The Mathematical Problem-Solving Ability through the Search, Solve, Create and Share (SSCS) Learning Model

Tiara[1*]; Yohanes Leonardus Sukestiyarno[2]; Mulyono[3]

[1,2,3]*Faculty of Mathematics and Natural Science, Universitas Negeri Semarang, Indonesia*
[1*]*Corresponding Email: tiarawin29@gmail.com, Phone Number: 0852 xxxx xxxx*

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Abstract: This study aimed to see the effect of applying the SSCS learning model with the mind mapping method on students' mathematical problem-solving abilities based on students' mathematical resilience. This research is experimental research with an experimental factorial design. The population of this study were all students of class X State Vocational High School 1 Sinabang, Aceh Province. The sample was chosen using the primary random sampling method, specifically selecting class X-TBS with 30 students as the experimental group and class X-OTKP with 30 students as the control group. The tool employed consists of a set of test questions designed to assess one's aptitude for solving mathematical problems and a questionnaire aimed at gauging one's level of resilience in mathematical pursuits. The data were subjected to analysis using a two-way ANOVA test. The research findings and data analysis indicate the following conclusions: (1) There are disparities in students' mathematical problem-solving skills between the experimental and control classes. (2) There are disparities in students' mathematical problem-solving skills between the experimental and control classes when considering their levels of mathematical resilience (high, medium, and low). (3) no interaction effect is observed between implementing the SSCS learning model with the mind mapping method and students' mathematical resilience in their problem-solving abilities in mathematics.

Abstrak: Tujuan penelitian ini adalah untuk mengetahui pengaruh penerapan model pembelajaran SSCS dengan memanfaatkan metode mind map terhadap kemampuan siswa dalam menyelesaikan masalah matematika berdasarkan pada resiliensi matematisnya. Penelitian ini menggunakan pendekatan eksperimen dengan desain faktorial. Sampel penelitian terdiri dari semua siswa kelas X di SMK Negeri 1 Sinabang, Aceh. Sampel dipilih dengan teknik *simple random sampling*, yaitu dengan memilih 30 siswa dari kelas X-TBS sebagai kelompok eksperimen, dan 30 siswa dari kelas X-OTKP sebagai kelompok kontrol. Untuk mengumpulkan data, digunakan instrumen penilaian kemampuan dalam pemecahan masalah matematika dan survei mengenai resiliensi siswa terhadap pembelajaran matematika. Data ini kemudian dianalisis melalui penggunaan uji statistik ANOVA dua arah. Hasil dari penelitian dan analisis data menyimpulkan hal-hal berikut: (1) Terdapat perbedaan dalam kemampuan siswa pada pemecahan masalah matematika antara kelompok eksperimen dan kelompok kontrol. (2) Terdapat perbedaan dalam kemampuan siswa pada pemecahan masalah matematika juga terlihat berdasarkan tingkat resiliensi matematisnya (tinggi, sedang, dan rendah). (3) Tidak ada pengaruh interaksi yang signifikan antara penerapan model pembelajaran SSCS dengan metode mind map dan tingkat resiliensi matematis siswa terhadap kemampuan siswa dalam memecahkan masalah matematika.

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A. Introduction

Mathematics is a subject that students should engage with, from elementary school through advanced levels of education. Mathematics is the gateway to many fields of science and technology, which, if abandoned, can limit students' opportunities to study other subjects (Li & Schoenfeld, 2019). Proficiency in mathematical problem-solving is an essential talent that students must attain. The primary objective of learning mathematics is to acquire problem-solving skills, as difficulties are an inevitable aspect of human existence to produce human resources that are resilient in facing challenges in the form of life's problems (Amidi & Zahra, 2018; Andal & Andrade, 2022; Irawan et al., 2018). This statement aligns with Regulation No. 21 of 2016 from the Minister of Education and Culture (Kemendikbud, 2016). problem-solving ability is one of the objectives of learning mathematics and is an aspect that must be part of the mathematics learning process. To solve problem-solving, you can use strategies or steps formulated by Polya (Ahdhianto et al., 2020; Aminah et al., 2023), namely: (1) understanding the problem, (2) planning the problem, (3) carrying out the problem, and (4) looking back.

