MATHEMATICAL CREATIVE THINKING AND SELF-REGULATED LEARNING THROUGH THE COOPERATIVE SCRIPT MODEL: A LEARNING-STYLE PERSPECTIVE

Rani[1*], Poppy Yaniawati[2], In In Supianti[3], Nenden Mutiara Sari[4]

[1*]SMA Pasundan 2, Cimahi, Indonesia

[2,3,4]Universitas Pasundan, Bandung, Indonesia

rani1120@guru.sma.belajar.id

Abstract

This study aimed to analyze students' mathematical creative thinking skills and Self-Regulated Learning (SRL) through the implementation of the Cooperative Script model, considering learning styles, and to examine the relationship between SRL and mathematical creative thinking skills. A mixed-methods approach with a convergent design was employed, combining a quasi-experimental pretest-posttest non-equivalent control group design with a case study. The participants consisted of 68 Grade XI students from SMA Pasundan 2, Cimahi City, divided into experimental and control groups of 34 students each. Research instruments included a mathematical creative thinking skills test, questionnaires on SRL and learning styles, interviews, and observations. Quantitative analysis involved prerequisite tests, N-gain, two-way ANOVA, post-hoc tests, and simple linear regression, while qualitative data were analyzed descriptively. The results indicated a combined effect of the learning model and learning style on the improvement of mathematical creative thinking skills ($F = 22.754$, $p = 0.000$, Partial Eta Squared = 0.647). The Cooperative Script group showed greater improvement compared to the expository group across learning style categories. However, no significant differences in SRL were found based on either the learning model or learning style. Conversely, SRL was positively correlated with mathematical creative thinking skills, with a regression coefficient of 0.724 and a significance level of 0.000. These findings suggest that the Cooperative Script model is effective in fostering mathematical creativity, whereas the development of SRL requires explicit and sustained self-regulation strategies..

Keywords: Cooperative Script; Mathematical Creative Thinking; Self-Regulated Learning; Learning Style.

Introduction

Education in the 21st century faces increasingly complex demands in response to social changes, technological advancements, and the evolving needs of the workforce, which require individuals to be adaptable. The quality of human resources can be reflected in the quality of graduates produced by educational institutions and their ability to compete at the international level. This condition encourages educational systems not only to equip students with knowledge and academic skills but also to develop their abilities to think creatively, solve problems, collaborate, and learn independently.

In mathematics education, these demands have become increasingly important because students are confronted with problems that cannot always be solved through the direct application of formulas and procedures. Students need to understand mathematical concepts, select appropriate strategies, develop alternative solutions, and provide sound reasoning for the thinking processes they employ. Therefore, mathematics education needs to be directed toward developing competencies that enable students to approach problems creatively while also managing their learning processes independently.

One of the essential abilities required in mathematics education is mathematical creative thinking, which refers to the ability to address open-ended mathematical problems by generating diverse ideas or novel solutions (Fitria, 2023). Mathematical creativity plays an important role in supporting students' ability to innovate and solve problems (Sumarno, 2013; Afriansyah, 2016; Faturrohman, 2020). In addition, Self-Regulated Learning (SRL) refers to a learning process in which students actively regulate their learning through goal setting, strategy use, process monitoring, and reflection on the achievement of their learning goals (Zimmerman, 2002). In mathematics education, SRL is associated with students' ability to independently organize and regulate their learning processes, enabling them to select appropriate strategies, monitor their understanding, and evaluate their learning outcomes (Rofifah et al., 2025). These two abilities are interconnected, as mathematical creative thinking encourages students to generate multiple alternative solutions, while SRL helps them direct, monitor, and evaluate their thinking processes to achieve their learning goals.

The urgency of developing these two competencies is evident from the performance of Indonesian students in international assessments. The results of the *Programme for International Student Assessment* (PISA) 2022 indicate that Indonesian students' mathematics performance remains below the OECD average and has declined compared with the results of PISA 2018. In terms of creative thinking, only approximately 31% of Indonesian students reached the baseline level, compared with the OECD average of 78%. This condition indicates that students' ability to generate and develop creative ideas still requires greater attention through learning environments that provide opportunities to explore ideas, employ diverse strategies, articulate reasoning, and develop alternative solutions.

