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Enhancing Creativity Skill and Mathematics Creative Self-Efficacy Primary Students through Tasks Modifying As Creativity Indicator

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ABSTRACT

Traditional mathematics instruction frequently neglects the cultivation of creativity and creative self-efficacy in elementary school students, as it prioritizes procedural problem-solving techniques and memorization strategies. This study examines the influence of creative mathematical tasks and task modification activities as indicators of creativity on the creative self-efficacy and creativity skills of students. This quasi-experimental study consists in pretests and control groups. Whereas the experimental group participates in learning by means of creative tasks and activities that change mathematical assignments to inspire artistic thinking, the control group follows conventional teaching tactics. Interviews with students helped to compile data on their experiences throughout task modification activities, written tests including creative projects, and self-efficacy creative relieving.

The findings indicated a notable enhancement in creativity skills and creative self-efficacy among students in the experimental group relative to the control group. Task modification activities engage students in advanced cognitive processes, foster the generation of innovative and adaptable solutions, and enhance their confidence in addressing mathematical challenges. This result shows that include creative mathematical activities and letting students modify their assignments will help to improve mathematics instruction and inspire early on creativity and confidence. This study proposes that in order to improve students' creative self-efficacy, teachers include student-led task modifications and problem-based task in mathematics education. The long-term consequences of this method and its relevance to other mathematical materials will be investigated in next studies.

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KEYWORDS: Mathematical creativity, task modification, creative self-efficacy, learning mathematics, elementary school students

I. INTRODUCTION

Creativity skills are the ability to generate original solutions to problems and generate new, innovative ideas. This capacity necessitates critical thinking skills, flexibility in identifying alternative solutions, and a divergent thought process (Gube & Lajoie, 2020; Dow, 2022). Concurrently, creative self-efficacy is an individual's conviction in their capacity to engage in innovative problem-solving or engage in creative activities. According to Tierney and Farmer (2002), individuals who possess a higher level of creative self-efficacy are more inclined to engage in creative pursuits and generate more innovative solutions. An individual who possesses a high level of creative self-efficacy is more likely to be confident in the development and application of their creativity abilities. Conversely, the development of creativity skills can be impeded by a lack of confidence in one's ability to take risks or experiment with new ideas (Bandura, 1997; Shalley & Gilson, 2004; Gilson, 2024).

It is crucial to cultivate creativity and creative self-efficacy skills at the elementary education level, as children are in a highly favorable cognitive development phase that allows them to refine their creative thinking abilities (Beghetto & Kaufman, 2007). This capacity not only facilitates academic learning but also assists them in confronting real-world obstacles. Furthermore, the cultivation of creative self-efficacy at a young age can foster a positive outlook on future learning and innovation (Hartley et al, 2016). In mathematics classes, creative assignments are indispensable. Nevertheless, there is a significant lack of research on the utilization of creative assignments in the context of basic education. The majority of research concentrates on secondary or advanced education levels, while elementary school education has not

been extensively examined (Puozzo & Audrin, 2021; Wang et al, 2023).

Self-efficacy, Creativity, and creative self-efficacy: Theoretical framework

The idea of self-efficacy derived from Bandura's social cognitive theory emphasizes the need of personal beliefs in the capacity to control and carry out the required actions to solve future events (Bandura, 1977). Self-efficacy is the main determinant of personal conduct since it influences a person's attitude to chores, problems, and goals. Strong self-efficacy students are more likely in the field of education to keep on in the face of hardship, finish demanding assignments, and achieve academic success (Schunk, 1991). Guilford (1967) on the other hand defines creativity as the ability to produce fresh ideas and worthwhile answers. Part of the creative process are cognitive skills including divergent thinking, adaptability, and the ability to see situations from several angles. In the sphere of education, creativity is a very valuable quality since it helps one to handle complex problems and adjust to new conditions.

