailed monitoring of classroom implementation are needed to clarify the conditions under which this approach may produce meaningful improvements in mathematical reasoning.

This interpretation is further supported by the effect size of 0.19, which falls within the small-effect category. This value indicates that the difference in achievement between the two groups was relatively small. The finding is consistent with the hypothesis test, which did not identify a statistically significant difference. Therefore, the results do not support the conclusion that implementing SSCS assisted by Quizizz produced a substantial improvement in mathematical reasoning abilities under the conditions of this study. However, the higher mean score in the experimental class indicates a positive trend that warrants further investigation through longer intervention periods and more supportive learning conditions. Future research

could consider longer implementation periods, larger sample sizes, and different mathematical topics to examine more comprehensively the potential of SSCS assisted by Quizizz to develop mathematical reasoning abilities.

This study provides empirical evidence for research on mathematics instruction that integrates the SSCS learning model with digital learning media. The findings indicate that integrating SSCS with Quizizz did not produce a statistically significant difference in mathematical reasoning abilities in the context examined, and the observed effect size was small. These results suggest that implementing SSCS assisted by Quizizz requires consideration of students' readiness, intervention duration, and the characteristics of the learning context. In practical terms, the findings may inform teachers' decisions to use SSCS assisted by Quizizz as an alternative instructional approach that encourages students to identify problems, develop solution strategies, construct solutions, and communicate their reasoning. Although this study did not establish a statistically significant difference in mathematical reasoning abilities, SSCS assisted by Quizizz may still be considered as an approach for promoting more active and collaborative learning and providing students with opportunities to develop reasoning skills through problem-solving activities (Yasin et al., 2020).

Conclusion

Based on the research findings, implementing the *Search, Solve, Create, and Share* (SSCS) learning model assisted by Quizizz did not produce a statistically significant difference in students' mathematical reasoning abilities in the topic of exponents at SMK Al-Ihya Selajambe. The Mann–Whitney U test yielded a significance value of 0.130 (> 0.05), indicating that the research data did not support the hypothesis of a difference in mathematical reasoning abilities between the experimental and control classes. Nevertheless, the experimental class achieved a higher mean score of 14.68 than the control class, which obtained a mean score of 12.93. The effect size of 0.19 falls within the small-effect category. These findings indicate a tendency toward higher achievement in the experimental class, although the observed difference remained relatively small and was not statistically significant.

Theoretically, this study contributes empirical evidence showing that integrating the SSCS learning model with Quizizz does not automatically produce a statistically significant difference in mathematical reasoning abilities. The outcomes of this instructional approach should therefore be interpreted in relation to the learning context and student characteristics. Practically, these findings may inform teachers' decisions to use SSCS assisted by Quizizz as an alternative approach to mathematics instruction, while considering students' readiness, intervention duration, and the suitability of the instructional context. Future research should consider longer intervention periods and different student populations or mathematical topics to establish a broader empirical basis for evaluating the potential of SSCS assisted by Quizizz to develop mathematical reasoning abilities.

Author Contributions

Endin Kamaludin contributed to the conceptualization, methodology, investigation, data collection and management, and preparation of the original draft. Benny Anggara contributed to the conceptualization, methodological development, data analysis, and review and editing of the manuscript. Lanlan Muhria contributed to the conceptualization, data management, research

supervision, and review and editing of the manuscript. All authors have read and approved the final version of the manuscript.

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