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THE EFFECT OF SSCS LEARNING MANAGEMENT COMBINED WITH BRAINSTROMING TECHNIQUE ON PROBLEM-SOLVING ABILITY AND MATHEMATICAL LEARNING ACHIEVEMENT OF GRADE 6 STUDENTS

Weerapon Ruanthai*, Bantita Insombat, and Supattana Hombubpha

mr.weerapon.r@nsru.ac.th*, bantita.i@nsru.ac.th, and bubpha_j@hotmail.com

Department of Curriculum and Instruction, Faculty of Education,
Nakhon Sawan Rajabhat University, Nakhon Sawan 60130 Thailand

*Corresponding author E-mail: mr.weerapon.r@nsru.ac.th

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ABSTRACT

This research was to compare the mathematical problem-solving ability and learning achievement in mathematics of Grade 6 students pre-post receiving learning using SSCS learning management combined with brainstorming techniques, and to compare students' post-learning problem-solving ability and learning achievement against the 70 percent criterion of the full score. The sample group in this study consisted of 12 students of Grade 6 from Wat Nong Kradon School, also under the Office of the Nakhon Sawan Primary Educational Service Area 1, totaling 1 classroom, selected using cluster random sampling. The research instruments included to six lesson plans on the topic of decimals based on SSCS learning management with brainstorming techniques on the topic of statistic with quality level 4.59, a 10-item mathematical problem-solving ability test with 0.48 - 0.63 difficulty index, 0.43 - 0.69 discrimination index and 0.71 reliability, and a 30-question mathematics learning achievement test with 0.25 - 0.75 difficulty index, 0.20 - 0.93 discrimination index and 0.72 reliability. The data were analyzed using mean, standard deviation, dependent-sample t-tests, andone-sample t-tests. The findings revealed that Grade 6 students' mathematical problem-solving ability and learning achievement after learning were significantly higher than before learning at the .05 level of statistical significance. Furthermore, the students' post-learning scores were significantly higher than the 70 percent criterion of the full score at the .05 significance level.

Keywords: SSCS learning management, Brainstorming technique, Mathematical problem-solving ability, Learning achievement

I. INTRODUCTION

Mathematics is a science with unique characteristics, distinct from other fields of study. Humans use mathematics both intentionally and unintentionally. However, mathematics deals with abstract concepts that are intangible. Few people clearly perceive the characteristics of mathematics. Mathematics is characterized by a clear structure, system, and pattern directly related to thinking, wisdom, the use of symbols to convey meaning, calculate, reason, and solve problems. It is a guide of learning through the integration of prior knowledge with new knowledge independently (Khammanee, 2021, pp. 90-96). Mathematics is a tool for finding accurate answers in various situations and for predicting future events (Makanong, 2010, pp. 1-2). Mathematical problem-solving ability refers to the capacity of finding methods for obtaining solutions to mathematical problems. This requires knowledge, reasoning, and the application of existing knowledge to solve new problems using various approaches. It involves applying mathematical knowledge in real life situations and consists of the following to understanding the problem planning the solution, following the plan, and summarizing the result (Angganapattarakajorn, 2023, pp. 54-66; Institute for the Promotion of Teaching Science and Technology [IPST], 2012, p. 127; Makanong, 2010, p. 174; Polya, 1980, pp. 5-40). Currently, student assessments are aligned with their mathematics problem-solving abilities. This can be seen from the result of the Ordinary National Educational Testing Service or O-NET scores (National Institute of Educational Testing Service [NIETS], 2023, Online; 2024, Online; 2025, Online) from the academic year 2021 to 2023 found that Grade 6 students had average test scores in mathematics of 29.99, 36.83, and 29.96 points, respectively, in accordance with the O-NET test results of Wat Nong Kradon School, it was found that the average score of the Mathematics at the Grade 6 level was 32.90, 19.24, and 19.05 points, respectively, which are all below 50 percent. These results indicate that exploring learning methods that influence students' mathematical problem-solving abilities and academic achievement remains both significant and necessary. Learning based on the theory of Constructivism emphasizes the notion that learning involves constructing cognitive structures, enabling students to resolve problematic situations and apply tools to solve problems and other related situations. Students must create knowledge in a variety of ways. Based on existing knowledge as a component, and on the teacher's side, they are responsible for expanding existing knowledge and adding new knowledge (Khammanee, 2021, pp. 290-291). The teacher's teaching methods are essential in organizing teaching and learning activities because teaching methods will help increase learning efficiency, make lessons more interesting, and motivate students to be more interested in learning (Khammanee, 2021, pp. 324-325). In addition to the theory of self-knowledge creation, another learning theory that can be used in managing mathematics learning is Sternberg's information processing learning theory (Sternberg, 1986, pp. 41-78), which has steps in the thinking process leading to problem-solving, namely, the step of defining the nature of the problem, reviewing the problem to understanding, setting goals and defining the problem to lead to the set goals, selecting components or steps necessary to solve the problem, and determining the steps so that each is of suitable complexity. The first step should be simple as a good starting point before proceeding to the next steps. Each step should be carefully considered in detail. The step of selecting strategies to organize the elements in solving the problem must ensure thorough consideration of the problem and avoid confusing conclusions. The sequence of steps should follow the nature of the problem or logical reasoning that leads to the desired goal, as errors may occur. The step of selecting mental representations for problem-related information requires understanding one’s own abilities and using various forms of internal and external mental representations. The step of identifying useful sources of information requires devoting time and fully applying existing knowledge to carefully plan which information sources to use. Flexibility is needed to adjust plans and information sources in accordance with the problem-solving context and to constantly seek new