When students try to solve a problem, they must have good fighting power in solving the problems they face. This fighting spirit is in line with mathematical resilience abilities. Mathematical resilience is the ability to keep struggling in learning and mastering the mathematical knowledge that is learned (Hutauruk & Naibaho, 2020). Students with mathematical resilience exhibit resilience and perseverance when confronted with obstacles and failures, enabling them to effectively solve problems, explore novel techniques, and exert maximum effort in the problem-solving process (Kuncoro & Juandi, 2023). The criteria for students' mathematical resilience in this research, as elucidated by Sumarmo (Hendriana et al., 2017) can be described as follows: (1) Displaying resilience, self-confidence, persistent effort, and an unwavering determination to persevere when encountering obstacles, setbacks, and uncertainties; (2) Demonstrating a proclivity for social interaction, a helpful attitude, participating in conversations with peers, and adapting to their environment; (3) Creating original ideas and searching for inventive solutions to challenges; (4) Converting failures into valuable learning experiences that cultivate self-motivation; (5) Exhibiting a sense of curiosity, engaging in reflection, conducting research, and making use of a variety of resources; and (6) Practicing self-discipline and emotional awareness.

The explanation elucidates the significance of mathematical problem-solving skills and students' perseverance in acquiring mathematical knowledge. The importance of mathematical problem-solving capabilities and the mathematical resilience of students are outside the expectations. Based on early observations at State Vocational High School 1 Sinabang, Aceh Province, the outcome of an interview with a mathematics teacher revealed that students needed help understanding problem-solving questions. Hence, students felt they needed clarification about solving the problem. The cause of the low ability of students' mathematical problem-solving is that, so far, the implementation of learning has yet to direct students to develop problem-solving abilities. In addition, the teacher also revealed that some students, when facing difficulties in solving problems, tend not to try to ask friends or

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their teachers. They also tend to avoid complex assignments, and this is due to a lack of ability and confidence. This shows that the mathematical resilience of students at State Vocational High School 1 Sinabang Aceh Province still needs to improve. The Search, Solve, Create, and Share (SSCS) learning methodology is employed to cultivate students' mathematical problem-solving proficiency and enhance their resilience in the subject.

The SSCS learning approach is highly effective for enhancing mathematical problem-solving skills (Yusnaeni & Corebima, 2017). This learning style emphasizes active student participation to ensure the effective execution of learning activities. Furthermore, this approach incorporates specific procedures that facilitate the enhancement of mathematical problem-solving skills (Hartanti, 2018; Nastiti et al., 2018), namely: (1) search, students, looking for information and identifying the situation or problem presented; (2) solve, students make hypotheses and then plan how to solve the problem; (3) create, students make solutions to be presented and discussed with friends and teachers; and (4) share, students share knowledge.

Based on the results of research by Meika et al (2021), which obtained the result of using the SSCS learning model, the proportion of students who demonstrated proficient problem-solving skills was 72%. Hartanti (2018) study revealed disparities in the aptitude for resolving mathematical problems between students who received instruction through the SSCS learning model employing LKPD media and those taught using standard learning models. The results of (Anshori & Masriyah, 2023; Murniati et al., 2019) research showed that there was a rise in students' proficiency in solving mathematical problems through the SSCS learning model. Based on some of these studies, it is known that learning only uses the SSCS learning model, but in this study, the SSCS learning model is associated with the mind mapping method. Mind mapping is an innovative and efficient method of note-taking that aids pupils in visually organizing their thoughts and can motivate students to think actively and control their minds (Dwijonagoro & Suparno, 2019; Rahayuningsih et al., 2023). The research conducted by Amalia et al (2024) found that mind mapping enhances inventive students' learning environment. The incorporation of engaging teaching and learning activities will foster increased student interest and participation in the study of mathematics. Implementing this approach in mathematics education is anticipated to enhance students' proficiency in solving mathematical problems.