In line with the demands of mathematics education, the development of students' competencies needs to focus on higher-order thinking skills and learning autonomy so that students are able to address complex and dynamic problems (Herdianti & Muntazhimah, 2023). Therefore, mathematics instruction should also encourage students to set learning goals, monitor their understanding, select appropriate strategies, and evaluate their learning processes, so that learning engagement is not solely oriented toward final outcomes. Consequently, the development of mathematical creative thinking and SRL requires a learning environment that enables students to actively construct knowledge while simultaneously regulating and managing their own learning processes.

These issues were also identified in mathematics learning at SMA Pasundan 2 Cimahi based on the findings of a preliminary study. The results of the Mid-Semester Assessment (*Penilaian Tengah Semester*, PTS) for the 2023/2024 academic year indicated that 52% of Grade 11 students scored below the Minimum Competency Criterion (*Kriteria Ketuntasan Minimal*, KKM). Classroom observations further revealed that students tended to focus on applying formulas and procedures without demonstrating adequate conceptual understanding. Students also experienced difficulties when confronted with problems requiring more than one solution strategy or involving the independent development of mathematical ideas.

These conditions indicate that the existing learning process has not fully provided learning experiences that encourage students to explore alternative solutions, reflect on their thinking processes, and regulate their learning activities. This issue highlights the need for an instructional approach that can simultaneously develop students' mathematical creativity and Self-Regulated Learning (SRL), while providing an interactive learning environment in which students can actively construct their mathematical understanding.

One instructional model that is relevant to these needs is the *Cooperative Script*, a cooperative learning model that engages students in pairs, with students taking turns as speakers and listeners to explain, summarize, clarify, and respond to the learning material. These activities provide students with opportunities to articulate their ideas, listen to their partners' perspectives, receive feedback, and monitor and clarify their own understanding. Suryaningsih et al. (2019) demonstrated that the implementation of the *Cooperative Script* model can improve students' mathematical creative thinking abilities, while its interactive characteristics are conceptually relevant to supporting Self-Regulated Learning (SRL) through learning-monitoring, feedback, and evaluation activities.

The implementation of this model should also take into account the diversity of student characteristics, particularly from the perspective of visual, auditory, and kinesthetic learning styles, to understand variations in how students receive, process, and respond to information. Thus, the *Cooperative Script* model offers potential for further investigation as an instructional approach that integrates cooperative interaction, mathematical creativity, learning regulation, and student characteristics.

Although research on *Cooperative Script* and mathematical creative thinking has been conducted, studies that simultaneously examine mathematical creative thinking and Self-Regulated Learning (SRL) while considering students' learning styles remain relatively limited. Previous studies have also provided limited explanations of the relationship between

SRL and mathematical creative thinking within the implementation of the *Cooperative Script* model, as well as how this relationship differs from that observed in expository instruction among students with visual, auditory, and kinesthetic learning styles.

Addressing this research gap, the present study aims to analyze students' mathematical creative thinking and SRL through the implementation of the *Cooperative Script* model from the perspective of learning styles and to compare the results with those of expository instruction. This study also examines the effect of SRL on mathematical creative thinking among students who participate in Cooperative Script and those who receive expository instruction. The novelty of this study lies in its integrated examination of Cooperative Script, mathematical creative thinking, SRL, and learning styles within a single research framework, thereby providing empirical evidence on mathematics instruction that supports both students' creativity and self-regulated learning.

Method

This study employed a convergent mixed-method design. The quantitative component used a quasi-experimental design with a pretest–posttest structure, while the qualitative component employed a case study design. Quantitative and qualitative data were collected and analyzed separately and were subsequently compared and integrated during the interpretation stage.

