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The Mathematics Creative Thinking Skills on the Connecting, Organizing, Reflecting, and Extending (CORE) Learning Model Seen from Students' Independence Assisted by Contextual Module

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Abstract

The goal of this research is to pinpoint the underlying factors contributing to students' poor mathematical creative thinking skills and to evaluate the impact of CORE learning with contextual modules on these skills. This research method uses a mixed-method approach with a sequential exploratory strategy. The population in this study is the seventh-grade students of SMP N 3 Kandangan for the 2021/2022 academic year. The researchers collected data through observation, interviews, tests, and questionnaires. The researchers analyzed the data descriptively, using both qualitative and quantitative methods. The research findings indicate that the CORE learning model, in conjunction with contextual modules, can effectively address the factors contributing to low mathematical creative thinking skills. Students with high independence are able to meet all four indicators of mathematical creative thinking skills, namely fluency, flexibility, originality, and elaboration. Students with low or very low independence can only meet two or three indicators of mathematical creative thinking skills, such as fluency, flexibility, and originality, but are unable to meet one of the other indicators. The result of this study are expected to help teachers and prospective teachers to choose teaching references related to active learning that can develop students mathematical creative thinking skills.

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INTRODUCTION

Self-improvement is increasingly required in 21st-century education. Skills and competencies are changing rapidly in this century. The National Education Association (NEA) (van Laar et al., 2020) lists three 21st-century learning skills: 1) learning skills (creativity, innovation, critical thinking, problem-solving, communication, and collaboration), 2) literacy skills (information, media, and ICT literacy), and 3) life skills. (AYTEKİN & TOPÇU, 2024) argue that creative problem-solving skill come to the fore in twenty-first century.

Mathematical concepts can boost student intelligence (Fatimah, 2019). 21st-century learning skills are increasingly complex, especially in improving critical thinking, communication, collaboration, and creativity to enable global change. According to the Indonesian Ministry of National Education, mathematics can develop students' critical, analytical, logical, and creative thinking. According to Regulation of the Minister of Education and Culture No. 21 of 2016, mathematics education should foster students' creativity (Gunawan et al., 2022).

Students' problem-solving creativity requires creative thinking (Syahara & Astutik, 2021). It is essential to mathematics education (Nurzulifa & Dwijanto, 2021), involving connecting ideas, generating new ones, and applying them to create fluent and flexible solutions. Students' efficient and flexible math problem-solving skills are closely related to mathematical creativity. (Saironi & Sukestiyarno, 2017) define mathematical creative thinking as easy, flexible problem-solving. Evans (cited in (Widyatiningtyas & Retnaninggrum, 2019)) defines creativity as sensitivity, fluency, flexibility, and originality. Munandar (Nursilawati et al., 2019) defines creative thinking as fluency, flexibility, originality, and elaboration. Creativity defined by flexibility, fluidity, and originality of an idea or product (Maestre et al., 2024).

In a preliminary study on mathematical creative thinking at SMP N 3 Kandangan, students scored 64.5, indicating low proficiency. Students also gave up on difficult questions and relied on peers for answers, demonstrating a lack of independence in problem-solving. Many students had trouble connecting old and new concepts, making problem-solving harder. Students usually view math as a curricular requirement and lack the motivation to learn independently outside of school, which limits their mathematical creativity. (Mulyana, 2019) found that students can improve their math creativity and independence.

"Independence" comes from "independent," which refers to self-reliance and minimal dependence on others to complete tasks. Independent learning is essential to education. (Abdurrahman & Natalliasari, 2019) found a positive correlation between mathematical problem-solving and learning independence. In mathematics, (Julaecha, 2019) find a positive correlation between learning outcomes and independence. Developing learning independence is crucial to improving students' academic performance, especially in math. Teachers need to have design thinking skills to improve students' ability (Saritepeci & Yildiz Durak, 2024).

Students can connect, organize, reflect, and extend knowledge using the CORE learning model (Noka Saputra et al., 2019). Students actively learn in CORE by connecting prior knowledge to new information. Next, students assess comprehension by organizing their knowledge. After reflecting, they share their knowledge. Finally, students solve related problems and learn more (Fatimah, 2019). (Nurmalasari, 2019) found that the CORE model improves academic performance, classical mastery, and self-independence. According to (Wiharso, 2019), cooperative CORE learners outperformed conventional learners.

Teaching modules are designed to aid learning with or without teacher assistance. Modules are self-study package that designed to help student participants achieve their

learning goals (Pratama et al., 2022). Modules with accessible language, contextual concepts, and engaging content help students learn. Feedback should be included in modules so students can self-assess their knowledge and skills. Learning mathematics is more effective with simple, contextual, and engaging language (Suastika, I. K., Rahmawati, 2019).

This study seeks to determine the causes of students' low mathematical creative thinking and assess CORE learning coupled with contextual modules' independence.