Creative self-efficacy is a more specific form of self-efficacy that pertains to an individual's convictions regarding their capacity to exercise creativity (Tierney & Farmer, 2002; Anderson, 2023). This concept combines self-efficacy and creativity by asserting that individuals who possess high self-efficacy are more likely to engage in creative activities, take risks, and succeed in the production of innovative ideas. Creative self-efficacy, like general self-efficacy, can impact an individual's performance in tasks that necessitate creativity. Tierney and Farmer (2002) assert that individuals who demonstrate high levels of creative self-efficacy are more likely to establish enduring and ambitious creative objectives, regardless of the obstacles they encounter. In the framework of education, creative self-efficacy has great importance since it motivates students to develop and apply their creative thinking capacity. According to Beghetto (2017), students who believe they have creative ability are more likely to work on projects that support creativity and try out original ideas, therefore improving their general creativity. Therefore, developing creative self-efficacy is essential to promote creativity in the classroom, especially in elementary schools when kids are developing basic ideas about their capacity.

Creativity, and creative self-efficacy for young learner

The development of creativity skills and creative self-efficacy in students has been the subject of extensive research. However, the majority of this work has been conducted on elder age groups, such as secondary and tertiary education students (Tierney & Farmer, 2002; Beghetto & Kaufman, 2007; Huang et al, 2020; Magenes et al, 2022). The research on the enhancement of creativity at the primary school level, particularly through problem-based learning approaches, is still limited. While the majority of current research has investigated the role of problem-based tasks in improving critical thinking or problem-solving abilities, there are only a handful of studies that have explicitly investigated their influence on creativity and creative self-efficacy in younger learners. In addition, the relationship between early-stage education interventions and their long-term effects on creative confidence and problem-solving abilities is not well understood.

According to recent research, problem-based tasks (PBT) are widely recognized as an effective instructional method for cultivating critical thinking and reasoning abilities in students, thereby facilitating their intellectual growth. The advantages of PBT in the development of advanced cognitive abilities within secondary and tertiary educational contexts have been demonstrated by research conducted by Hmelo-Silver (2004), Savery (2015), and Suryanti et al. (2022). The results suggest that PBT fosters the practical application of knowledge, enhances collaboration among colleagues, and facilitates thorough interaction with resources. However, the majority of these studies concentrate on higher-level students, particularly those in secondary and post-secondary education, who are more capable of participating in complex, self-directed learning activities as a result of their enhanced developmental preparedness. The literature on the implementation of PBT in younger demographics, particularly in primary education, is significantly restricted. The development of cognitive skills, creativity, and creative self-efficacy in primary education is substantially under-researched in relation to the impact of PBL.

Moreover, creativity is often perceived as a subordinate result rather than a central objective within educational frameworks, despite the considerable research dedicated to it. Sternberg (2013) and Amabile (1996) undertook investigations into the interplay among creativity, cognitive processes, cognitive capacity, and motivational factors. Nevertheless, these inquiries have predominantly concentrated on the adult learner demographic. Investigations concerning younger students often emphasize tasks that cultivate creative thinking or artistic endeavors, rather than concentrating on problem-solving activities that replicate real-world scenarios. Moreover, the foundational aspects have insufficiently explored the connection between creativity and creative self-efficacy, a crucial element in fostering a student's belief in their creative abilities. The body of current studies does not fully examine how early-stage interventions, such PBT, affect the long-term creative growth and confidence enhancement in younger students in solving creative problems. This discovery emphasizes the need of doing focused research to find the particular ways in which problem-based assignments might improve creativity and creative self-efficacy among elementary school students.

Mathematical Creativity and modifying tasks

The ability to conceive innovative ideas in mathematics is defined by fluency, flexibility, and originality (Silver, 1997). Involving students in the alteration of mathematical inquiries

or tasks serves as a means to cultivate their creative capacities. The modification of tasks offers students the chance to adapt, enhance, or reconstruct queries in accordance with their own understanding and situational context. This process conforms to social constructivist ideas as stated by Khadidja (2020). This approach stresses the need of students as active learners who pick knowledge by means of their engagement with challenging assignments. Changing the questions helps students to develop their critical and creative thinking abilities as well as expand their knowledge of mathematical ideas.