Table 1 Non-equivalent Control Group Pretest-Posttest Research Design

Group	Pretest	Treatment	Postest
Eksperiment	O^1	X^1	O^2
Control	O^3	X^2	O^4

Keterangan:

O^1 = Experimental group pretest

O^2 = Experimental group posttest

O^3 = Control group pretest

O^4 = Control group posttest

X^1 = Treatment using the Cooperative Script method

X^2 = Treatment with expository application

This study was conducted at SMA Pasundan 2 Cimahi among Grade 11 students during the

2022–2023 academic year. The population consisted of all Grade 11 students at the school. The sample comprised individuals selected from the population to represent the characteristics of the population under investigation. Two classes were selected as the research sample, with one class assigned to the experimental group and the other to the control group. Randomization was employed to determine the assignment of the classes to the experimental and control groups. The experimental group consisted of Grade 11 Social Sciences 2 (*XI SOSIAL 2*), comprising 34 students, while the control group consisted of Grade 11 Social Sciences 3 (*XI SOSIAL 3*), also comprising 34 students.

The research instruments consisted of a written test of mathematical creative thinking, a *Self-Regulated Learning* (SRL) questionnaire, a learning-style questionnaire, interviews, and observations. Both groups were administered a pretest and the SRL questionnaire before receiving the respective instructional treatments. After the intervention, both groups were administered a posttest and completed the SRL questionnaire again.

The quantitative data analysis included prerequisite tests, N-gain analysis of mathematical creative thinking, two-way ANOVA, *post hoc* tests, and simple linear regression. Meanwhile, qualitative data obtained from observations and interviews were analyzed descriptively to support and strengthen the interpretation of the quantitative findings.

Results and Discussion

The study was conducted with two groups of Grade 11 students at SMA Pasundan 2 Cimahi. The XI SOS 3 class served as the experimental group and received the Cooperative Script instructional model, while the XI SOS 2 class served as the control group and received expository instruction. Each group consisted of 34 students. The research data included mathematical creative thinking ability, measured through pretests, posttests, and N-gain scores, as well as Self-Regulated Learning (SRL), measured using a questionnaire administered after the intervention.

The distribution of learning styles showed that the experimental group consisted of 16 visual learners (47.1%), 14 auditory learners (41.2%), and 4 kinesthetic learners (11.7%). In contrast, the control group consisted of 25 visual learners (73.5%), 6 auditory learners (17.6%), and 3 kinesthetic learners (8.9%). This composition indicates variations in student characteristics across the two groups, highlighting the importance of analyzing learning styles to examine their relationship with patterns of improvement in mathematical creative thinking ability.

The preliminary analysis showed that the pretest scores for mathematical creative thinking ability in both groups were normally distributed, with a Kolmogorov–Smirnov significance value of 0.200, and had homogeneous variances, with a Levene's test significance value of 0.582. A two-way ANOVA conducted on the pretest scores indicated that learning style did not result in a statistically significant difference ($p = 0.559$). Similarly, the instructional model did not show a statistically significant difference ($p = 0.296$), and the interaction between learning style and instructional model was also not statistically significant ($p = 0.263$).

These findings indicate that the initial levels of mathematical creative thinking ability were relatively comparable across the groups before the intervention. This baseline equivalence provides a stronger basis for interpreting changes following the intervention as being associated with the learning experiences provided. Methodologically, relatively equivalent pretest conditions also reduce the possibility that differences in the final outcomes were solely attributable to imbalances in students' initial abilities.

Following the intervention, the N-gain analysis indicated that the data on the improvement in mathematical creative thinking ability were normally distributed and homogeneous. The homogeneity test yielded a significance value of 0.240 ($p > 0.05$).

Table 2 Results of Two-Way ANOVA on N-gain Scores for Participants' Mathematical Creative Thinking Ability Based on Learning Style

Tests of Between-Subjects Effects

Dependent Variable: Mathematical creative thinking N-gain score

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.370[a]	5	.074	22.754	.000	.647
Intercept	26.648	1	26.648	8186.290	.000	.992
Kelas*GayaBelajar	.370	5	.074	22.754	.000	.647
Error	.202	62	.003			
Total	45.666	68				
Corrected Total	.572	67				

a. R Squared = .647 (Adjusted R Squared = .619)

The results of the two-way ANOVA revealed a significant effect of the combination of instructional group and learning style on the improvement of mathematical creative thinking ability (F = 22.754; $p < 0.001$), with a Partial Eta Squared value of 0.647. This Partial Eta Squared value indicates a large effect size, suggesting that the differences in the improvement of mathematical creative thinking ability were not only statistically significant but also had substantial practical significance. These findings are consistent with those of Suryaningsih, Lusiana, and Mulbasari (2019), Yudiawati and Yusepa (2017), and Purba and Harahap (2021), who reported that the Cooperative Script model can support improvements in students' mathematical creative thinking abilities.