and useful information sources. The step of evaluating the problem-solving method determines whether the chosen approach effectively leads to the established goal. From the learning theory mentioned above, the researchers have studied the concepts, theories, and principles of organizing effective teaching and learning activities and promoting students' problem-solving abilities even more. From studying research related to mathematics learning management, the researchers have chosen a learning management model to study: Search, Solve, Create, and Share (SSCS) learning management combined with brainstorming techniques.

SSCS learning management combined with brainstorming technique is a learning approach the researchers synthesized by integrating SSCS learning management and the brainstorming technique. SSCS learning management was developed by Pizzini et al. (1989, pp. 523-532) based on scientific problem solving. It is used to manage learning that focuses on students, to practice problem-solving skills, and to use logical thinking processes by themselves. The teacher is the only one who defines the problem, encourages students to study and research, face the problem, analyse, plan, implement problem-solving, and exchange knowledge to find the solution. The goal is to enable students to develop knowledge, understanding, and problem-solving skills, to confront problems and solve them step by step by applying their understanding and the problem-solving process. This will enhance students' problem-solving ability (Sutthirat, 2009, pp. 411- 419), which is consistent with the research of Juntuma et al. (2022, pp. 176-189), who found that Grade 5 students who learned using the open-ended approach with the SSCS model had a significantly higher problem-solving ability and mathematics achievement after learning than beforelearning at a statistically significant level of .05, and the research results of Silaporn and Khamrat (2020, pp. 89-102) found that secondary 4 students had a significantly higher problem-solving ability and mathematics achievement after learning than before learning at a statistically significant level of .05.

Another technique that can develop mathematical problem solving simultaneously is the brainstorming technique. It is a group exchange activity developed by Osborn (1957, p. 228) based on the creativity theory of E. Paul Torrance. According to Torrance’s creative thinking process, it begins with identifying facts and discovering the problem. Once the root of the problem is identified, hypotheses are formulated. Then, relevant information is gathered, and the hypothesis is tested until a solution is found. After that, the result is verified. Guilford's theory of creativity explains three dimensions of human intelligence: content dimension, operational dimension, and product dimension (Thongleud, 2020, pp. 74-78). Brainstorming emphasizes the quantity of ideas by letting the ideas flow freely. There will be no judgment or criticism until it is complete. Then, those ideas are evaluated, improved, refined, and combined to get the best idea, which is a learning management approach to enable students to have the ability to solve problems. The brainstorming process involves presenting a situation and encouraging members to express as many opinions as possible without criticism. Participants share their ideas systematically to arrive at the best solution, leading to effective problem-solving. From the study of research on the use of brainstorming techniques, it is a technique that can develop the ability to solve mathematical problems to a higher level (Bungkilo & Heingraj, 2014, pp. 140-148; Daungkhamjan & Pavaputanon, 2015, pp. 63-70; Jainan & Art-In, 2019, pp. 23-33; Powiangkham & Heingraj, 2014, pp. 77-84).