Moreover, the engagement of students in the alteration of tasks facilitates the cultivation of divergent thinking abilities, enabling them to generate multiple solutions or viewpoints regarding a mathematical issue (Torrance, 1974). When students are afforded the opportunity to modify or generate new inquiries from established assignments, they are subtly guided to discern patterns, investigate the interconnections among concepts, and devise alternative solutions that are pertinent (Liljedahl, 2017). This process encourages the growth of independent, creative learners, while also bolstering their self-assurance in addressing challenges with innovative solutions. Additionally, this methodology enables students to establish connections between objectives and real-world contexts, thereby increasing the importance of their learning and enriching their educational experiences (Zazkis & Leikin, 2010). As a result, this theoretical framework emphasizes the proactive involvement of students in the modification of tasks as a method of fostering mathematical creativity and advanced cognitive abilities in the field of mathematics.

Research Question:

- RQ1: Do Problem-Based Tasks Enhance Student Creativity Skills and Creative Self-Efficacy?
- RQ2: How does modifying mathematical tasks enhance student creativity?

II. METHODS

This study uses a quasi-experimental approach combining a pretest-posttest control group approach. Two groups—an experimental group using task modification techniques and a control group using conventional learning approaches—were formed from fifth-grade elementary school pupils for the study. Students' questions were modified during the preparation stage of this research, which consisted in the development of instruments including the Torrance Test of Creative Thinking (TTCT)-based creativity test, a creative self-efficacy scale questionnaire, semi-structured interviews, and the design of mathematical tasks related to the area and circumference of flat shapes. The studies ran six weeks.

Students in the experimental group participate in context-based mathematics activities including the computation of the area and circumference of flat forms relevant for daily life during the course of learning. Students are required to identify updated task elements—that is, changes to the conditions of the problem, the insertion of narrative background, or numerical value changes. Subsequently, participants were instructed to formulate new questions and identify solutions to the modified inquiries. This activity is conducted individually or in groups, with the teacher serving as a facilitator who offers guidance and feedback. Students in the control group engaged with the same topic using direct learning methods, without any modifications to the tasks.

Beginning and ending the study, pretests and posttests were given to evaluate students' creativity—more especially, their creative self-efficacy—with an eye toward signs of originality, adaptability, and fluency. Together with qualitative analysis of student assignments to gauge originality in task modification, the outcomes of the study were examined using inferential statistical tests to compare experimental and control groups. This study intends to show that changing assignments given to students improves both creativity and creative self-efficacy, and provides useful directions for instructors to apply this approach into primary mathematics education.

III. RESULT

RQ1: Do Problem-Based Tasks Enhance Student Creativity Skills and Creative Self-Efficacy?

The results indicated that the creative self-efficacy and creative skill of students in the experimental group were considerably enhanced in comparison to those in the control group as a result of creative mathematical tasks. The experimental group exhibits an increase in the pretest score to posttest for both research variables, namely creativity and creative self-efficacy, as indicated by the Independent T-Test analysis. In contrast, the control group did not exhibit a substantial increase. Students in the experimental group exhibit a consistent increase in indicators of fluency, flexibility, and originality in the creativity skill variable. They are capable of developing a solution that is more distinctive and diverse than that of the control group. Particularly in relation to task modification, in the creative self-efficacy variable, the students of the experimental group claimed more confidence in facing mathematical obstacles. The posttest results of the experimental and control groups showed a significant difference demonstrated by the data of the Independent T-Test statistical analysis. This implies that the growth of students' creative creativity and self-efficacy benefited from creative mathematical tasks.