The findings of this study further support previous evidence that the structure of the *Cooperative Script* learning model has the potential to create learning conditions that foster the development of mathematical creative thinking. The characteristic of *Cooperative Script*, in which students take turns acting as speakers and listeners, provides opportunities for them to organize information, articulate ideas, clarify their understanding, and receive feedback from their learning partners. This process is consistent with the characteristics of mathematical creative thinking, which require students not only to obtain correct answers but also to generate multiple ideas, employ diverse strategies, and elaborate their solutions in greater detail. Opportunities to compare different solution strategies may also encourage students to view mathematical problems from multiple perspectives. Therefore, the higher N-gain observed in the *Cooperative Script* group can be understood as a consequence of a learning environment that provides greater opportunities for elaboration, communication, and the exchange of ideas.

The results of the post hoc test showed that the improvement in the *Cooperative Script* group was significantly higher than that in the control group across various learning-style categories. The mean difference between the experimental auditory and control auditory groups was 0.13886 ($p < 0.001$), between the experimental auditory and control visual groups was 0.13374 ($p < 0.001$), and between the experimental auditory and control kinesthetic groups was 0.11957 ($p = 0.0095$). For the visual learning-style category, the mean difference between the experimental visual and control auditory groups was 0.16029 ($p < 0.001$), between the experimental visual and control visual groups was 0.15517 ($p < 0.001$), and between the experimental visual and control kinesthetic groups was 0.14100 ($p = 0.0015$). For the kinesthetic learning-style category, the mean difference compared with the control auditory group was 0.02543 ($p < 0.001$), compared with the control visual group was 0.15917 ($p < 0.001$), and compared with the control kinesthetic group was 0.14500 ($p = 0.009$). Overall, these findings indicate that the *Cooperative Script* group demonstrated a more consistent improvement than the expository instruction group across the different learning-style categories.

These findings are relevant to the study by Rizqi, Suyitno, and Dwijayanto (2021), which indicated that mathematical creative thinking may exhibit different characteristics when examined in relation to visual, auditory, and kinesthetic learning styles. Triwibowo, Dwidayati, and Sugiman (2017) also demonstrated that the characteristics of mathematical creative thinking can be described based on students' learning styles in open-ended learning environments. Nevertheless, these findings should be interpreted with caution, as learning styles should not be regarded as a single factor that determines learning success. Through a critical review published in *Psychological Science in the Public Interest*, Pashler et al. (2008) found that empirical evidence supporting the matching of instructional methods to students' learning styles remains insufficient. Therefore, the findings of the present study are more appropriately interpreted as indicating that *Cooperative Script* provides an interactive, communicative, and representational learning environment that can accommodate diverse student characteristics, rather than suggesting that its effectiveness is solely attributable to its alignment with a particular learning-style type.

The findings further indicate that *Cooperative Script* provides a learning context that enables students to actively construct and communicate mathematical ideas. In this model, students do not merely receive explanations; instead, they take turns explaining, summarizing, clarifying, responding to, and receiving feedback from their learning partners or group members. This process provides students with opportunities to articulate their thinking verbally while also listening to the reasoning of others. Such interactions may broaden the range of possible solution strategies because students are exposed to ways of thinking that may differ from their own. Thus, peer interaction in *Cooperative Script* functions not only as a social activity but also as a means of supporting the cognitive and metacognitive processes required for the development of higher-order thinking skills.