METHOD

This study applied a mix method with a sequential explanatory design. This research began with qualitative research.

This mixed-method design integrates qualitative and quantitative approaches (Sukestiyarno, 2021). This method was selected to produce robust and complementary data from both qualitative and quantitative viewpoints. The study employed a sequential exploratory mixed-methods design, initiating with qualitative research, succeeded by quantitative research. The researcher initiated the analysis of qualitative data and subsequently employed the findings to guide the quantitative phase.

The research was carried out at SMP N 3 Kandangan. The population comprised seventh-grade students at SMP N 3 Kandangan, with class VII A designated as the experimental group and class VII B as the control group. Qualitative data analysis was conducted through documentation, interviews, and observations of chosen research subjects. Qualitative research emphasizes in-depth analysis of problems to uncover root causes or underlying issues (Sukestiyarno, 2021). The qualitative data analysis used (Sukestiyarno, 2021) concept is delineated as follows:

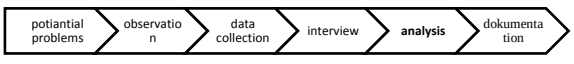

Figure 1. Qualitative Process

This study focus was mathematical creative thinking and students's independences. The qualitative research began by taking the initial skill data of the students to determine the potential problems. Then the researchers observed and collected the data with interview for further analysis along with documentation results. On the other hand, the quantitative data collection applied mathematics creative thinking skill test.

The following research is experimental with a population like the scope above using simple random sampling, namely one experiment class, and one control class. Creative thinking is the dependent variable of this study, and the independent variabel is CORE learning coupled with contextual modules' independence.

We analysed the experimental data to test the effectiveness of learning. The criteria of effectiveness 1) learning in the experiment class achieved the minimum 70; process with analysis one sample t-test, 2) CORE learning coupled with contextual modules' independence in the experiment class better than CORE learning coupled with contextual modules' independence in the control class; comparing difference with the independent t-test, 3) creative thinking has a posstive effect on the stiudents with CORE learning coupled with contextual modules' independence; tasted the data using the regression effect test analysis (Sukestiyarno, 2021).

RESULTS AND DISCUSSIONS

Describing the underlying problems of low mathematics creative thinking skills of the students

Observations and interviews with mathematics teachers indicated that students predominantly depended on their instructors during the mathematics learning process, thereby impeding the cultivation of their independent learning skills. The students' proficiency in resolving contextual problems was inadequate, and no modules with contextual mathematics resources and exercises were accessible to promote

autonomous learning. The researcher acquired interview results pertaining to students' independent learning in class VIII A at SMP N 3 Kandangan. Factors influencing included motivation, enthusiasm, curiosity, and module availskills. Students encountered challenges such as comprehension difficulties, reliance on peers, an unsupportive educational atmosphere, parental pressure, and ambiguity regarding accurate responses.

The first step entailed conducting a preliminary skill assessment for class VIII students who had previously covered the topic of Lines and Angles in class VII. The initial assessment sought to evaluate students' mathematical creative thinking skills. The researcher chose a sample from class VIII-A at SMP N 3 Kandangan. The test results were evaluated, and two students were selected for interviews. The interviews depended on the steps taken by students in solving mathematics creative thinking ability test, and interviews students what feelings by students about mathematics problems.

Mathematical creative thinking data collection was using a questionnaire with fluency, flexibility, originality, and elaboration indicators. After that the researchers interview a students' sample. The first student said, *"I can't solve the problem any other way",* this shows that the students just only answer on the originality indicator. Meanwhile, the other students said, *"I can to solve problems according to existing formulas and work examples",* this shows that the students answer the fluency and originality indicator.

The initial interview indicated that the first student could address two criteria: fluency and originality. The student responded with precision and fluency for both criteria, employing techniques typically instructed by the teacher.

The second interview revealed that the second student could solely address the originality indicator. This resulted from the student's confusion in utilizing alternative methods, as they were unaccustomed to employing multiple approaches. It can act as an affective barrier to the fulfilment of creative potential (Hadromi et al., 2024; Daker et al., 2023).

The interviews concluded that students' mathematical creative thinking skills remain underdeveloped. This occurred due to students' unfamiliarity with engaging in creative thinking exercises. Students were unaccustomed to solving problems through alternative methods, having relied solely on a singular approach. Furthermore, their elucidations during problem-solving were deficient in detail. Students often proceeded directly to the answers without detailing the steps, compromising the accuracy of their responses due to a lack of attention to detail.

Consequently, alternative strategies are required to augment students' mathematical creative thinking skills by integrating contextual and interactive components into the educational process. These methods can assist students in surmounting challenges in cultivating creative thinking skills.

The CORE learning model, enhanced by contextual modules, provides an active learning approach for mathematics. Contextually designed mathematics modules can promote independent learning and enhance students' mathematical creative thinking skills.

