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The Effect of the Search, Solve, Create, and Share (SSCS) Learning Model on Students' Scientific Reasoning Ability

Atik Indriati Putri[*1], Dewi Lengkana[1], Berti Yolida[1]
[1]Biology Education Study Program, Faculty of Teacher Training and Education, University of Lampung, Indonesia
[*]*Corresponding author:* atikinaa28@gmail.com

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Abstract: This study aims to determine the effect of using the Search, Solve, Create, and Share (SSCS) learning model on the scientific reasoning abilities of 12th-grade students in the topic of heredity. The sample consisted of 62 students from two classes, selected using purposive sampling. This research employed a quasi-experimental method with a non-equivalent pretest-post-test control group design. The data were analysed using an independent sample t-test at a 5% significance level. The results showed that the application of the SSCS model had a significant effect on improving students' scientific reasoning, with a sig. (2-tailed) value of 0.000 < 0.05. The average N-Gain in the experimental class was 0.46, which falls under the medium category. The highest increase occurred in the probabilistic reasoning aspect (N-Gain = 0.42), while the lowest increase was in the combinatorial reasoning aspect (N-Gain = 0.36), both classified as medium. The effect size of the SSCS model on scientific reasoning was 1.47, which is categorized as large. Based on the questionnaire results, 78.43% of students agreed that the SSCS learning model made them more active in the learning process and helped them achieve a better understanding of heredity material. It can be concluded that the application of the SSCS model positively influences the improvement of students' scientific reasoning skills and is well accepted by the students.

Keywords: Search, Solve, Create, and Share Model; Scientific Reasoning

INTRODUCTION

One of the essential skills that students must possess is the ability to think critically and creatively through the use of inductive and deductive reasoning (Zulkipli et al., 2020). According to the Curriculum Development Center (2005), the importance of acquiring reasoning skills lies in its potential to help students think beyond conventional boundaries. Moreover, previous studies have shown that scientific reasoning is strongly correlated with cognitive abilities, as effective scientific reasoning involves logic, justification, rational thinking, and decision-making. In general, scientific reasoning refers to a form of reasoning where students develop hypotheses—particularly about how things work—and then test those hypotheses. During the reasoning process, individuals tend to relate the phenomena under investigation to their prior knowledge and seek new understanding when previous knowledge is corrected or challenged.

Scientific reasoning is also one of the 21st-century thinking skills that students are expected to apply in science classrooms to prepare themselves to face global challenges. Subiki and Supriadi (2018) stated that scientific reasoning plays a vital role in guiding students toward their future. In addition, scientific reasoning is crucial to understand because it encompasses a set of skills and abilities necessary for solving problems during scientific inquiry (Han, 2013). However, field observations reveal that students' scientific reasoning skills remain low and need improvement. This is supported by research from Handayani et al. (2020), which showed that 11th-grade students in Sukabumi had poor scientific reasoning skills in the 2019/2020 academic year. Similarly, research by Mandella et al. (2011) found that 10th-grade students' scientific reasoning was in the "very low" category with a score of only 19%.

According to OECD (as cited in Wardani et al., 2018), low scientific reasoning ability is partly due to students' inability to use their knowledge to conduct simple experiments, interpret data, use scientific ideas or concepts to explain phenomena, formulate arguments or hypotheses, and draw conclusions. This low performance may be attributed to students’ lack of understanding of concepts and subject matter (Pyper, 2012; Sundari & Rimadani, 2020).

Another contributing factor to students' low scientific reasoning ability is the inappropriate selection of learning models (Maasawet, 2018). This is supported by Ulfah et al. (2020), who found that students' low thinking ability was due to teacher-centered instruction. Similarly, Hapsari et al. (2012) noted that many teachers still rely on lecture methods, leading to passive student interaction and a lack of emphasis on developing thinking skills. Teacher-dominated instruction limits students' active engagement and cognitive development, as students are more likely to receive information, memorize textbook content, and complete tasks that do not stimulate higher-order thinking (Nurkanti, 2010; Rambe et al., 2020).

Therefore, more effort is needed to enhance students’ scientific reasoning skills. One strategy that teachers can employ is using learning models that actively engage students, allowing them to develop cognitive skills in applying concepts and solving problems (Agboeze & Eugwoke, 2013; Herlina et al., 2019). One such learning model is the Search, Solve, Create, and Share (SSCS) model. According to Febriyanti et al. (2014), the SSCS model engages students in problem investigation and real-world problem solving while fostering their scientific reasoning skills. The SSCS model, introduced by Pizzini (1991), encourages students to broaden their conceptual understanding, apply it in daily life, and enhance their thinking abilities.