These findings are consistent with previous research on *Cooperative Script*, which has shown that the model can improve students' mathematical creative thinking compared with conventional instruction. Suryaningsih et al. (2019) explained that *Cooperative Script* requires students to work in pairs and actively participate in the learning process. Yudiawati and Yusepa (2017) likewise found greater improvements in mathematical creative thinking among students who learned through *Cooperative Script* than among those who received conventional instruction. Purba and Harahap (2021) reported that the implementation of *Cooperative Script* supported by GeoGebra can also enhance the mathematical creative thinking of senior high school students. These findings strengthen the interpretation that explaining, listening, responding, and constructing shared understanding are important characteristics that can support the development of mathematical creativity.

In the *Cooperative Script* group, the learning activities provided students with opportunities to discuss, exchange explanations, provide feedback, and reflect on solution strategies. For example, when solving limit problems, students with auditory characteristics benefited from verbal explanations, visual learners received support through graphical representations and algebraic procedures, while kinesthetic learners gained experience through collaborative activities and the manipulation of learning objects. In contrast, expository instruction was more heavily centered on teacher explanations, resulting in relatively more limited opportunities for students to develop alternative solution strategies. This difference in the learning process helps explain why the improvement in mathematical creative thinking was greater in the *Cooperative Script* group and is consistent with the findings of Ernita, Isnarto, and Suyitno (2024) concerning the importance of instructional designs that provide opportunities for problem solving, strategy exploration, and support for SRL.

Interestingly, no significant differences were found at baseline based on either instructional model or learning style, whereas significant differences in improvement emerged after the intervention. This pattern suggests that the differences in outcomes were not simply attributable to initial imbalances in students' abilities. The interaction between instructional group and learning style in the N-gain scores also indicates that learning experiences during the intervention played an important role in shaping patterns of improvement in mathematical creative thinking. However, this interaction should not be interpreted as evidence that learning style is a single causal factor underlying the improvement. Rather, the findings are more appropriately understood as indicating that student characteristics and the learning environment may interact to produce different learning experiences. Therefore, teachers need to provide varied activities, representations, opportunities for communication, and solution strategies to accommodate diverse student characteristics.

The SRL analysis yielded different results from those obtained for mathematical creative thinking. The SRL data were normally distributed, with a Kolmogorov–Smirnov significance value of 0.200, and had homogeneous variances, with a significance value of 0.410.

Table 3 Two-Way ANOVA Results for Self-Regulated Learning by Learning Style

Tests of Between-Subjects Effects

Dependent Variable: Skor Self Regulated Learning

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	705.631[a]	5	141.126	.822	.539	.062
Intercept	259469.454	1	259469.454	1510.935	.000	.961
Kelas	1.118	1	1.118	.007	.936	.000
Gaya_Belajar	497.347	2	248.674	1.448	.243	.045
Kelas * Gaya_Belajar	131.096	2	65.548	.382	.684	.012
Error	10647.119	62	171.728			
Total	488309.000	68				
Corrected Total	11352.750	67				

a. R Squared = .062 (Adjusted R Squared = -.013)

The two-way ANOVA showed that there was no significant difference in Self-Regulated Learning (SRL) between students who participated in the *Cooperative Script* model and those who received expository instruction ($p = 0.684$). Learning style also had no significant effect on SRL ($p = 0.243$), while the post hoc analysis yielded significance values above 0.05. These findings indicate that the effectiveness of an instructional model in improving mathematical creative thinking does not necessarily correspond to similar changes in students' self-regulation abilities.

The absence of a significant difference in SRL may be explained by the fact that SRL is a multidimensional construct encompassing cognitive, metacognitive, behavioral, motivational, and affective aspects. Panadero (2017) explained that SRL involves planning, performance, monitoring, and reflection processes that operate dynamically throughout learning. Although *Cooperative Script* incorporates activities that are conceptually conducive to self-regulation, such as explaining, monitoring understanding, receiving feedback, and clarifying ideas, the presence of these activities does not necessarily lead to immediate changes in students' self-regulation abilities within a relatively limited intervention period. Therefore, the findings of this study are more appropriately interpreted as indicating that the implementation of *Cooperative Script* during the study period was not sufficient to produce measurable and statistically significant changes in SRL.

