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STEAM approach to enhance the creativity of students with special needs in inclusive primary schools

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ABSTRACT

This research is motivated by the lack of 21st-century skills, especially among students with special needs in the slow learner category. The study aims to enhance students' creativity in learning science by implementing the STEAM approach in class VD of Elementary School 24 Ujung Gurun. This research follows the classroom action research method, conducted in two cycles, with each cycle comprising two meetings. The process involves four essential stages: planning, implementation, observation, and reflection. The research employed teacher observation sheets and student creativity observation sheets as instruments. The data analysis technique used is comparative descriptive statistical analysis, comparing learning creativity between cycle I and cycle II. The specific creativity indicator observed is elaboration, with sub-indicators focusing on developing or enriching other people's ideas. The results indicate that the application of the STEAM approach led to an increase in the creativity of students with special needs. The observation and data analysis results demonstrate a rise in students' creativity from an average of 64% in cycle I to 81% in cycle II. In conclusion, the study revealed an improvement in the creativity of students with special needs through the implementation of the STEAM approach at Primary School 24 Ujung Gurun. Despite challenges such as assessing work based on student's abilities and some students lacking honesty in their efforts, it is recommended to continue using the STEAM approach as an alternative method to enhance the creativity of slow learners in learning, given its positive impact on students' creative abilities.

1. Introduction

Today, alongside human necessities, the progress of science, technology, and information has been significant. This progress equips humans with insightful knowledge in the field of science and technology. Various technological innovations have been developed to enhance human activities, including those related to education. The era of the Fourth Industrial Revolution demands educators to be more creative in integrating technology into the learning process [1]. This adaptation is essential to enhance students' critical thinking and creativity in alignment with the 21st-century learning system. The 21st-century individual skills, also known as the 4C's (critical thinking, creativity, collaboration, and communication) [2], highlight creativity as the ability to generate novel and unique solutions to problems [3]. According to Selvi, creativity encompasses the freedom to think, act, and create. Human creativity can be nurtured from an early age, including elementary school students [4], [5]. Hills *et al.* assert that every individual possesses creativity; the extent of its development depends on one's willingness to cultivate and refine it [6]. Through the learning process, students' creativity can be honed, enabling them to discover innovative perspectives and solutions for life's challenges [7]. Boonpracha suggests that there are five indicators of creativity: fluency, flexibility, originality, elaboration, and evaluation [8].

Fluency refers to students' ability to generate various questions. Flexibility is the capability of students to approach problem-solving from different perspectives. Originality pertains to students' ability to formulate their ideas. Elaboration involves the capacity of students to provide detailed descriptions of an object, idea, and/or situation. Evaluation refers to the ability to make decisions in open situations [9]. Low creativity in students is influenced by learning activities that predominantly revolve around the teacher (teacher-centered learning). This is supported by Demchenko's research, which demonstrates that students' creativity needs to be optimized because it can serve as a foundation for their future careers. The creativity of regular students must always be nurtured, as well as that of students with special needs who may experience slow learning [10]. Slow learners are those who exhibit low learning achievement, performing slightly below the average of children in general in one or more academic areas [11]. According to Vuong, students' creativity abilities are still relatively low, primarily due to difficulties in understanding the material, a lack of use of educational media, and limited variety in the learning strategies employed by educators [12].

In this technological era, learning strategies have evolved significantly. To address the issue of low creativity among students, one effective strategy is to implement an engaging learning approach known as STEAM (Science, Technology, Engineering, Art, and Mathematics). The STEAM learning approach has garnered substantial attention in the field of education due to its ability to nurture students' creativity, enabling them to develop problem-solving skills, think critically, and reason logically and systematically [13]. Additionally, STEAM is employed to integrate and apply STEAM elements by connecting them with real-life natural phenomena. Learning science through the STEAM approach offers students novel experiences, enhancing their creativity, even among those with slow learning abilities [14], which include students with special needs. Slow learners do not exhibit physical differences but tend to struggle when asked to perform tasks [15]. Sumaira *et al.* emphasized that children with learning disabilities (slow learners) encounter delays in learning compared to their peers of the same age [16]. To mitigate the challenges faced by slow learners, specific strategies are required, one of which involves enhancing their creativity through the STEAM learning approach [17].

