



Implementation of STEAM in Preschool as a 21st-Century Learning Innovation

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Abstract

STEAM in the world of education is no stranger. Many countries in the world have implemented learning using this approach. STEAM is considered to influence learning because STEAM is a combination of several sciences that become one unit. One of the benefits of learning STEAM is that children are taught to be able to solve the problems they are facing. The use of technology that is very supportive makes this one of the supporting factors. The research method used in this study was qualitative, with a sample of 12 children aged 4-5 years who were selected using a purposive sampling technique. The research was conducted at Sungai Rumbai Kindergarten IB in Jorong Kampung Baru. This study aimed to see the implementation of STEAM in Preschool as a 21st Century Learning Innovation. Data collection techniques used non-test techniques obtained from interviews, observations, and documentation obtained from class teachers. The study results show that STEAM has been implemented in TK IB Sungai Rumbai through various activities.

Keywords: STEAM; Preschool; Learning Innovation

Introduction

The curriculum is a set of educational tools as a reference and guide in learning. Every country in various parts of the world uses a curriculum according to what has been set by their respective education departments. Likewise, with the country of Indonesia. Since the proclamation of independence, the curriculum in Indonesia has undergone many updates to adapt to the times. The curriculum shift occurred again from the 2013 curriculum to the independent curriculum.

Today the independent curriculum has launched learning that prioritizes students to be more able to master the technology; not only students but educators must also be able to face the increasingly rapid developments of the era by mastering science and technology more. As a developing country, Indonesia strives to make reforms in the world of education so that it is ready to face the times of the golden generation of 2045. So in the learning process, there is a need for innovations to be carried out, one of which is the implementation of STEAM based on an independent curriculum. STEAM is a process of teaching and learning activities combining several processes. In line with this, Dwi Rahayu and SriHartati (Anizal & Hartati, 2022) said

that the learning process using STEAM is an approach by combining various fields of knowledge such as science, technology, engineering, art, and mathematics in a coherent manner that is intended explicitly for starting from pre-school to high school age levels.

Through STEAM learning implemented in each formal educational institution, it is hoped that it will make students more innovative and work in learning. This was also explained by Yuyun Estriyanto (Estriyanto, 2020), who states that the purpose of STEAM is to encourage students to be able to think more critically globally and produce various forms of innovation to be able to solve the problems at hand. This is motivated because the application of STEAM focuses on using science and technology in practice in everyday life.

In essence, learning to use STEAM is not only used at a more advanced level. However, it has started since preschool age, such as Preschool institutions. In Preschool institutions, STEAM has begun to be implemented simultaneously with the independent curriculum in every school. In Preschool, STEAM can build children's cognition through meaningful activities that generate and stimulate various ideas to give birth to creativity (Lire Pratiwi & Syarifin, 2018). Furthermore, the Ministry of Education and Culture (Nurdiana, 2020) also said that through STEAM learning, children are directly involved in learning so that children can solve problems, collaborate, and can work creatively. The implementation of STEAM learning in Preschool institutions uses materials that are easy to find, one of which is the use of loose part materials. The principle of using tools and materials in STEAM learning does not have to use expensive materials; they come from environmental materials that are attractive and safe for children (Hasbi, 2021).

This research examined the Implementation of STEAM in Preschools as a 21st Century Learning Innovation. This research used a qualitative approach. The purpose of the qualitative approach is to obtain information regarding the application of STEAM in preschool through various fun activities for children. The subjects of this study focused on early childhood aged 5-6 years. It was found that in TK IB Sungai Rumbai, the activities carried out were STEAM-based by combining all fields of knowledge in one activity. This can be seen in various fields of science, such as science, technology, engineering, art, and mathematics, that are present in all activities carried out by children.