These findings are consistent with Dignath and Büttner (2008), who, through a meta-analysis of various studies, demonstrated that SRL can be developed through instructional interventions. However, the characteristics of the program, the strategies being taught, the subject-matter context, and the theoretical foundation of the intervention may influence the outcomes. Thus, developing SRL requires not only collaborative activities but also instruction that explicitly trains self-regulation strategies. Panadero, Jonsson, and Botella (2017) showed that self-assessment practices can influence SRL by encouraging students to evaluate and reflect on their learning processes. These findings suggest that collaborative learning activities need to be complemented by processes involving goal setting, monitoring, strategy evaluation, and individual reflection. Therefore, *Cooperative Script* could be further developed by incorporating explicit self-regulation components so that its potential to enhance SRL can be more strongly realized.

The analysis of SRL should also be linked to empirical research examining the relationship between SRL and mathematical creative thinking. Hermawan, Asikin, and Dwidayati (2021) found that mathematical creative thinking exhibited different characteristics when examined according to students' levels of SRL. Students with high levels of SRL tended to demonstrate greater fluency in generating ideas, producing diverse ideas, and elaborating and enriching ideas compared with students with low levels of SRL. These findings suggest that self-regulation ability may serve as an internal condition that supports the process of mathematical creativity. Therefore, the absence of significant differences in SRL between the groups in the present study does not contradict previous research identifying a relationship between SRL levels and mathematical creative thinking, as the two analyses address different research questions and have different analytical focuses.

Table 4 Linearity Test of Post-test Data on Mathematical Creative Thinking Ability and Self-Regulated Learning

ANOVA Table

			Sum of Squares	Df	Mean Square	F	Sig.
*Self Regulated Learning ** Mathematical Creative Thinking Ability	Between Groups	(Combined)	3039.126	24	126.630	.864	.643
		Linearity	152.644	1	152.644	1.041	.313
		Deviation from Linearity	2886.483	23	125.499	.856	.649
	Within Groups		6305.153	43	146.631		
	Total		9344.279	67			

The relationship between mathematical creative thinking and Self-Regulated Learning (SRL) provides additional findings in this study. The residual normality test yielded a significance value of 0.200 ($p > 0.05$), while the linearity test showed a deviation from linearity value of 0.649 ($p > 0.05$), indicating that the relationship between the two variables met the assumption of linearity. The results of the simple linear regression analysis showed a significance value of 0.000 ($p < 0.05$) and a regression coefficient of 0.724, with the regression equation $Y = 24.404 + 0.724X$. These results indicate a positive relationship, suggesting that higher levels of SRL are associated with higher predicted levels of mathematical creative thinking based on the regression model.

The positive relationship between SRL and mathematical creative thinking can be explained by the fact that creative thinking does not end with the generation of ideas but also requires the ability to direct, evaluate, and develop those ideas. Students who are able to set goals, select strategies, monitor their progress, evaluate errors, and engage in reflection are more likely to persist when faced with mathematical problems that have multiple possible solutions. Zimmerman conceptualized SRL as a process through which students actively regulate their learning by employing strategies and exercising self-control. Panadero (2017) further emphasized that SRL encompasses interrelated cognitive, metacognitive, motivational, behavioral, and affective dimensions within the learning process. Therefore, the positive regression coefficient of 0.724 provides empirical support that self-regulation is one of the internal conditions associated with students' ability to generate and develop mathematical ideas.

Taken together, the findings indicate that the primary strength of *Cooperative Script* in this study was more evident in improving mathematical creative thinking than in producing differences in SRL scores between the groups. *Cooperative Script* provides an interaction structure that enables students to articulate their thinking, receive feedback and corrections, compare strategies, and reflect on their solutions. These findings further support previous studies by Suryaningsih et al. (2019), Yudiawati and Yusepa (2017), and Purba and Harahap (2021), which demonstrated the relevance of *Cooperative Script* to the development of mathematical creative thinking. Meanwhile, SRL functions as an internal ability that is positively associated with mathematical creative thinking; however, changes in SRL did not differ significantly based solely on the instructional model used in this study. Thus, the findings reveal a distinction between the effects of instruction on mathematical creative thinking and its effects on students' self-regulation.