The Effetiveness of Connecting, Organizing, Reflecting, Extending (CORE) Learning Model with Contextual Module Assistance toward the Mathematics Creative Thinking Skills of the Students

Learning is deemed effective when the learning objectives are met (Y. I. Sari & Putra, 2015). Effective learning is demonstrated through cognitive restructuring, behavioral modifications, and psychomotor advancement resulting from educational outcomes (Bistari, 2018). Hamdani's criteria for effectiveness (Hidayati, 2019) indicate that effective learning is characterized by the attainment of mastery in learning, both individually and collectively. A student is deemed to have achieved individual mastery upon attaining a minimum score of 75%. Classical mastery is attained when a minimum of 75% of students

reach the individual mastery threshold, resulting in an enhancement of the overall student skills.

The independence of the CORE learning model, supplemented by contextual modules, in enhancing students' mathematical creative thinking skills satisfied the effectiveness criteria. The individual mastery test revealed a significance value of sig = 0.8% < 5%, indicating that students' creative mathematical thinking skills surpassed the minimum competency criterion (MCC) of 70. The proportion test indicated sig = 0.00% < 5%, signifying that over 75% of students attained scores exceeding the MCC of 70. The gain test demonstrated a 31% enhancement.

These findings correspond with Wiharso & Helfi (2019), who indicated that student outcomes in cooperative CORE learning surpassed those in traditional learning. Likewise, (Nurmalasari, 2019) evidenced that student learning outcomes utilizing the CORE learning model attained classical mastery, with students' self-independence assessed as high. Moreover, (Arisandy et al., 2021) emphasized that the utilization of practical and effective instructional media can improve students' creative thinking skills. CORE learning model positive impact on the development of students' mathematical capabilities (Diani et al., 2021; E. P. Sari & Karyati, 2020).

argue that teacher training is vital for imparting creative thinking techniques and strategies in teaching. Contextual problem helps students to understanding mathematics in the context of daily life. (Dewi & Primayana, 2019; Kurniasari et al., 2018) argue that there are differences in understanding of concepts between students facilitated by learning contextual module. the construction of students' mathematical knowledge through contextual based learning experiences will be able to foster better student understanding (Rochsun & Agustin, 2020).

It shows that increasing CORE learning model with contextual module is effective to explore mathematics creative thinking skills of the students.

Descriptions of Creative Thinking Skill based on Independence

The mathematics creative thinking skill test, in the form of answer sheets and independence test results, had some categories such as high, moderate, and low. Here are the categorization guidelines at Table 1.

Table 1. Categorization The Students Independence Test

No	Criteria	Categories
1	$x > (\mu + 1.0\sigma)$	High
2	$(\mu - 1.0\sigma) \leq x \leq (\mu + 1.0\sigma)$	Moderate
3	$x < (\mu - 1.0\sigma)$	Low

Table 2 indicate that the results of the students' independence test were grouped into 3 categories: high, moderate, and low. Table 2 shows the categorization based on the guidelines.

Table 2. The Result of Student Independence Test

Independence	Frequency	Percentage
High	4	14.286
Moderate	16	57.143
Low	8	28.571

The results of the student independence test revealed that among 28 students, the majority were classified in the moderate category, with 57.143% (16 students) categorized as moderate, in contrast to the high and low categories. Simultaneously, 14.286% (4 students) were classified as high, while 28.571% (8 students) were designated as low.

Subsequently, two research participants were chosen from each independence category for a comprehensive observation of their learning independence, based on the indicators of mathematical creative thinking skills: fluency, flexibility, originality, and elaboration. Students exhibiting high independence demonstrated proficiency in all four indicators of mathematical creative thinking skills: fluency, flexibility, originality,

and elaboration. Conversely, students exhibiting low or moderate independence could fulfill only two or three indicators—specifically, fluency, flexibility, and originality—yet failed to satisfy one of the remaining indicators.

It shows that increasing creative thinking skills base on independence of students is moderate a more comprehensive using contextual module. Creative thinking skills help students develop their knowledge through active and creative learning (Nursilawati et al., 2019). Learning that involves contextual situations requires student independence. Mathematics learning using modules can improve students' learning independence and creative thinking skills (Novalia & Noer, 2019).

CONCLUSION

The results show that the fundamental problems of the low level of students in mathematics creative thinking skills is difficult to understand the material, dependency on other people, learning situation is not support, don't know which answer of the problems is correct, modules. After finding many problems in mathematics creative thinking by students, the researchers carried out learning that was able to develop mathematical creative thinking abilities, namely CORE learning coupled with contextual modules' independence. Contextual mathematics module can be used by students to learn independently.

This study concludes that the CORE learning model, supplemented by contextual modules, effectively enhances the development of mathematical creative thinking skills. Furthermore, the degree of student independence does not inherently influence mathematical creative thinking skills, underscoring the necessity for high-quality educational innovations.

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