According to Park, STEAM can stimulate creativity and enhance problem-solving skills in students with disabilities, enabling them to think critically and devise innovative solutions to challenges [18]. Moreover, research conducted by Stehle *et al.* demonstrated that STEAM learning makes a positive contribution by enhancing students' critical thinking, cooperation, and problem-solving abilities [19]. Dimitrova *et al.* further suggested that many learners with special needs can thrive in science, technology, engineering, and mathematics programs and careers if the barriers associated with learning, including those faced by children with special needs, are overcome [20]. STEAM-based learning has been shown to improve learning outcomes for deaf students [21]. Angreni revealed no significant difference in the learning models used for special needs students and regular students. Given the previously presented information, it is evident that research efforts aimed at enhancing students' creativity have primarily focused on students with special needs falling into categories other than slow learners. Therefore, it is imperative to conduct research specifically targeting the improvement of creativity among slow learners through the STEAM approach.

2. Method

This research is a classroom action research (CAR) consisting of 2 cycles. This research procedure has four stages, namely (1) planning, (2) implementation, (3) observation, and (4) reflection [22]. The four-stage research procedure—planning, implementation, observation, and reflection—serves as a methodical framework that researchers follow to conduct meaningful and organized studies. In the planning stage, researchers meticulously define the scope of their research [23], formulate research questions [24], and devise a detailed plan outlining the methodology and data collection techniques [25]. This phase acts as the roadmap, guiding researchers throughout the study, and involves a thorough literature review to understand the existing body of knowledge [26]. The implementation stage is the practical execution of the research plan. Researchers collect data adhering to the established methodology, ensuring precision and consistency [27]. This phase demands careful attention to detail and adherence to ethical standards. The observation stage involves systematically recording data, which can encompass various aspects depending on the research focus. Researchers must maintain objectivity and accuracy during this stage, whether through direct observation, experiments, surveys, or interviews. Finally, the reflection stage is where researchers analyze the collected data, draw conclusions, and interpret findings in the context of the research questions. This phase often includes statistical analysis or qualitative coding, enabling researchers to critically evaluate the results, identify patterns, and consider the broader implications of their work. Reflection also entails comparing findings with existing literature, helping researchers understand the significance of their contributions and paving the way for future studies in the field. The details of the research are described in Fig 1.

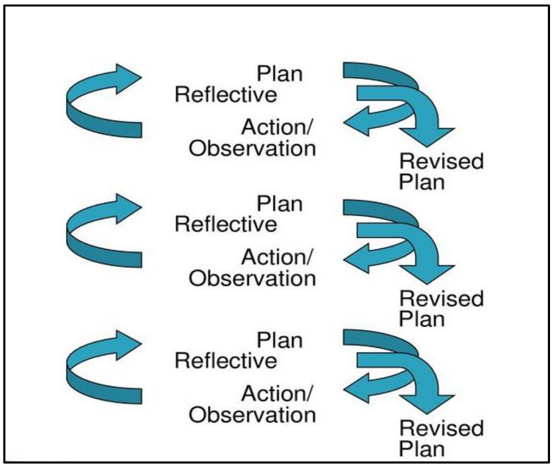

Fig. 1. Class action research cycle [28]

This research was conducted at SDN 24 Ujung Gurun Padang during the 2022/2023 school year, involving a total of 28 students categorized as slow learners based on information provided by the class teacher, which included nine individuals. The study focused on the creativity of slow learners exhibiting challenges in reading, writing, and counting. The sampling technique employed was purposive sampling, selecting samples based on specific criteria. Following interviews with the teacher, the population was determined to be 24 individuals. Subsequent tests included objective questions and essays to assess students' cognitive abilities. After analysis, nine slow-learning students were included as the sample for this study. Data collection techniques involved non-test methods, specifically observation. An observation sheet served as the instrument for data collection. The data analysis method used was comparative descriptive statistical analysis, involving a comparison of learning creativity between cycle I and cycle II. This research aimed to evaluate the creativity of students with learning disabilities; therefore, not all creativity indicators were observed, taking into account the students' abilities. The creativity indicator examined was elaboration, with sub-indicators focusing on developing or enriching other people's ideas. Students' creativity was assessed based on their work related to the properties of light. Table 1 outlines the criteria for student creativity. The sub-indicators were further evaluated with specific aspects, including product cleanliness, product neatness, product location suitability, product color suitability, and the functionality of the product. The following formula was utilized to analyze the data.