The objective of this research is to compare the mathematical problem-solving ability and learning achievement in mathematics of Grade 6 students pre-post receiving learning and the 70 percent criterion of the full score learning using SSCS learning management model combined with brainstorming techniques.

II. LITERATURE REVIEW

The researchers studied the research results related to SSCS learning management combined with brainstorming techniques of Jainan and Art-in (2019, pp. 23-33). The research results found that Grade 11 students had problem-solving skills and academic achievements in mathematics after receiving the learning management higher than the specified criteria of 70 percent, and the number of students who passed was higher than the specified criteria of 70 percent, which was statistically significant at the .05 level. Similarly, the research of Silaporn and Khamrat (2020, pp. 89-102). The research results found that Grade 10 students could solve problems and achieve academic performance in mathematics after receiving the learning management that was higher than the 70 percent criterion, with a statistical significance of .05, and their academic achievement in mathematics after receiving the learning management was significantly higher than before receiving the learning management, at a statistical significance level of .05. This is also consistent with the research of Syafri et al. (2020, pp. 309-317). The research results found that the mathematics problem-solving ability of students who received SSCS learning management was higher than that of students who received the regular learning management, with statistical significance at the .05 level. In addition, the researchers studied the research results specifically in the scope of learning management using the brainstorming technique of Saeho (2021, pp. 35-37). The research results found that academic achievement in mathematics after receiving the learning management was higher than before receiving the learning management. The control group's academic achievement was significantly higher than that of the experimental group, at a statistical significance level of .05. In addition, the research of Namnual and Chanprasert (2022, pp. 330-345). The research results found that Grade 12 students were most satisfied. The average score after receiving the learning management was higher than before receiving the learning management, significantly at the .05 level, which is consistent with the researchers studied the research results specifically for the scope of SSCS learning management by Phankanok and Intasena (2022, pp. 223-238). The research results found that Grade 11 students had overall satisfaction at a high level. The ability to solve mathematics problems after receiving the learning management was higher than before receiving the learning management significantly at the .05 level. Similarly, the research of Hadaming (2021, pp. 334-337). The research results found that the average score before receiving the learning management was 65.55, and the average score after receiving the learning management was 89.78. It can be concluded that students with higher self-efficacy tend to demonstrate greater problem-solving ability in mathematics, with statistical significance at the .05 level. This is consistent with the research of Metta et al. (2021, pp. 124-137). The research found that Grade 5 students could solve problems and be creative after receiving the learning management higher than 70 percent criterion, which was statistically significant at the .05 level. Similarly, Nancharee et al. (2021, pp. 125-139). The research results found that Grade 9 students had academic achievement in mathematics after receiving the learning management higher than the 70 percent criterion and could solve mathematics problems higher than the 70 percent criterion, which was statistically significant at the .05 level. Similarly, the research of Awiria and Septiani (2018, pp. 108-113). The research results concluded that Grade 5 students who received learning through brainstorming techniques showed significantly higher academic achievement in mathematics on fractions, with a statistical significance level of .05. Similarly, the research of Anaguna and Suhendra (2018, pp. 1-6). The research results concluded that Grade 8 students who learned through the Knisley learning model combined with brainstorming techniques showed a statistically significant increase in academic achievement in mathematics at the .05 level. This is also consistent with the research of Quaba (2021, pp. 1050-1075). The study results found that students who received learning using the brainstorming technique scored significantly higher than those in the control group, at a statistically significant level of .05.

The research hypothesis is that Grade 6 students have higher problem-solving ability and academic achievement in mathematics after receiving learning management using the SSCS model combined with the brainstorming technique than before receiving it. Furthermore, their problem-solving ability and academic achievement in mathematics after receiving the SSCS model combined with brainstorming technique are higher than the 70 percent criterion of the full score.

