



The Effect of the STEAM Method on Children's Creativity

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Abstract: In the globalization era, education requires schools to create students who can think critically in terms of STEAM (Science, Technology, Engineering, Art, and Mathematics) and carry out their activities independently. For instance, the rapid development of technology has changed how people communicate, interact, eat, and perform other things. This causes education to become important in preparing students to be independent. Therefore, teachers need to follow the latest developments regarding strategies, approaches, or methods in the learning process. Agyei, D. D., & Voogt, J. (2012). Education is an effort used in helping students to develop their potential, abilities, and talents. This study aims to examine the effect of STEAM (Science, Technology, Engineering, Art, and Math) on the creativity of children aged 5-6 years at Lenterahati Islamic boarding school. In this study, the STEAM method is the independent (X) and creativity is the dependent variable (Y). This instrument preparation is known as the Torrance test of creative thinking consisting of fluency, flexibility, originality, and elaboration skills. A total of 25 children in the preschool were selected as the participants using a pretest and posttest. The results showed there is a difference in students' creativity before and after receiving STEAM treatment. This method uses loose parts which help to increase children's creative thinking. High creativity is characterized by fluent, flexible, original, and detailed skills. Therefore, the use of STEAM in learning can increase children's creativity and provide them the ability to solve problems as well as connect with the environment.

Keywords: Creativity; Science; STEAM method

Introduction

Creativity in education is currently very necessary, it is time for the world of education to consider the aspect of creativity in educating students, especially in the era of globalization which is full of competition like today. Creativity is important in life, including in early childhood, because through creativity children can express various things that children think through observing, questioning, communicating, reasoning and pouring everything in the form of a work. In addition, creativity can improve the quality of life and can make it easier to find a way out of a problem (Agyei et al., 2012).

Creativity affects other aspects of development, so that if it is not developed early, children's intelligence does not develop optimally. According to Ata-Aktürk et al. (2021). "In this era of development, it is undeniable that the welfare and glory of society and the state depend on creative contributions, in the form of new

ideas, new discoveries and new technologies from community members". Thus, creativity is very important to be stimulated from an early age so that children can have critical thinking power to overcome various problems, this has an impact on children's lives in the future, so that children who have creativity can overcome the various problems they face. In the current era, it is undeniable that the well-being and glory of society depends on creative contributions, in the form of new ideas, new inventions, and new technologies. To achieve this, creativity must be cultivated from an early age.

According to Amiruddin et al. (2022) there are five stages in the creative process namely: preparation, concentration, incubation, illumination, verification. So from the explanation above, a teacher must stimulate the child's creativity by preparing what the child should learn, the teacher gives directions to the child to study the material that has been presented by the teacher, the

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teacher allows the child to reflect or think about what the child will do or make without any pressure, the teacher lets the child explore his own thoughts until the child can create a product.

The results of initial observations at PAUD Lenterahati Islamic Boarding School during learning are still often asked questions and confusion in making various forms of work, children are less enthusiastic about carrying out learning activities because the media is less varied, and also the learning methods are still not varied so that it does not provide a stimulus that supports children's creativity. From these problems, of course, teachers must find solutions so that children's creativity can increase. Researchers are trying to improve the quality of education through the implementation of educational reforms, trying to change the changes that occur in conventional learning towards learning that further enhances the critical thinking power that creates creative children.

One form of education reform can be done using a learning approach that can help teachers create creative children, namely through the application of the STEAM approach (Andriani, 2020). "STEAM stands for science, technology, engineering, art, and mathematics". STEAM is a learning model that requires students to produce a product, through STEAM learning activities children are stimulated by providing freedom to express themselves in making works by utilizing the existing environment so that learning is more contextual which gives children freedom to explore (Anisimova et al., 2020).

Learning through the application of the STEAM approach the teacher acts as a facilitator and provides infestation as well as a provocation to the child. Through the STEAM approach in early childhood education is a learning approach that stimulates children through learning activities that require children to have scientific traits, know simple technology, and learn to solve problems, have aesthetic value or beauty value in producing a work and be able to think logically that can be measured in solving problems. In other words, through the STEAM approach in Early Childhood Education, it can stimulate children's activities. The STEAM approach provides more vibrant and active classroom learning so that children feel happy and can express all the ideas in the child's imagination, and can produce meaningful work for children. Children's creativity can be stimulated through a STEAM approach. In accordance with the opinion of Nuraini et al. (2022), that at the Early Childhood Education level, it is suitable to be given a STEAM approach that aims to encourage children to build knowledge about the world around them through observing, questioning, and investigating so as to increase children's creativity in thinking.