Based on the problems described, this study focuses on students' mathematical problem-solving abilities with the SSCS learning model with the mind mapping method based on their mathematical resilience. This study aimed to examine the impact of implementing the SSCS learning model, coupled with the mind mapping technique, on students' mathematical problem-solving skills, taking into account their level of mathematical resilience.

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B. Method

Based on the research purpose, this research is included in experimental research. In addition to looking at the effect of applying the SSCS learning model with the mind mapping method, this study also pays attention to moderator variables that might have an influence, namely mathematical resilience. The experimental design used in this research is factorial experimental in Table 1 and the research flow in Figure 1.

Table 1. Factorial Experimental Design

Learning Model (A_i)	**Mathematical Resilience (B_j)**		
	High (B_1)	**Medium (B_2)**	**Low (B_3)**
The SSCS Learning Model with Mind Mapping Method (A_1)	(A_1B_1)	(A_1B_2)	(A_1B_3)
Discovery Learning Model (A_2)	(A_2B_1)	(A_2B_2)	(A_2B_3)

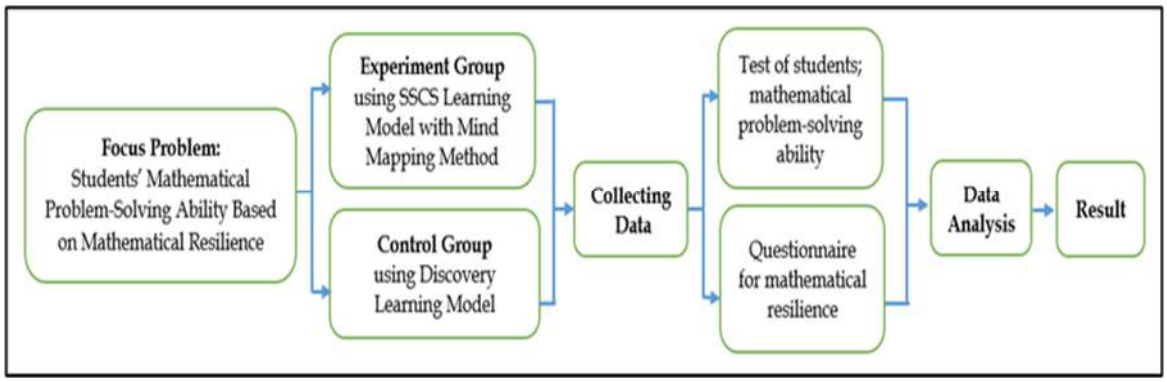

Figure 1. Research Flow

The investigation was conducted at State Vocational High School 1 Sinabang in the Aceh Province. The study population consisted of all tenth-grade students enrolled at State Vocational High School 1 Sinabang in Aceh Province. The utilization of a basic random sampling procedure obtained the research sample. The experimental class, X-TBS, consists of 32 pupils, while the control class, X-OTKP, also has 32 students. The process of data collection involved the administration of exams and questionnaires. The research instrument employed consisted of a mathematical problem-solving assessment for students and a questionnaire designed to measure their level of mathematical resilience. The data consists of assessments measuring students' mathematical problem-solving skills to evaluate their talents. The data collected from the questionnaire will be examined to categorize pupils into three distinct groups based on their resilience levels: high, medium, and low. The data were subjected to a two-way analysis of variance (ANOVA) test. Below is a scoring system for evaluating each indicator of pupils' mathematical problem-solving skills (Damayanti & Kartini, 2022).