III. RESEARCH METHODOLOGY

This research is a pre-experimental design with a single-group sample research plan with a pre-and post-test (Koonkaew, 2023b, p. 13). The sample group in this study consisted of 12 students of Grade 6 from Wat Nong Kradon School, also under the Office of the Nakhon Sawan Primary Educational Service Area 1, totaling 1 classroom, selected using cluster random sampling. The independent variable used in this research was SSCS learning management combined with the brainstorming technique. The dependent variables were mathematical problem-solving ability and mathematical learning achievement as shown to Figure 1.

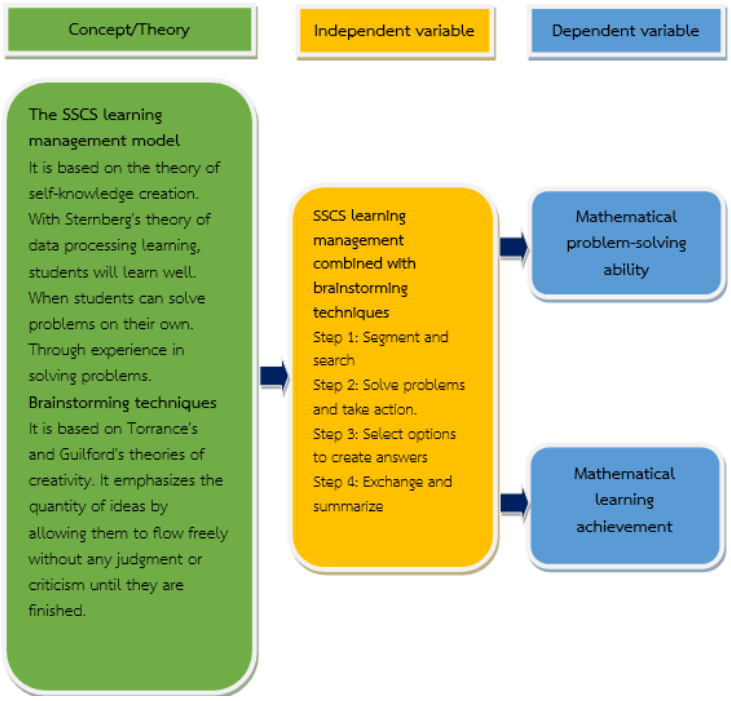

Figure 1: Research methodology

The experiment was conducted, and data was collected as follows to pretest consisting of a mathematics problem-solving ability test, and a mathematical learning achievement test. The scores were recorded as pretest scores for use in data analysis. The teaching experiment was conducted using SSCS learning management combined with brainstorming techniques plan for a total of 15 learning hours during the second semester of the 2024 academic year. The learning process was carried out according the following steps to search and segment, solve problem and take action, select options to create answers, and exchange and summarize. The learning process was carried out according to the following independent variable by Figure 1. After the experiment, the Grade 6 students in the sample group took a posttest using the same mathematics problem-solving ability test and mathematics achievement test on decimals as in the pretest. The duration for each test remained the same. The scores were recorded as posttest

scores, and pretest and posttest scores from both the problem-solving ability test and the mathematical achievement test were analyzed data by mean and standard deviation, testing for normal distribution assumptions, and conducting a one-sample t-test as well as a paired-sample t-test to summarize the results.

IV. RESULTS

Table 1: The results of the quality assessment of SSCS learning management model combined with brainstorming techniques lesson plans by three experts

Lesson plan	$\bar{x}$	SD	Quality
Writing fractions in decimal form	4.53	0.32	Highest
Dividing decimals by decimals	4.57	0.33	Highest
Dividing a number by a decimal	4.62	0.24	Highest
Currency exchange problems	4.66	0.25	Highest
Measurement Problems	4.63	0.24	Highest
Problems related to decimals	4.54	0.32	Highest
Total score		**4.59**	**Highest**

From Table 1, SSCS learning management combined with the brainstorming technique lesson plans, a total of 6 lesson plans covering 15 learning hours was used in this study. Assessed by the plan alignment assessment with learning objectives on a 5-level scale. The plans received the highest average suitability rating to highest (Koonkaew, 2023a, p. 121; Koonkaew, 2023b, p. 136; Sutthirat et al., 2023, p. 139).