Previous research has shown the effectiveness of the SSCS model. For example, Yasin and Fakhri (2020) found that the SSCS model significantly improved students' reflective mathematical thinking and conceptual understanding. Research by Zulnaidi, Heleni, and Syafri (2021) showed that the SSCS model produced significant differences in students' problem-solving abilities and self-efficacy in the experimental group compared to the control group. Similarly, Milama et al. (2017) reported that the use of SSCS learning steps positively affected students' critical thinking skills by focusing on knowledge application and problem-solving, making learning more meaningful. Based on the aforementioned studies, the Search, Solve, Create, and Share (SSCS) learning model appears to be a promising alternative to improve the scientific reasoning abilities of students at high school in Bandar Lampung.

METHOD

This study employed a quasi-experimental research design using a pretest-post-test non-equivalent control group design. Two classes were selected as samples: one as the experimental group and the other as the control group. The research instrument consisted of pretest and post-test essay questions designed to assess students' scientific reasoning ability. These instruments were validated and tested for reliability using Cronbach's alpha. Prior to hypothesis testing, the data were subjected to normality and homogeneity tests to meet statistical assumptions. The hypothesis was then tested using the independent sample t-test to examine differences in scientific reasoning ability between the two groups. After the completion of the learning sessions, students in the experimental class were given a response questionnaire to gather their perceptions of the SSCS learning model.

RESULTS AND DISCUSSION

The study was conducted at SMAN 13 Bandar Lampung, where data on students' scientific reasoning abilities were collected from both the experimental and control classes. The scientific reasoning ability was assessed using pretests and post-tests, consisting of 8 essay questions administered to both groups. The scores obtained from the pretest and post-test were used to calculate the N-Gain, which indicates the magnitude of improvement in scientific reasoning ability for both the experimental and control classes. The resulting N-Gain scores were then analysed using statistical tests. The results of the statistical analysis are presented in Table 1.

Table 1. Statistical Test Results of Students' Scientific Reasoning Ability

Data	Class	$\bar{x}$ ± Sd (Kategori)	df	Normality	Homogenity	Uji T [Sig. (2-*tailed*)]
N-Gain	E	0,46 ± 0,19 (Sedang)	31	Sig. 0,415 > 0,05	Sig. 0,092 > 0,05	

C	0,22 ± 0,14 (Rendah)	31	Sig. 0,388 > 0,005		Sig. 0,000 < 0,05

Table 1 shows that the data were normally distributed and homogeneous. The results indicated a Sig. (2-tailed) value of 0.000 < 0.05, which leads to the rejection of H_0 and acceptance of H_1. This confirms that there is a significant difference in the average gain in scientific reasoning ability between the experimental and control classes. Therefore, it can be concluded that the use of the SSCS learning model has a significant effect on students' scientific reasoning ability.

To determine the magnitude of the effect of the SSCS model on students' scientific reasoning—specifically in the context of biology learning on the topic of heredity—an effect size analysis was conducted. The effect size test is a follow-up statistical analysis aimed at quantifying the strength of the treatment's impact. The result of the effect size analysis is presented in Table 2.

Table 2. Effect Size of the SSCS Learning Model on Scientific Reasoning Ability.

Class	Average Gain	Standard Deviation	*Effect Size*	Category
Experiment	29,64	11,46	1,47	High
Control	14,52	8,82		

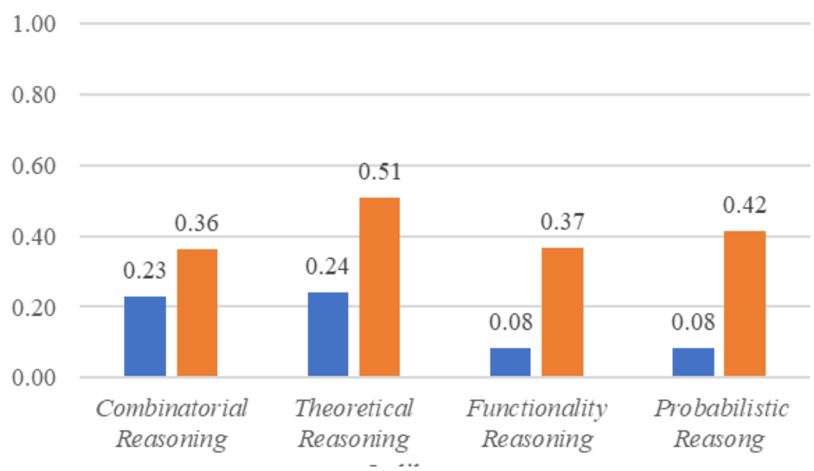

Figure 1. N-Gain Scores by Indicator of Scientific Reasoning Ability (control and experiment class).