Table 1. Creativity skill of experiments and control group

Indicator	Experiment group		Control group	
	Pre-test	Post-test	Pre-test	Post-test
Fluency	2.35	3.67	2.31	2.67
Flexibility	2.1	3.5	2.12	2.81
Originality	1.8	3.1	1.77	2.54
Elaboration	2.05	3.78	2.1	2.73

The experimental group exhibits an average score that is higher than that of the control group, as indicated by table 1. In the experimental group, the four indicators demonstrate exceptional inventive abilities, as evidenced by an average score exceeding 3.

In the experimental group, Figure 1 illustrates one of the students' creativity abilities in the completion of problem-based activities.

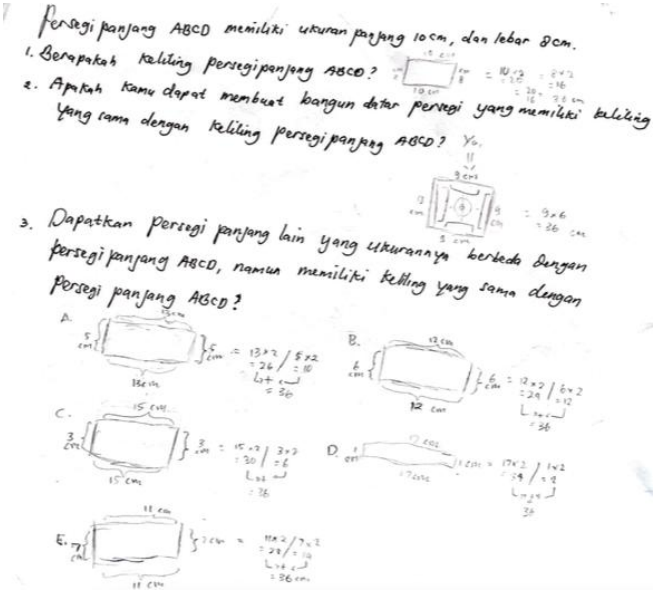

Figure 1. Students' creativity abilities in the completion of problem-based task (AZ)

Student AZ exhibits his ability to be creative by identifying five additional rectangles that share the same perimeter as the rectangle ABCD in Figure 1. This is accomplished by identifying various length and width combinations that satisfy the same perimeter equation, while simultaneously guaranteeing that each combination generates a distinctive rectangle. This process is indicative of the student's comprehension of the perimeter concept and their capacity to think creatively in order to identify a variety of solutions.

Table 2. Students' Creative self-efficacy of experiments and control group

Item	Experiment group		Control group	
	Pre-test	Post-test	Pre-test	Post-test
I have confidence in my ability to solve mathematical problems	3.1	4.2	3	3.5
I feel that I am good at developing/generating new ideas in mathematics	2.7	3.5	2.1	2.78
I feel that I am good at developing the mathematical ideas than others	2.4	3.7	2.1	2.8
I have confidence in my ability to modified mathematical task	1.8	4.25	1.87	2.81
I modified the task faster than my friends	1.78	4.1	1.67	2.75

The experimental group's average score for the 'I have confidence in my ability to modified mathematical task' was the highest at 4.25, as indicated in table 2. This score experienced a significant increase of 1.8 from its initial score. This discovery demonstrates that the intervention employing the modulating task approach significantly enhances students' capacity to modify mathematical tasks, which is one of the creative self-efficacy indicators. In contrast, the control group did not experience any substantial changes in the average score for these indicators.

RQ2: How does modifying mathematical tasks enhance student creativity?

The activity of modifying mathematical tasks has been shown to be effective in enhancing pupil creativity through a variety of mechanisms, as indicated by the results of qualitative data analysis. Students are afforded the opportunity to investigate novel concepts and modify the task components in accordance with their comprehension and preferences through the task modification process. Students show a development in their indicators of creativity—fluency, originality, and flexibility among others. They can thus create a wide range of relevant and unique questions, express ideas that go beyond the limitations of the taught rules or patterns, and show their ability to investigate a problem from several sides.