Table 2: The results of the difficulty and discrimination index of the mathematical problem-solving ability test by 20 non- sample students

Items	S_U	S_L	n	X_{max}	X_{min}	P	D
1	37	30	5	8	5	0.57	0.47
2	37	29	5	8	5	0.53	0.53
3	37	28	5	8	4	0.63	0.45
4	36	29	5	8	5	0.50	0.47
5	29	12	5	8	0	0.51	0.43
6	38	33	5	8	6	0.55	0.50
7	34	25	5	8	4	0.48	0.45
8	37	13	5	8	1	0.57	0.69
9	36	29	5	8	5	0.50	0.47
10	26	9	5	7	0	0.50	0.49
			α				0.71

when	S_U	mean	Sum of high group scores.
	S_L	mean	Sum of low group scores.
	X_{max}	mean	Highest score.
	X_{min}	mean	Lowest score.
	P	mean	Whitney and Sabers's difficulty index.
	D	mean	Whitney and Sabers's Discrimination index.
	α	mean	Cronbach's alpha reliability coefficient.

From Table 2, a subjective mathematics problem-solving ability test consisting of 10 items that required students to show their solution processes. The test values ranging from Whitney and Sabers difficulty index (P) ranging from 0.48 to 0.63, a discrimination index (D) ranging from 0.43 to 0.69 (Koonkaew, 2023a, p. 239), and a Cronbach's alpha reliability coefficient (α) of 0.71 (Koonkaew, 2023a, p. 241).

Table 3: The results of the difficulty and discrimination index of the mathematical learning achievement test by 20 non-sample students

Items	*U*	*L*	n_1	n_2	*p*	*B*
1	5	5	5	15	0.50	0.67
2	3	6	5	15	0.45	0.20
3	5	10	5	15	0.75	0.33
4	5	7	5	15	0.60	0.53
5	3	2	5	15	0.25	0.47
6	5	7	5	15	0.60	0.53
7	3	5	5	15	0.40	0.27
8	4	9	5	15	0.65	0.20
9	4	3	5	15	0.35	0.60
10	4	9	5	15	0.65	0.20
11	4	7	5	15	0.55	0.33
12	5	7	5	15	0.60	0.53
13	5	9	5	15	0.70	0.40
14	5	5	5	15	0.50	0.67
15	3	5	5	15	0.40	0.27
16	5	3	5	15	0.40	0.80
17	3	3	5	15	0.30	0.40
18	4	6	5	15	0.50	0.40
19	4	5	5	15	0.45	0.47
20	2	3	5	15	0.25	0.20
21	5	5	5	15	0.50	0.67
22	3	4	5	15	0.35	0.33
23	3	6	5	15	0.45	0.20
24	4	6	5	15	0.50	0.40
25	3	4	5	15	0.35	0.33
26	3	3	5	15	0.30	0.40
27	5	1	5	15	0.30	0.93

Table 3: (continued) The results of the difficulty and discrimination index of the mathematical learning achievement test by 20 non-sample students

Items	*U*	*L*	n_1	n_2	*p*	*B*
28	5	3	5	15	0.40	0.80
29	5	4	5	15	0.45	0.73
30	5	5	5	15	0.50	0.67
			r_α			0.72

when	***U***	mean	The number of candidates who answered correctly in the qualifying group.
	L	mean	The number of candidates who answered correctly of the group did not meet the criteria.
	n_1	mean	Number of qualified candidates.
	n_2	mean	Number of candidates who did not pass the exam.
	p	mean	Difficulty index.
	B	mean	Brennan's discrimination index.
	r_α	mean	Lovett's reliability coefficient.

From Table 3, a 30-item multiple-choice mathematical learning achievement test was also used. The test values a difficulty index (p) ranging from 0.48 to 0.63 (Koonkaew, 2023a, p. 225), a criterion-referenced discrimination index (B) according to Brennan ranging from 0.43 to 0.69 (Koonkaew, 2023a, p. 233), and a reliability coefficient (r_α) according to Lovett of 0.72 (Koonkaew, 2023a, p. 235).

Table 4: The comparative results of the mathematical problem-solving ability of grade 6 students before and after learning, and criterion of 70 percent of the full score receiving SSCS learning management combined with brainstorming techniques by 12 sample students

Testing	n	Full score	70 percent criteria	$\bar{x}$	SD	df	t	Sig.
Pre-test	12	80	56	29.08	11.22	11	9.211	0.000*
Post-test	12	80		60.83	6.20			

*Statistically significant at the .05 level.