Based on Figure 1, the scientific reasoning ability scores for each indicator can be observed. The graph shows that all scientific reasoning indicators in the experimental class experienced higher improvement compared to the control class. The highest increase in the experimental class (which used the SSCS model) was found in the Theoretical Reasoning indicator, with an N-Gain score of 0.51 (moderate category), whereas the control class only reached 0.24 (low category) on the same indicator. The lowest improvement in the experimental class was in the Combinatorial Reasoning indicator, with a score of 0.36, and the smallest gap between classes, with the control class scoring 0.23 (still categorized as low).

As shown in Figure 2, Theoretical Reasoning was the indicator with the highest N-Gain score among all reasoning aspects. The graph reveals that 35% (11 students) in the experimental class reached a high category in Theoretical Reasoning, compared to only 16% (5 students) in the control class. Meanwhile, 26% (8 students) in the experimental class remained in the low category, whereas the control class had twice as many students (52% or 16 students) in this low category.

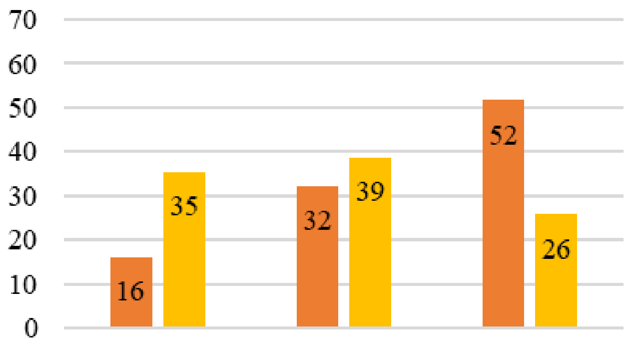

Figure 2. N-Gain Distribution in Theoretical Reasoning Indicator (low, medium, and high).

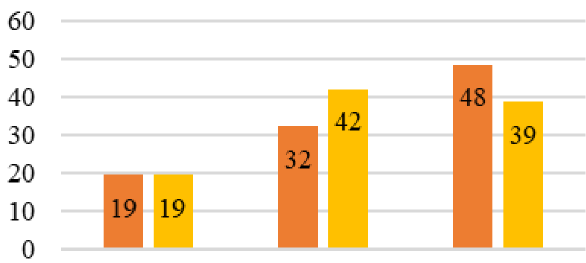

Figure 3. N-Gain Distribution in Combinatorial Reasoning Indicator (low, medium, and high).

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Combinatorial Reasoning was the scientific reasoning pattern with the lowest N-Gain score among all indicators. Based on Figure 3, both the experimental and control classes had the same percentage of students (19% or 6 students) who achieved a high category in Combinatorial Reasoning. The difference between the groups was more apparent in the moderate category. In the experimental class, 42% of students were in the moderate category, while in the control class, only 32% reached the same category. In contrast, the control class had a higher percentage of students in the low category, with 48% (15 students) compared to the experimental class.

To gain insights into how students perceived the biology learning experience on the topic of heredity using the SSCS model, a student response questionnaire was distributed in the experimental class. The responses were collected from 31 students who participated in the SSCS-based learning activities. The collected questionnaire scores were converted into percentages and interpreted accordingly. The summary of student responses is presented in Table 2.

Table 2. Students' Responses Toward the SSCS-Based Learning

Indicators	Percentage	Interpretation
Shows the ability to apply and relate concepts or theories in analyzing phenomena/events of heredity based on Mendel's laws	78.06%	Good
Shows the ability to analyze functional relationships in heredity	80%	
Shows the ability to interpret data to draw conclusions	78.39%	
Shows the ability to analyze possible relationships from theory or experiments	77.42%	
Shows a positive learning experience using the SSCS model	78.38%	
Average	78.43%	Good

Based on the research results, it was found that the implementation of the SSCS learning model had a significant effect on students' scientific reasoning abilities, with a significance value of 0.000 ($p < 0.05$). This is supported by the t-test results for the pretest, posttest, and N-Gain scores (Table 1). The students' pretest, posttest, and N-Gain scores in the class that used the SSCS model differed significantly from those in the class that did not. The average N-Gain in the experimental class was categorized as moderate, while the control class fell into the low category. This indicates that the implementation of the SSCS model was effective in improving the scientific reasoning ability of students.