In the globalization era, education requires schools to create students who can think critically in terms of STEAM (Science, Technology, Engineering, Art, and Mathematics) and carry out their activities independently. For instance, the rapid development of technology has changed how people communicate, interact, eat, and perform other things. This causes education to become important in preparing students to be independent. Therefore, teachers need to follow the latest developments regarding strategies, approaches, or methods in the learning process. Education is an effort used in helping students to develop their potential, abilities, and talents (Agyei et al., 2012).

The level of children's creativity which is still minimal is one of the problems faced at Lenterahati Islamic Boarding School in West Nusa Tenggara. Therefore, students need continuous assistance since they lack initiative in carrying out activities. This Lenterahati Islamic Boarding School is still implementing the 2013 Curriculum (K13) but later changes to independent learning. The K13 needs to use a scientific approach consisting of observing, asking, collecting information, reasoning, and communicating. Moreover, the learning environment is required to support the entire development of students. Children need encouragement from parents and teachers to carry out their activities independently.

This is in line with Anggraeni et al. (2022) that the quality of education can be developed by implementing reform in Indonesia. The use of STEAM which assists teachers in creating an expert becomes one of the education reforms. This approach refers to the four components of science including science, technology, engineering, and mathematics (STEM). According to Chen et al. (2019), the STEAM method helps students to develop new knowledge and answer questions based on investigations.

Cheng et al. (2013) identified four "Learning and Innovation skills" including creativity, critical thinking, communication, and collaboration. In the 21st century, these skills are often called 4Cs, while in Indonesian, they are regarded as 4K. This is in line with Bloom's theory that creativity is the highest ability in cognitive development. Therefore, this skill is important to Early Childhood Education.

Learning is carried out through various programs to stimulate children's creativity. The type of education that enable children to face the 21st century is based on STEAM. Science is a subject that teachers only have little time for or even ignore in educating students. However, it is the subject that makes children curious, excited, and hungry to learn (Dejarnette et al., 2018).

Science refers to knowledge that is acquired systematically through observation, study, and experimentation. It includes physics, chemistry, biology,

astronomy, geology, oceanography, ecology, botany, and zoology. This is because the contents in children's lives are physical, approachable, and intertwined. The following are activities teachers need to perform in educating early childhood about science: 1) Plan experiences concerning children's physical, social and moral, emotional, and cognitive development. 2) Provide a curriculum reflecting their needs. 3) Start planning a study unit that integrates other fields.

Technology is another tool and adults believe it is an electronic good or digital equipment such as cameras, computers, or sophisticated machines in factories. These tools include crayons, pencils, rulers, and scissors that children use to play or encounter in their daily life. Therefore, it is necessary to ensure that technology is age-appropriate and used in line with the child's wishes to solve problems.

According to Cook et al. (2018), people tend not to be separated from the rapid development of technology in this revolutionary era. This is because they are in the middle of a sociocultural quantum shift. Moreover, technology which is not fading tends to revolutionize the world children live in. Adults are only to balance the appropriate skills, core principles, and necessary experiences to develop healthy children (Gunawan et al., 2019). Therefore, technology is an essential tool that needs to be introduced to people from an early age.

Engineering can be interpreted as the development of technology and it starts with identifying a problem before being solved. For instance, children try to figure out how to make a strong foundation because their building blocks can be taller (Hafiz et al., 2019).

Meanwhile, expressive arts include drawing, painting, sculpture, architecture, music, literature, drama, and dance. It is regarded as richness to life by elevating thoughts and feelings beyond mundane events. Art also stimulates early childhood cognitive, social, emotional, and physical development. However, children participate in music by singing, listening, moving, composing, playing, and making instruments. Their visual arts include drawing, painting, and sculptures of all kinds, as well as working with clay or similar materials. Children's abilities in art-related experiences are affected by their development level. Conversely, the arts curriculum contributes to the entire development of early childhood.