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Table 2. Scoring Rubric of Mathematical Problem-Solving Ability

Rated Aspect	Reaction to Problems	Score
Understanding the problem	No answer at all	0
	Stating what is known without stating what is being asked or otherwise.	1
	Stating things that are known and asked but need to be corrected.	2
	State what is known and ask appropriately.	3
Planning the problem	Need to write down the solution steps.	0
	Write down the steps for solving what needs to be corrected.	1
	Write down the steps for the solution correctly.	2
Carrying out the problem	Not working at all.	0
	Doing calculations, but answers are wrong, or only a few are correct.	1
	Doing calculations of half of the total completion or most of the correct answers.	2
	Doing calculations and writing answers wholly and correctly.	3
Looking back	Do not write a conclusion at all.	0
	Write conclusions but could be more precise.	1
	Accurately write conclusions.	2

The students' mathematical resilience questionnaire comprises 40 statements and four answer options. Each indicator has a positive and negative statement. The answer options were categorized as strongly agree (SS), agree (S), disagree (TS), and strongly disagree (STS). For each successive positive statement, the score for the answer choices is 4, 3, 2, 1, while for each negative statement respectively 1, 2, 3, 4. The following is the distribution of the questionnaire items on each indicator of students' mathematical resilience.

Table 3. Distribution of Students' Mathematical Resilience Question Items

Indicator	Statement
Displaying resilience, self-confidence, persistent effort, and an unwavering determination to persevere when encountering obstacles, setbacks, and uncertainties	1, 2, 3, 4, 5, 6, 7, 8, 9
Demonstrating a proclivity for social interaction, a helpful attitude, participating in conversations with peers, and adapting to their environment	10, 11, 12, 13, 14, 15
Creating original ideas and searching for inventive solutions to challenges	16, 17, 18, 19, 20, 21
Converting failures into valuable learning experiences that cultivate self-motivation	22, 23, 24, 25, 26, 27
Exhibiting a sense of curiosity, engaging in reflection, conducting research, and making use of a variety of resources	28, 29, 30, 31, 32, 33, 34, 35
Practicing self-discipline and emotional awareness	36, 37, 38, 39, 40

Students' mathematical resilience is categorized into high, medium, and low. Determination of the category of mathematical resilience scale is to use a formula *Mean Ideal*

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$(M) = \frac{1}{2} \times (X_{maks} + X_{min})$ dan *Standard Deviation* $(SD) = \frac{1}{6} \times (X_{maks} - X_{min})$. The categorization of students' mathematical resilience in this study is shown in Table 4 below.

Table 4. The Categorization for Students' Mathematical Resilience

Statement Type Response	Mathematical Resilience Scale	Category
$X \geq (M + 1SD)$	$X \geq 120$	High
$(M - 1SD) \leq X < (M + 1SD)$	$80 \leq X < 120$	Medium
$X < (M - 1SD)$	$X < 80$	Low

C. Result and Discussion

Result

The research results encompass test scores related to students' mathematical problem-solving skills, including the minimum, maximum, average, and standard deviation scores. The data is presented in Table 5 below.

Table 5. Description of the Mathematical Problem-Solving Ability Test

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Experiment	30	60	96	78.20	10.390	107.959
Control	30	52	82	68.67	9.238	85.333
Valid N (listwise)	30					

In the table above, you can see the difference in mathematical problem-solving ability between the experimental class and the control class. The lowest and highest scores obtained in the experimental class were 60 and 96, while the control class received the minimum and maximum values of 52 and 82. The average values obtained for the experimental class using the SSCS learning model with the mind mapping method were more significant than the control class, which was taught using the discovery learning model, namely 78.20 obtained by the experimental class and 68.67 obtained by the control class. Based on this average value, the data indicates that the pupils in the experimental class have superior mathematical problem-solving skills compared to those in the control class.

Students' mathematical resilience scores were divided into three categories: students with high, medium, and low resilience. The following is the number of students in each resilience category.

Table 6. Students' Mathematical Disposition Category

Mathematical Resilience	Category	Experiment	Control
120 – 160	High	9	10
80 – 119	Medium	12	11
40 – 79	Low	9	9

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The average mathematical problem-solving abilities of students, categorized by their mathematical disposition, are displayed in Table 7 for both the experimental and control classes.