$$P = \frac{\text{Number of students who do the indicator}}{\textit{Total number of students}} \times 100\% \quad (1)$$

Table 1. Criteria for student creativity [1]

Percentage	Creativity Criteria
81 – 100	Very High
61 – 80	High
41 – 60	Medium
21 – 40	Low
1 - 20	Very Low

3. Results and Discussion

3.1. Cycle I

The data collected for this study were sourced from student creativity sheets over two cycles. The research was conducted in class VB at SDN 24 Ujung Gurun Padang City. The Participatory Action Research (PAR) comprised two cycles, each consisting of two meetings [29]. Each meeting followed stages including planning, implementation, observation, and reflection. The planning phase involved creating teaching modules based on the independent curriculum, focusing on the topic of light and its properties. In cycle I, this entailed compiling student worksheets, preparing learning materials, creating student creativity sheets, and developing teacher activity sheets. The first cycle comprised two meetings. During the implementation stage, the prepared learning tools were utilized. The learning process was facilitated by the research team members and observed by peers. The learning activities were integrated with the STEAM approach, encompassing introductory, core, and closing activities. Preliminary activities involved greetings, attendance, apperception exercises, and ending with questions and answers about the upcoming material. The core activity involved explaining the material while integrating the STEAM approach. In this phase, the teacher acted as a facilitator, encouraging students to engage in creative learning through the elaboration stage (developing or enriching other people's ideas). Students' creativity was assessed using the student creativity sheets created earlier. Additionally, teacher activity was observed and recorded using specific sheets to ensure alignment with the designed learning tools. The closing activity, involving both teachers and students, summarized the material covered and reviewed the products created by the students. The observation stage focused on collecting the results from the teacher activity observation sheets and the student creativity assessment sheets obtained from the implementation activities. These results were then averaged to calculate the percentage of creativity in cycle I, as illustrated in Fig. 2.

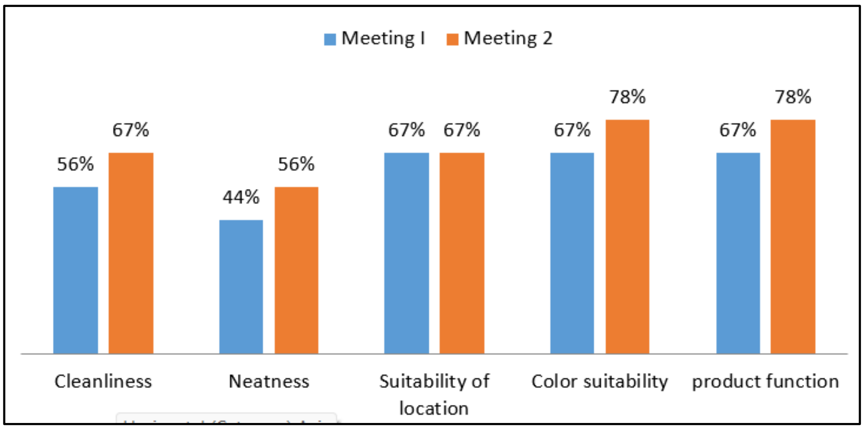

Fig. 2. The results of students' creativity cycle I

The reflection stage occurs after the teacher conducts the learning process and involves the participation of the teacher, peers, and students. In Cycle I, based on the observation results, it can be concluded that the learning process needs improvement. Despite meeting the high criteria, there are still significant shortcomings. Regarding the teacher's performance, it was noted that the teacher has not fully mastered the STEAM approach; the teaching appeared rigid, with occasional points being forgotten. Additionally, concerning the students, most indicators were attempted, but the assessment was suboptimal. This occurred because students didn't pay adequate attention to the teacher's instructions on the steps of creating the products, failed to collaborate effectively within their groups, and neglected cleanliness and neatness while working. Consequently, the resulting products did not meet the expected standards. Building upon the shortcomings identified in Cycle I, adjustments were made for Cycle II, emphasizing the teacher's role as a facilitator in the learning process. Teachers were better prepared for the implementation of the learning activities.