The field of mathematics includes a variety of subfields, skills, and systems that are appropriate for children to learn. According to Henriksen et al. (2019), the common topics being taught include classification, serialization, calculation, measurement, geometry, chart, and arithmetic. In the field of mathematics, teachers implemented the following 1) planning math activities to stimulate children's physical, social, and cognitive development, 2) planning these activities considering

the child's needs, and 3) incorporating math activities into all areas of the curriculum.

Language also plays a role in mathematics when children use words such as bigger, thicker, and smaller. Higher-order thinking skills are indicated when students know that comparison is relative, depending on what is being compared. Mathematical concepts are better understood when the subject becomes part of people's daily activities. According to Syafi'i et al. (2021), "children failed to view their world as if it were divided into tiny holes like "mathematics" or "literacy". Also, effective practice failed to limit this field of study to one particular period. Teachers tend to help children develop mathematical knowledge throughout the day and across the curriculum. Therefore, the learning environment is organized to enable students to investigate mathematics through various types of hands-on experience (Jacques et al., 2020).

STEAM-based learning is taught at Lenterahati Islamic Boarding School in an integrated manner. Loose parts become an important element of this learning and they tend to be exposed to items that are easy to find in environments. Nature contains loose parts, such as twigs, pinecones, shells, stones, leaves, flowers, and others. Therefore, parents and teachers can collect them free of charge from anywhere.

These loose parts not only support children's development but also help in connecting them with the environment. For instance, toys are designed with a specific purpose and are usually used by students in one or two ways. Children who carry a basket of toy cars tend to use them to play, like running a car. However, students use loose parts according to their ideas since these objects help in developing imagination, creativity, language, and knowledge.

STEAM focuses on understanding the integrated nature of science, technology, engineering, arts, and mathematics, as well as their importance in children's long-term academic success, economic well-being, and community development (Jesionkowska et al., 2020), STEM education covers grades from pre-school to post-doctoral level as well as classrooms, and afterschool programs. This type of learning is recognized in the U.S. as an important reform because it is an instructional approach to prepare children for the global economy (Katz-Buonincontro, 2018).

The targets were children aged 5-6 years in Aisiyah Sumber III and Al Huda Surakarta kindergarten school. This study aims to implement learning in preschool based on STEAM that helps to develop students' creativity. It also uses active and creative models where children dig up information about new things through the environment.

Method

In this study, the STEAM method is the independent (X) and creativity is the dependent variable (Y). This instrument preparation is known as the Torrance test of creative thinking consisting of fluency, flexibility, originality, and elaboration skills (Katz-Buonincontro, 2018).

A total of 25 group B children in Lenterahati Islamic Boarding School aged 5-6 years consisting of two campuses were selected as the participants. Campus 1 is in Ireng Jaya, Jatisela, Gunungsari, West Lombok, while campus 2 is located on Bandaseraya Mataram Street, West Nusa Tenggara. A purposive sampling method was used based on the characteristics of the children that were the same. Moreover, this preschool participated in socialization and used STEAM in learning.

First, the two pre-schools were observed to see the learning process and the children's abilities, particularly in creativity. They collaborate to conduct a study based on STEAM that was used at the Lenterahati Islamic Boarding School. The next step was to arrange creativity instruments for group B children aged 5-6 years. In this study, the instrument preparation is known as the Torrance test of creative thinking, which consists of fluency, flexibility, originality, and elaboration skills. A pretest was conducted to measure children's creativity in preschool after the instrument was ready (Sugiyono, 2019).

The measurement of the creativity of group B children aged 5-6 years become the instrument employed at Lenterahati Islamic Boarding School. Also, the learning tools and media used were arranged after the pretest.

Table 1. Prerequisite Test

Prerequisite Test	Signification (p)
Normalitas	
Pretest	0.281
Post test	0.388
Homogeneity	0.630
Note : $p \geq 0.05$	
Data Analysis	
Time	Signification (p)
Pretest ---- Post test	0.000
Note : $p \leq 0.05$	

This instrument was first tested before being distributed to the participants. The trial questions were examined to discover whether the validity and reliability tests were true. This validity item is carried out using the Pearson Product Moment. A follow-up test was performed for the reliability instrument after the items are declared valid. The reliability test is carried out using the Cronbach Alpha coefficient formula. For proper

analysis, it is necessary to study the normality test and data homogeneity. Parametric statistics and t-tests were used to examine the hypothesis differences before and after treatment. Furthermore, the final data is processed using SPSS.