Table 7. Mathematical Problem-Solving Ability Based on Students' Mathematical Resilience

Mathematical Problem-Solving Ability	Resilience Category	$\bar{x}$
Experiment	Low	66.67
	Middle	79.17
	High	88.44
Control	Low	59.78
	Middle	67.27
	High	78.20

Table 5 and Table 7 reveal disparities in the mathematical problem-solving skills of pupils between the experimental class and the control class in general, as well as in students' mathematical resilience. However, a hypothesis test will be carried out using a two-way ANOVA test to ensure that the difference is significant. Previously, prior to conducting the analysis, a precondition test was performed to assess the normal distribution of the data using the Kolmogorov-Smirnov test and to examine the equality of variances using the Levene test. Below is a table displaying the results of the normality tests conducted on the data.

Table 8. Test of Normality

		Kolmogorov-Smirnov[a]		
	Class	**Statistic**	**df**	**Sig.**
The value of problem-solving abilities' test	Experiment	.109	30	.200
	Control	.120	30	.200
Mathematical resilience's score	Experiment	.156	30	.061
	Control	.159	30	.052

Based on Table 8, the normality test results can be summarized as follows: (1) With a significance value of 0.200, which exceeds 0.05, we confirm the null hypothesis (H0) for the problem-solving abilities test scores in the experimental class, signifying a normal distribution. (2) Likewise, the significance value of 0.200 in the control class surpasses 0.05, leading to the acceptance of H0, indicating a normal distribution of problem-solving abilities test scores. (3) In the case of mathematical resilience scores in the experimental class, the significance value is 0.061, higher than 0.05, resulting in the acceptance of H0, suggesting a normal distribution. (4) Similarly, the mathematical resilience scores in the control class have a significance value of 0.052, more significant than 0.05, leading to the acceptance of H0, denoting normal distribution.

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Table 9. Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
The value of problem-solving abilities' test	Based on Mean	.768	1	58	.385
	Based on Median	.575	1	58	.451
	Based on the Median and with adjusted df	.575	1	57.312	.451
	Based on trimmed mean	.758	1	58	.388
Mathematical resilience's score	Based on Mean	.000	1	58	.996
	Based on Median	.049	1	58	.826
	Based on the Median and with adjusted df	.049	1	54.152	.826
	Based on trimmed mean	.001	1	58	.975

Based on Table 9, the calculation results of a test of homogeneity of variances show that (1) significant value = 0.385 > 0.05, so that H0 is accepted. Namely, the value of the problem-solving abilities test is homogenous; (2) a significant value of 0.996 > 0.05 so that H0 is accepted, namely, mathematical resilience's score is homogeneous.

Thus, based on the results of the prerequisite test, the prerequisites for normality and homogeneity of the data have been fulfilled so that it is feasible to carry out further analysis to test the hypothesis. The results of the two-way ANOVA test obtained by interaction (ANAVA 2 x 3) follow.

Table 10. Two-Way Anova Test Results

Variant Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Class / Model	1386.794	1	1386.794	41.346	.000
Mathematical Resilience	3730.686	2	1865.343	55.613	.000
Model x Resilience	64.165	2	32.083	.957	.391

The results from the computations conducted using IBM Statistics SPSS 26 reveal the following conclusions: (1) With a significance value of 0.000, which is less than 0.05, the null hypothesis (H0) is invalidated. This signifies a substantial distinction in students' proficiency in solving mathematical problems between the experimental classes that utilize the SSCS learning model with the mind mapping approach and the control class that employs the exploration education model. (2) Similarly, a significance value of 0.000, less than 0.05, results in the rejection of H0. This indicates a noteworthy difference in students' proficiency in solving mathematical problems between the experimental and control classes, accounting for the students' mathematical resilience levels (high, medium, low). (3 Nevertheless, a significance value of 0.391, exceeding 0.05, leads to the acceptance of H0. This suggests a need for more relationship effect between the SSCS learning model with the mind mapping method and students' mathematical resilience and problem-solving abilities.