These findings have important implications for mathematics education. *Cooperative Script* can be considered as an alternative instructional approach for improving mathematical creative thinking because it provides students with opportunities to communicate their ideas, listen to alternative solutions, clarify their understanding, and receive feedback. The development of

SRL, however, needs to be designed more explicitly through activities that require students to set goals, select strategies, monitor their learning processes, evaluate outcomes, and engage in reflection. Learning styles should be used as information for providing varied learning experiences rather than as a basis for rigidly grouping students based on the assumption that a particular learning style is compatible with only one instructional method. This perspective is consistent with Pashler et al. (2008), who argued that empirical evidence supporting the matching of learning styles with instructional methods remains insufficient.

Accordingly, mathematics instruction through *Cooperative Script* may be considered an alternative approach that emphasizes student engagement, mathematical communication, collaboration, and the development of multiple solution strategies. Learning styles may be used, to a limited extent, as a consideration for providing varied representations and learning activities, but they should not be regarded as the sole determinants of students' mathematical creative thinking or SRL. SRL should be viewed as an ability that develops through a continuous process and requires explicit instruction and consistent opportunities for reflection. The findings indicate that mathematical creative thinking and SRL are two positively related constructs, but they do not necessarily change at the same rate in response to a particular instructional model. Therefore, future implementations of *Cooperative Script* could be enhanced by incorporating explicit self-regulation components, such as goal setting, *self-monitoring*, self-assessment, reflective journals, and strategy evaluation, so that the development of mathematical creative thinking and SRL can be more systematically integrated.

Conclusion

The implementation of the *Cooperative Script* model resulted in greater improvement in mathematical creative thinking than expository instruction among students with diverse learning-style characteristics. The ANOVA results showed that the combination of instructional model and learning style had a significant effect on the improvement of mathematical creative thinking, with a large effect size. However, *Cooperative Script* did not produce a significant difference in Self-Regulated Learning (SRL), and learning style likewise had no significant effect on SRL. The regression analysis indicated a positive relationship between SRL and mathematical creative thinking, suggesting that the better students are able to regulate, monitor, and evaluate their learning processes, the higher their level of mathematical creativity.

Therefore, *Cooperative Script* can serve as an alternative approach to mathematics instruction for developing creativity through activities involving explanation, idea exchange, clarification of understanding, comparison of strategies, and feedback. Future research should integrate explicit self-regulation strategies, such as goal setting, *self-monitoring*, self-assessment, reflective journaling, and strategy evaluation, so that the development of mathematical creative thinking and SRL can be more systematically integrated.

References

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64–70. https://doi.org/10.1207/S15430421TIP4102_2.

Rofifah, J., Rahayu, W., & Hidajat, F. A. (2025). Validitas psikometrika instrumen *Self-Regulated Learning* dalam pembelajaran matematika SMA. *Jurnal Didactical Mathematics, 7*(1). https://doi.org/10.31949/dm.v7i1.12602.

Herdianti, I. A., & Muntazhimah. (2023). Pembelajaran era *new normal*: Pengaruh *self-regulated learning* terhadap kemampuan berpikir kreatif matematis siswa SMP. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 12*(1). https://doi.org/10.24127/ajpm.v12i1.6772.

Dignath, C., & Büttner, G. (2008). Components of fostering self-regulated learning among students: A meta-analysis on intervention studies at primary and secondary school level. *Metacognition and Learning, 3*(3), 231–264. https://doi.org/10.1007/s11409-008-9029-x.

Ernita, E., Isnarto, I., & Suyitno, A. (2024). Improving mathematical creativity through self-regulated learning in a problem-based learning model supported by GeoGebra. *Mosharafa: Jurnal Pendidikan Matematika, 13*(1). https://doi.org/10.31980/mosharafa.v13i1.1982.