Interviews with students indicate that this activity offers a more profound creative thinking experience. Initially, certain students experienced confusion due to their lack of familiarity. However, by the third week, they were ecstatic and delighted, and they were willing to experiment and attempt new solutions when they modified mathematical questions. Some students claim that by forcing them to explore the background of problems, the relationships between concepts, and logical answers, this technique helps them to grasp mathematical ideas in a more complete sense. Moreover, teachers who act as facilitators provide comments that inspire students to improve their ideas and evaluate them, therefore creating an environment that supports invention and inquiry.

> *Usually I just address the current questions, but right now I have to consider how to solve the issue. It's thus like being creative, sis, since I have to consider several issues but still apply the same mathematical idea. Exciting; more confident to ask my own questions (AZ).*

Initially, I was perplexed; however, it became thrilling after a considerable period. Additionally, I acquired additional strategies for resolving the issue by formulating my own inquiries (AS).

This is interesting since it differs from typical. Making my own questions helps me to be more creatively (MI)

Additionally, this activity has been observed to enhance student engagement in the learning process. One gets more driven to participate in class, have conversations, and share thoughts. By use of teamwork, this contact pattern promotes the growth of a greater spectrum of innovative ideas. Thus, changing mathematical assignments not only improves students' individual creativity but also facilitates group learning, so augmenting the general creative thinking process.

IV. DISCUSSION

The results of this study indicate that elementary school students' creative self-efficacy and creativity are considerably improved by the modification of mathematical tasks and the completion of Creative Mathematical Tasks. These results are consistent with the research conducted by Runco and Jaeger (2012), which suggests that creativity in education can be cultivated by offering students the chance to engage in original and flexible thinking through challenging open-ended tasks. In mathematics, task modification allows students to explore alternative solutions, thereby promoting creativity indicators such as originality, fluency, and flexibility (Leikin, 2009).

This research further supports the findings of Sun et al. (2018), which suggested that the inclusion of creative assignments in mathematics education improves the self-efficacy of students in completing difficult tasks and their creativity. This research suggests that students who participated in the task modification process reported increased confidence, which was attributed to their perceived control over allotted tasks and the tangible results of their creative contributions. This is consistent with Bandura's (1997) theory, which contends that students' self-efficacy can be improved by successfully completing assignments that test their abilities.

This finding supports Silver's studies (1997), which imply that mathematics assignments requiring students to create or change original questions can enhance high-level thinking, a fundamental component of creativity. This approach helps pupils to develop critical thinking in connection to the modification or extension of an issue, therefore enhancing their cognitive flexibility. Leikin (2009) contributes to the field by illustrating that elementary-level students can also improve their creativity through task modification, with a particular emphasis on students with exceptional mathematical abilities. This emphasizes the creative task-based approach's extensive applicability across various educational levels.

V. CONCLUSION

By emphasizing the importance of incorporating creative tasks to cultivate higher-order thinking skills, this research significantly contributes to the development of innovative learning methods in fundamental education, particularly in mathematics. This investigation illustrates that the engagement of elementary school students in creative mathematical tasks that necessitate task modification can substantially improve their creative self-efficacy and creativity skills. Through exploring several alternatives, the process of assignment modification helps students to participate in creative, flexible, and fluent thinking, so enhancing their creativity measures. Furthermore, students who participated in this exercise claimed more confidence when faced with mathematical challenges, suggesting that changing the nature of the work can improve their creative self-efficacy. This study's results indicate that creative assignment-based learning fosters an environment that is conducive to the exploration of innovative concepts and fosters the development of students' creative potential from a young age. Students are able to identify the significance and relevance of their education when they are granted autonomy regarding their responsibilities. This method not only encourages students to develop their imaginations but also enhances their self-assurance regarding their abilities.

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