3.2. Cycle II

In Cycle II, to maintain a conducive learning environment, the teacher enforces rules during learning activities. Activities in this cycle commence with improvements in planning, implementation, observation, and reflection. During the planning stage, teaching modules are compiled based on the independent curriculum, focusing on the continuation of Cycle I material, namely light and its properties. Teachers create student worksheets, elaborate on work steps, prepare additional learning materials, design student creativity sheets, and develop teacher activity sheets. In the observation stage of Cycle II, students actively engage in the learning process and collaborate effectively within their groups. Additionally, the teacher successfully implements STEAM integration in the learning activities, a fact supported by positive evaluations from peers. All steps of the learning activities have been executed, encouraging student participation. Detailed results of student creativity research in Cycle II are presented in Fig. 3.

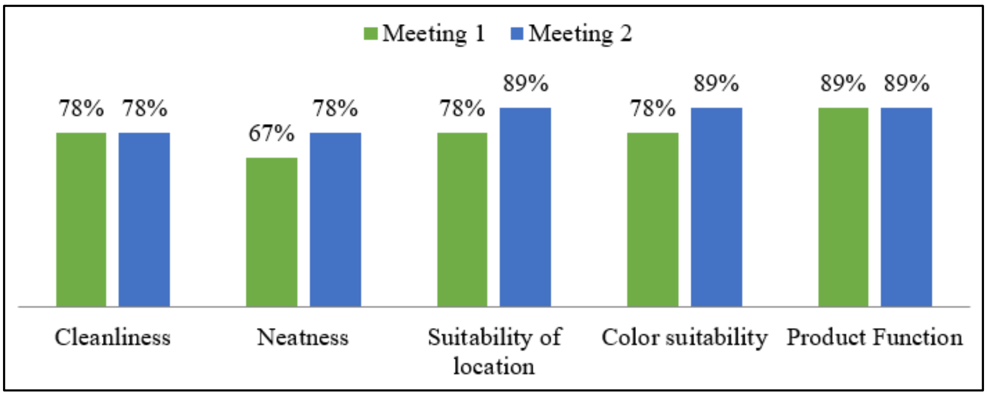

Fig. 3. The results of students' Creativity Cycle II

The reflection stage in cycle II was carried out collaboratively between the researcher and the class teacher, which was carried out at the end of the cycle. Based on the results of cycle I and improvements made in cycle II, it turned out to have a significant impact on the process of cycle II. In cycle II, the learning process was well implemented, although the creativity of students was still unsatisfactory, but for the average results, it had reached the target, namely the very high category. So that this research is not continued in the next cycle. Based on diagrams I and II, which describe the results of the assessment of students' creativity, the average obtained in cycle I was 64% with high criteria and increased to cycle II 81% with very high criteria. This data is obtained from cycle I and II activities, which consist of planning, action, observation, and reflection. Based on the average of cycle I, it is concluded that learning has not reached the target. Therefore, it was continued in cycle II. Efforts to achieve the target in cycle II planning were carried out in accordance with the reflection of cycle I. As a result, in cycle II, the expected creativity was achieved. The increase in student creativity is due to the provision of action in the form of learning designed using STEAM integration. According to [28], The STEAM approach encourages students to learn to explore all the abilities they have in their own way. The average creativity of cycle I and cycle II can be seen in Fig 4.