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Discussion

In the first stage of the SSCS model, the *search* phase, the researcher divided students into heterogeneous groups and gave instructions to students to solve problems regarding learning material. In the second stage, the *solve* phase, the researcher motivates students to ask questions about how to get ideas to solve problems. However, at the first meeting, at this stage, students should have asked questions. Students were silent and only hoped the teacher would explain. However, some students actively asked questions in the second to fourth meetings. Furthermore, the researcher guides students in finding and collecting information on the problem.

In the third stage, the *create* phase, the researcher directs students to work on the problems in groups in the worksheets given and prepare the results of their group work in mind maps. The researcher went around meeting each group to find out the difficulties and answered questions from students who needed help understanding the meaning of the questions. At this stage, there were no obstacles experienced by students at each meeting, and students were even very enthusiastic about working on LKS and making mind maps due to their group work. This is because the mind mapping method is new for students in mathematics.

In the fourth stage, the *sharing* phase, the researcher invites each group to present their work results to other groups. However, not all groups could present their work at each meeting due to limited time. Thus, researchers provide opportunities for groups that have never presented their work to explain in front of the class. The researcher directs the course of the discussion guides and provides explanations if errors are found in presentations and discussions.

It is evident from the research findings and data analysis that variations exist in the mathematical problem-solving proficiency of pupils who receive instruction through the SSCS learning model with the mind mapping method with students who learn with the discovery learning model. This strengthens the results of research conducted by Meika et al (2021), which obtained that using the SSCS learning model showed that 72% of students possessed solid problem-solving skills. Setiani et al (2020) findings indicate that mind mapping-assisted learning improves students' mathematical problem-solving abilities.

Additionally, the research findings indicated a statistically significant disparity in the mathematical problem-solving proficiencies of pupils who were instructed to utilize the SSCS learning model using the mind mapping method with students who studied using the discovery learning model in terms of mathematical resilience. Thus, mathematical resilience also influences students' mathematical problem-solving capabilities. In line with the results of the study, Maulina & Harun (2022) and Attami et al (2020) show that mathematical resilience has a positive and significant effect on the ability to solve mathematical problems. With this positive influence, this mathematical resilience will encourage students' skills in solving mathematical problems. As a follow-up, students' mathematical resilience should be a concern for teachers if they want to develop students' mathematical problem-solving abilities. Thornton (Maarif & Fitriani, 2023) said that the cultivation of mathematical

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resilience enables pupils to modify the solutions they encounter in the field of mathematics in light of their prior learning experiences.

The two-way ANOVA test results indicate that the interaction between the SSCS learning model and the mind mapping method, in conjunction with mathematical resilience, does not affect students' mathematical problem-solving abilities. In simpler terms, mathematical resilience and the learning models individually influence problem-solving capabilities. Interestingly, students taught using the SSCS learning model with the mind mapping method exhibited higher skills in solving mathematical problems than those taught using the discovery learning approach. This achievement still needed to be improved, as seen from the average scores obtained by the two classes, which were yet to be classified as high. This is probably due to time constraints so that only a few problems can be solved. In practice, the teacher must be able to become a facilitator in guiding students to find solutions to mathematical problems.

D. Conclusion

The research carried out at State Vocational High School 1 Sinabang in Aceh Province led to the following conclusions: (a) Significant differences exist in students' mathematical problem-solving skills between the experimental class, which received instruction using the SSCS learning model along with the mind mapping method, and the control class, which was taught using the discovery learning model. (b) Notable differences in students' mathematical problem-solving skills were observed between the experimental class, instructed with the SSCS learning model and the mind mapping method, and the control class, taught with the discovery learning model when considering different levels of mathematical resilience (high, medium, and low). (c) There is no interaction effect between applying the SSCS learning model with the mind mapping method and students' mathematical resilience on students' mathematical problem-solving abilities.

In summary, the SSCS learning approach, which incorporates the mind mapping method, offers an alternative method to enhance students' mathematical problem-solving skills. However, teachers must review several factors influencing learning, such as student conditions, class conditions, time management, and material suitability.

Further research needs to be developed to obtain more complete information regarding students' mathematical resilience and ability to tackle mathematical problem-solving.

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