Literature Review

The Nature of STEAM in the World of Education

STEAM is a learning approach that combines several disciplines. STEAM is the development of science that combines learning using elements of art and technology to stimulate children's development to face meaningful learning (Windasari et al., 2022). STEAM (Science, Technology, Engineering, Art, and Mathematics) learning is not only applied in further education but has been widely applied in preschool education. Almost half of the world's countries have implemented learning using STEAM. This is because STEAM makes one field of study in the same family, making learning more complex and compelling. STEAM is an essential element appropriate for preparing a generation with literacy and competitiveness in

science and technology. Learning to use STEAM prepares children to face the challenges of the next world (Imaduddin et al., 2021).

The principle of learning uses the STEAM approach

STEAM-based learning in Preschool units focuses on several principles so that learning can occur correctly. Ministry of Education and Culture (Penelitian et al., n.d.) explained that there are several principles in the implementation of STEAM learning in Preschool units, namely: 1) Adjusted to the child's interests, 2) Realizing learning objectives through various strategies, 3) Encourage and facilitate children to be involved in activities, 4) Encouraging children to provide ideas during learning takes place, 5) Encouraging children to think critically, communicatively, creatively, and collaboratively.

Benefits of STEAM in Learning

STEAM in the world of education is very influential. This is because STEAM, through the STEAM approach, provides direct access to students to explore during learning. Besides that, STEAM also presents fun learning because it presents real or concrete learning. This proves that the media and props used are directly from nature. One of the uses of natural materials used as teaching media in the STEAM approach is loose parts. Fun learning like this follows early childhood education's nature, namely learning while playing. In line with this, Sri Wahyuni et al. (Wahyuni et al., 2020) also added that STEAM can train students cognitively, skillfully, and effectively. The knowledge students gain is not only in the form of theory but directly into practice.

STEAM in Children's Cognitive Development

The person who introduced cognitive theory was Jean Piaget. He argues that the way children think is very different from adults; children are still immature in solving a problem, and this is because children still need to be more complex in gathering information. Apart from being different in terms of the knowledge obtained, they are also different in quality. Furthermore, through research, he proved that the stages of an individual's intellectual development and changes in age significantly affect an individual's ability to observe science (Ibda, 2015). According to Piaget, a person will go through several stages of cognitive development. Next is Leny Marinda (Marinda, 2020) explains an individual's cognitive development stages: (1) sensory-motor stage; This stage occurs at the age of 0-2 years. According to Piaget, at this stage, the child's thinking pattern is essential for coaching to develop his intelligence. In this case, the child's thinking at this stage is practical and easily shaped according to what he is doing. So this stage lays the foundational moment for children to be ready to face the following stages of life. (2) pre-operational stage; This developmental phase occurs at 2-7 years old. Previously, the child was given a strong foundation regarding knowledge with some understanding; then, at this stage, the child has begun interpreting the knowledge obtained through more tangible things such as words and pictures. This stage is a concrete manifestation of the knowledge received and processed by the child. (3) the concrete operational

stage; occurs between the ages of 7 and 11. After going through the stages above, the child will begin to think logically from the events he gets from his life. Even though, at this stage, the child already has a particular classification of a problem, the child still cannot solve the problem he is facing. (4) formal operation stage; This stage is the last in the process of cognitive development. Occurs in the age range of 11 years to adulthood. This phase is known as adolescence. Children can decide on a problem that is being faced. Children have started to think logically and more idealistically.

In education, cognitive development is closely related to mathematics learning activities. This is because in learning mathematics, children will be required to be able to think logically in solving problems. However, in broad terms, mathematics does develop not only cognitive matters but also critical and symbolic thinking. This was also stated by Iik Nurhikmayati (Nurhikmayati, 2019) that cognitive ability broadly can be interpreted as learning that develops several aspects ranging from affective to psychomotor. These activities are then utilized in developing a person's ability to respond to situations and conditions that are being faced, especially in everyday life.