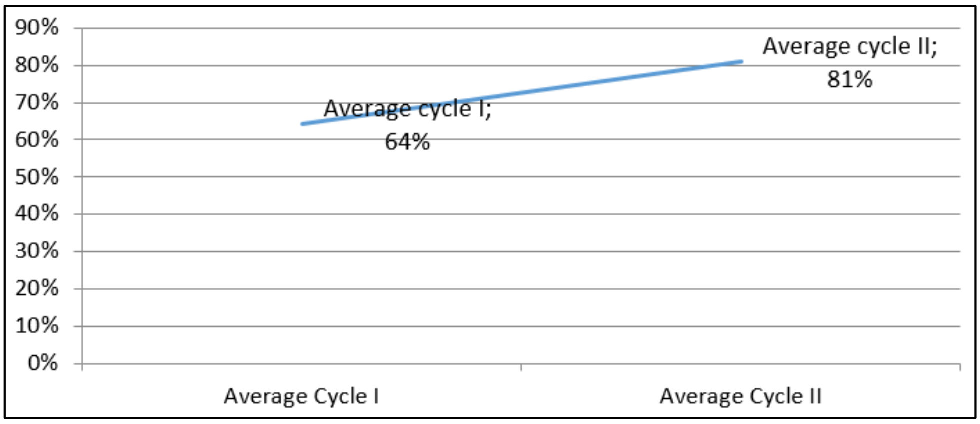

Fig. 4. Average creativity of students in cycle I and II

Based on the research results from cycle I, there was an improvement in the cleanliness and neatness sub-indicators in cycle II. Creativity increased significantly, with the cleanliness sub-indicator achieving a high rating and the neatness sub-indicator attaining a moderate score. In cycle I, students' products met the high criteria for cleanliness, with an average of 61.5%. However, despite meeting the criteria, the products were not maintained in a clean condition; they still had many stains and adhesive files. Additionally, the neatness sub-indicator averaged 50% in the medium category. The products appeared less tidy; for example, the glass frame created for transparent objects looked tilted instead of standing upright. This discrepancy can be attributed to the limited coordination skills of special students with learning disabilities when using stationery and other items. Therefore, guidance from teachers is essential to assist students with special needs in their learning process. In accordance with the opinion of Walther *et al.*, the teacher's proactive approach creates coordinated joint activities to jointly access plan learning and behavior towards groups of learners, including learners with special needs in inclusive education settings [30]. Campbell *et al.* add that to fully and optimally develop the potential of students with special needs, a positive attitude towards these children is necessary [31]. An assessment of the initial cycle of creativity among slow learners necessitates support from both teachers and regular students, aiding them in their educational pursuits. Additionally, the collaboration facilitated by the STEAM approach has successfully mitigated the challenges faced by slow learners, enhancing their creative abilities. STEAM is an educational approach that engages learners actively in the learning process [32]. Kennedy *et al.* add that the STEAM approach encourages students to develop essential competencies and skills required in the 21st century [33]. This equips students with the ability to identify and solve problems that arise within themselves and their environment.

The sub-indicator assessing the suitability of location and color achieved very high scores, as evidenced by an increase from the average in cycle I to cycle II. This indicates that slow learners are generally unaffected by color and can organize the layout of the products they create. However, there are still instances where some slow learners make mistakes in placing and selecting the right color for their products. Among the nine learners, three individuals in both meetings I and II made errors. This discrepancy is not observed among other students; the improvement in creativity regarding location and color suitability is attributed to students' comprehension of the product-making steps explained by the teacher. According to Quigley *et al.*, the STEAM approach leads to diverse and unexpected creations from each individual or group [34]. Moreover, collaboration, cooperation, and communication naturally emerge in the learning process as this approach encourages group work [35]. Classroom creativity enables learners to explore, think critically, play, observe, reflect, and ask unconventional questions [36]. Houghton *et al.* also noted that the STEAM approach enhances collaborative skills within and between groups [37]; the production process's success relies on collaborative efforts. Consequently, the collaboration between students with special needs, slow learners, and regular students fosters mutual care, respect, and assistance, contributing to a meaningful learning environment. The utmost importance lies in preventing bullying behaviors among students. Higgins *et al.* suggested that selecting appropriate learning strategies can address bullying issues in schools [38]. Implementing the STEAM approach to enhance the creativity of students with special needs has yielded positive results, meeting the desired objectives. Therefore, it is strongly recommended to incorporate this approach into the learning process to enhance students' creative abilities.

4. Conclusion

Based on the analysis and discussion, it can be concluded that there has been an increase in the creativity of students with special needs when learning science through the STEAM approach. The average creativity score in cycle I was 64%, meeting high criteria, which then rose to 81% in cycle II, indicating very high criteria. However, even with such high creativity levels, teacher assistance remains essential to further enhance their creative abilities. They cannot be considered fully independent in developing this creativity. The specific creativity criterion observed is elaboration, focusing on sub-indicators such as developing or enriching other people's ideas. Students' creativity was assessed based on their work related to the properties of light. The assessment aspects considered included product cleanliness, product neatness, product location suitability, product color suitability, and product functionality. It is strongly recommended that teachers utilize the STEAM approach as an alternative method to enhance the learning creativity of both slow learners and regular students.

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Declarations

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