Result and Discussion

STEAM-based is one of the learnings that employed the STEAM approach. The approach uses science, technology, engineering, art, and mathematics as the entrance to guide student analysis, discussion, and collaboration, as well as critical thinking. This is because its learning will produce a project and train children on how to work together with their friends, make decisions, as well as solve problems (Kereluik et al., 2013).

STEAM-based learning enables students to broadly think, have freedom and be safe in expressing ideas, feel comfortable while performing activities, determine what they are exploring, and work collaboratively. Meanwhile, critical thinking means making reasoned judgments since it is the ability to formulate or digest information that can be accepted with common sense and accounted for. This skill is a complex activity used to analyze questions or arguments (Mu'minah et al., 2020).

From the results of critical thinking, students perform independent activities in the way they want and in any situation. For instance, children wear shoes and clothes by themselves as well as receive directions from others. Independence is an attitude acquired cumulatively during the developmental period. An individual continues to become independent in dealing with various situations and conditions since they can critically think and act without involving others (Lestari et al., 2021).

Developing the students' creativity to improve problem-solving skills is one of the effects of the STEAM method in learning activities for children aged 5-6 years (Perignat et al., 2019). Several reasons indicating that this method increases children's creativity include first, they learn processes in the form of observing, playing, recognizing patterns, and practicing creativity, as well as collaboration and communication skills to complete a task (Guyotte et al., 2015). Second, the learning used to solve problems is based on scientific technology. Third, children are trained to dare to express themselves through criticism and opinions. Therefore, the STEAM method improves student's verbal and nonverbal communication skills as well as their openness to people's perceptions and understanding of new things (Yakman et al., 2012).

Fourth, developing children's potential to connect learning materials, designs, and the environment

(Perignat et al., 2019). A total of 5 students who study in the classroom using the STEAM method are not aware that they will find a variety of overlapping information. Therefore, this method requires children to think creatively and critically about new things that are received. Wahyuningsih et al. (2019) indicated that STEAM encourages students to solve problems with their teachers and peers.

The development of creative thinking skills is required to begin at an early age. Therefore, students need to be encouraged to imagine, create, and recognize various knowledge, as well as practices. Parents and teachers also need to build children's perceptual, conceptual, and analytical points of view from an early age because they enter the roots of self-creativity at this stage (Pujiati, 2020).

Furthermore, the real activities for developing students' creativity are when they are given learning materials with the theme of pharmacies. Children can think creatively to make and package medicines, as well as to correctly share information related to it. Moreover, students can channel their creativity to turn blocks into hospitals, houses, garages, and high-rise buildings when given various shapes and sizes.

STEAM is an acronym for Science, Technology, Engineering, Arts, and Mathematics. This learning model increases children's interest and makes them understand technology, as well as solve problems in the real world (Quigley et al., 2016). According to Rinke et al. (Rinke et al., 2016). STEAM contains scientific technology-based learning that provides the ability to solve problems.

Moreover, this learning model encourages children to develop curiosity, openness to experience, and ask questions to build knowledge around them by exploring, observing, discovering, as well as investigating (Sen et al., 2021). STEAM focuses on creating a new thing such as the final product and the manufacturing process. The manufacturing process is more important than the final product because there are aspects of exploration, creative thinking, engineering design, expression, evaluation, and redesign (Setiyawin et al., 2021). Therefore, the STEAM method teaches children to process new things through observing, playing and recognizing patterns, practicing creative, collaboration, as well as communication skills (Singh, 2021). Students need to think creatively and critically about new things that they obtain. They are also encouraged to solve problems with teachers and peers (Shatunova et al., 2019).

Creativity develops a supportive environment where students are motivated to think, explore, play, observe, reflect, and ask unusual questions. Teachers tend to be a model of behavior and build this skill in students since it is developed through examples and

direct practice (Tabiin, 2020). Therefore, children can connect learning materials with the environment, and design (Soh et al., 2010).

Conclusion

The STEAM method help in increasing children's creativity and makes them capable of solving problems effectively. It is important to note that students tend to improve the quality of solving problems ability when they are given the right method. Early Childhood is children with high curiosity to explore themselves in daily activities, particularly in terms of creativity. Students need to have initiative and critical thinking according to their ability level. Therefore, the STEAM method supports the development of creativity in children's activities. It also trains their critical thinking skills to carry out activities and solve problems.

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