Hermawan, J. S., Asikin, M., & Dwidayati, N. K. (2021). Students' mathematical creative thinking ability judging from self-regulated learning in MiC learning with an open-ended approach. *Unnes Journal of Mathematics Education Research, 10*(2), 129–135. Diakses dari: https://journal.unnes.ac.id/journals/ujmer

Istiqomah, F., Rochmad, & Mulyono. (2017). Mathematical creative thinking ability of the seventh grade students in terms of learning styles to the Preview-Question-Read-Reflect-Recite-Review (PQ4R) learning. *Unnes Journal of Mathematics Education, 6*(2). https://doi.org/10.15294/ujme.v6i2.17201.

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology, 8*, 422. https://doi.org/10.3389/fpsyg.2017.00422.

Panadero, E., Jonsson, A., & Botella, J. (2017). Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses. *Educational Research Review, 22*, 74–98. https://doi.org/10.1016/j.edurev.2017.08.004.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest, 9*(3), 105–119. https://doi.org/10.1111/j.1539-6053.2009.01038.x.

Purba, M. C., & Harahap, N. A. (2021). Kemampuan berpikir kreatif matematis menggunakan model pembelajaran Cooperative Script berbantuan aplikasi Geogebra di SMA Negeri 1 Rantau Utara. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 5*(2). https://doi.org/10.31004/cendekia.v5i2.661.

Rizqi, M., Suyitno, H., & Dwijanto. (2021). Students' mathematical creative thinking ability in terms of learning styles and gender in Problem Based Learning. *Unnes Journal of Mathematics Education Research, 10*(1), 24–34. Diakses dari: https://journal.unnes.ac.id/sju/ujmer/article/view/43225

Suciati, N. (2025). The influence of self-regulated learning on students' creative thinking skills. *International Journal of Advance Research in Mathematics Education, 1*(2). https://doi.org/10.56916/ijr.v1i2.2230.

Suryaningsih, N., Lusiana, L., & Mulbasari, A. S. (2019). Pengaruh model pembelajaran Cooperative Script pada peningkatan kemampuan berfikir kreatif matematis siswa SMP Negeri di Palembang. *Jurnal Pendidikan Matematika RAFA, 5*(2), 111–119. https://doi.org/10.19109/jpmrafa.v5i2.3534.

Triwibowo, Z., Dwidayati, N. K., & Sugiman. (2017). Analysis of mathematical creative thinking ability viewed from students learning styles in seventh grader through Treffinger learning model with open-ended approach. *Unnes Journal of Mathematics Education, 6*(3). https://doi.org/10.15294/ujme.v6i3.17987.

Yudiawati, N., & Yusepa, B. (2017). Penerapan model pembelajaran Cooperative Script untuk meningkatkan kemampuan berpikir kreatif matematis sekolah menengah pertama (SMP). *Teorema: Teori dan Riset Matematika*. DOI: https://doi.org/10.25157/.V2I1.766

Zimmerman, B. J. (2015). Self-regulated learning: Theories, measures, and outcomes. Dalam *International Encyclopedia of the Social & Behavioral Sciences* (2nd ed., pp. 541–546). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.26060-1.

Fitria, K. N., Dwijanto, & Dewi, N. R. (2023). Kemampuan berpikir kreatif matematis ditinjau dari self-esteem pada model PBL dengan pendekatan STEAM. *Jambura Journal of Mathematics Education, 4*(2), 110–118. https://doi.org/10.37905/jmathedu.v4i2.20395

Afriansyah, E. A. (2016). Makna *realistic* dalam RME dan PMRI. *LEMMA: Letters of Mathematics Education, 2*(2), 96–104. DOI: https://doi.org/10.22202/jl.2016.v2i2.578

Faturrohman, I., & Afriansyah, E. A. (2020). Peningkatan kemampuan berpikir kreatif matematis siswa melalui *Creative Problem Solving*. *Mosharafa: Jurnal Pendidikan Matematika, 9*(1), 107–118. DOI: https://doi.org/10.31980/mosharafa.v9i1.596

OECD. (2024). *PISA 2022 results (Volume III): Creative minds, creative schools*. OECD Publishing. https://doi.org/10.1787/765ee8c2-en