Several factors contribute to the SSCS model's effectiveness in enhancing students' scientific reasoning skills. One of them is the constructivist and contextual nature of the SSCS model, which encourages students to practice scientific reasoning by developing hypotheses, making predictions, solving problems, and analyzing data. Through the SSCS model, students are trained to discover information and concepts independently, which helps them improve their skills in identifying problems, solving them, and expressing ideas more effectively. As Rimadani et al. (2017) stated, students who are actively involved in learning are better able to understand concepts, and conceptual understanding is strongly linked to scientific reasoning.

Moreover, the SSCS model encourages students to engage in analytical thinking and solve problems independently. This aligns with Wibowo et al. (2016), who argued that SSCS-based learning places students at the center of the learning process, allowing them to explore and discover knowledge on their own. Hatari et al. (2016) also emphasized that learning environments that foster student engagement enhance creativity, thinking skills, and conceptual understanding.

Figure 1 shows that students experienced the greatest improvement in the Theoretical Reasoning indicator compared to the other three scientific reasoning patterns. This is supported by Wati (2023), who found that students performed better in theoretical reasoning than in other reasoning patterns, which still required further development. Theoretical reasoning involves analyzing phenomena based on concepts or theories and linking events to previously learned concepts. This type of reasoning can be developed through the SSCS model, as students were provided with student worksheets to conduct group observations. In the first phase (Search), students analysed the presented phenomenon and generated questions based on the concept of heredity.

When examined in detail, 39% of students achieved a moderate N-Gain in theoretical reasoning, followed by high and low categories (Figure 2). This suggests that SSCS-based learning is optimal for fostering theoretical reasoning skills, particularly in the moderate category. The effectiveness of the SSCS model in improving theoretical reasoning can be attributed to the fact that 78.06% of students were able to apply and relate concepts or theories when analysing phenomena (Table 15). According to Meilindawati et al. (2021), students engaged in SSCS-based learning are required to play a more active role and use their reasoning skills to solve problems.

In contrast, Combinatorial Reasoning had the lowest average N-Gain in this study (Figure 1). This finding contrasts with Khumaira (2023), who reported that the lowest increase in students' reasoning during biology learning was not in combinatorial reasoning, but in functionality and proportional reasoning. However, this study's results are in line with Fawaiz (2020), who stated that combinatorial reasoning tends to be the weakest among students.

Figure 3 shows that in combinatorial reasoning, the highest increase was in the moderate category (42%), while only 19% of students achieved a high category. This suggests that although combinatorial reasoning had the lowest improvement among the four reasoning patterns, the gains still fell within the moderate category. This type of reasoning can be improved through the SSCS model, as it engages students in exploring new situations, considering possible answers, and solving realistic problems. Nasir & Hayya (2023) noted that during the Create phase, small group discussions encourage students to communicate and share opinions. This environment stimulates students to apply their knowledge and collaborate in evaluating experiments or theories.

The effect size test showed that the impact of the SSCS model on scientific reasoning ability falls within the high category (Table 2). This could be attributed to the active and creative involvement of students during SSCS-based learning, which supports the development of their reasoning skills. This finding is supported by student responses (Table 3), which revealed that SSCS-based learning helped students apply and relate concepts or theories about heredity based on Mendel's Laws. In the classroom, the SSCS model allowed students to actively participate in problem-solving, hypothesis formulation, and drawing conclusions. This student-centered learning process significantly enhanced their scientific reasoning ability.

This result aligns with the findings of Nasir and Hayya (2023), who reported a significant effect of the SSCS model on students' scientific reasoning ability in the topic of the human musculoskeletal system. Furthermore, Satriawan (2017) found that scientific reasoning abilities were better developed under the SSCS model compared to conventional learning models.

CONCLUSION

Based on the research findings and discussion, it can be concluded that the implementation of the Search, Solve, Create, and Share (SSCS) learning model has a significant effect on the scientific reasoning abilities of 12th-grade students at SMA Negeri 13 Bandar Lampung on the topic of heredity. This conclusion is supported by the higher N-Gain scores in the experimental class compared to the control class.

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