From Table 4, it was found that Grade 6 students who received SSCS learning management combined with the brainstorming technique had a mean pretest score for mathematical problem-solving ability of 29.08 with a standard deviation of 11.22, and a mean posttest score of 60.83 with a standard deviation of 6.20. The mathematical problem-solving ability after learning was significantly higher than before learning, and higher than the 70 percent criterion of the full score at the .05 level of statistical significance.

Table 5: The comparative results of the mathematical learning achievement of Grade 6 students before and after learning, and criterion of 70 percent of the full score receiving SSCS learning management combined with brainstorming techniques by 12 sample students

Testing	n	Full score	$\bar{x}$	70 percent criteria	SD	df	t	Sig.
Pre-test	12	30	11.91	21	4.69	11	6.133	0.000*
Post-test	12	30	22.25		2.30			

*Statistically significant at the .05 level.

From Table 5, it was found that Grade 6 students who received SSCS learning management combined with the brainstorming technique had a mean pretest score for mathematics learning achievement of 11.91, with a standard deviation of 4.69, and a mean posttest score of 22.25, with a standard deviation of 2.30. The mathematical learning achievement after learning was significantly higher than before learning, and higher than the 70 percent criterion of the full score at the .05 level of statistical significance.

V. CONCLUSION AND DISCUSSION

The research findings were as follows to Grade 6 students who received using SSCS learning management combined with brainstorming techniques had a pre-learning average mathematical problem-solving ability score of 29.08 with a standard deviation of 11.22, and a post-learning average score of 60.83 with a standard deviation of 6.20, and Grade 6 students who received using SSCS learning management combined with brainstorming techniques had a pre-learning average academic achievement score of 11.91 with a standard deviation of 4.69, and a post-learning average score of 22.25 with a standard deviation of 2.30. The findings revealed that Grade 6 students' mathematical problem-solving ability and learning achievement after learning were significantly higher than before learning at the .05 level of statistical significance. Furthermore, the students' post-learning scores were significantly higher than the 70 percent criterion of the full score at the .05 significance level.

The posttest mathematical problem-solving ability and learning achievement score was significantly higher than the pretest score, and higher than the 70 percent criterion of the full score at the .05 level of statistical significance. This finding indicates that SSCS learning model combined with brainstorming effectively enhances students' problem-solving abilities. It promotes interactive learning and collaborative analytical thinking, which clearly improves students' problem-solving performance. This result is consistent with Khammanee (2021, pp. 290 - 291), who stated that students construct knowledge through multiple approaches by building on prior knowledge, while teachers play a role in expanding existing knowledge and introducing new concepts. It also aligns with the findings of Jainan and Art-In (2019, pp. 23 - 33), who found that students' mathematical problem-solving ability significantly increased after participating in learning activities based on the SSCS model and brainstorming techniques, with posttest scores also exceeding the 70 percent criterion. Moreover, the results correspond with the study by Butwan and Prasertsang (2021, pp. 43 - 51), which found that Grade 6 students who received SSCS learning management demonstrated very high levels of mathematical problem-solving skills, and their posttest scores were significantly higher than their pretest scores at the .05 significance level.

SUGGESTION

In implementing SSCS learning management combined with brainstorming techniques, teachers are encouraged to explore its effectiveness in other mathematics learning units to examine students' problem-solving abilities and academic achievement across different content areas. Teachers should also prepare thoroughly in advance by studying lesson details and clearly outlining learning activities to ensure smooth and effective classroom learning. Moreover, when applying the SSCS model with brainstorming, teachers should pose thought-provoking questions that continuously stimulate student thinking throughout each session. They should incorporate problems or situations that reflect local contexts or everyday life and may also allow students to formulate their own problems. Extending the learning period beyond the timeframe used in this study such as over an entire semester or academic year-could support long-term tracking of learning outcomes. Finally, future research on SSCS learning management with brainstorming techniques should also consider other educational variables beyond problem-solving ability and academic achievement, such as student attitudes, connection-making skills, reasoning ability, and communication and expression skills.

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