STEAM in the Development of Children's Creativity

Besides being closely related to the cognitive development of an individual, STEAM is also consistently associated with developing a child's creativity. This can be seen from the various creative activities always associated with the STEAM approach. Creativity enters the art stage in its application, whereas STEAM will be in the Art section. In the world of education, learning activities that develop creativity have been carried out by many educators. It starts from activities that are simple and even activities that are complicated. Ninit Permatasari (Permata Sari, 2020) argues that the combination of artistic elements in STEAM can provide opportunities for students to be more creative and make students more innovative in the form of artistic creativity integrated into learning outcomes.

Next Fitri, D.A.N, Suryana (2022) also explained further about STEAM on student creativity that the development of creativity is critical to be carried out and developed, especially in the world of education. He also added that creativity is closely related to cognitive abilities. So educators must be able to stimulate a child's creativity because creativity developed from an early age will affect the development of his thinking.

Methods

This study uses a qualitative method. Qualitative research is research that emphasizes the understanding of various problems that exist in social life based on actual conditions that are comprehensive, complex, and detailed (Murdiyanto, 2020). Researchers conducted research at Sungai Rumbai Kindergarten IB, located in Jorong Kampung Baru. This observation began when the researcher obtained research permission, and in the end, the researcher conducted the research as a whole. TK IB Sungai Rumbai components, namely the principal, teachers, and students, were selected as respondents in this study. Data collection techniques in this study

used non-test techniques obtained from interviews, observations, and documentation obtained from class teachers. Researchers use data analysis in this study using the Miles and Huberman method with the stages of data reduction, data presentation, concluding, and verification (Nurhusni Kamil, 2023). The steps in data analysis are: (a) data reduction is the activity of summarizing all the selected data and focusing on the data to be used in research; (b) the presentation of the data in this study is in the form of a brief description; (c) conclusion and verification.

Result/Findings

Learning planning

Based on the data obtained in the field, it was found that scientific planning was initially carried out by making RPPH. RPPH contains activity plans prepared by the teacher to stimulate children's science activities by observing and investigating natural objects and phenomena. Teachers can design activities stimulating children's scientific abilities, such as understanding concepts, shapes, and colors, developing an understanding of plants and animals, and so on. Teachers can provide various supporting facilities and infrastructure for technology planning to achieve a goal. The technology in question is in the form of writing instruments and everything that supports learning. Based on the explanation above, TK IB Sungai Rumbai has implemented part of the STEAM approach, namely technology.

The learning that has been done at TK IB Sungai Rumbai has implemented STEAM-based learning, namely learning that stimulates art in students. This learning teaches children to use various painting tools through painting and coloring activities. The study results show that the planning of learning at TK IB Sungai Rumbai has planned the STEAM approach in the learning process. This can be seen from the material obtained by children during learning.

Implementation of STEAM Learning

This learning implementation is based on the STEAM approach through various artistic activities. Based on the observations, findings were obtained from the implementation of STEAM learning in Sungai Rumbai IB Kindergarten.

Recreational Activities to The Goat Pen

In this activity, the teacher will invite the children to go directly to the goat's kennel for recreation. In this activity, the scientific knowledge gained by children is that children can know the concept of animals belonging to livestock. In addition, through this activity, children can see directly the tools and materials used for agricultural activities, such as buckets and sponges. In addition, children are allowed to gain knowledge by inviting children to feed goats with grass that children have obtained from the teacher. After the child has carried out direct observation activities at the goat pen, the child can find out the color of the goat when asked to color the picture of the goat and count the number of goats and the number of buckets used in the goat.



Fig. 1. Recreation to the goat pen

Finger Painting

Science knowledge in this activity is that children are invited to get to know the concept of their fingers. In this activity on the concept of technology, children will learn the tools and materials used during the activity, namely various sizes of brushes, colored paper, and paste. For technical concepts, children are given the freedom to color finger patterns according to their favorite color. In art and mathematics, the child paints fingers that have been colored on paper neatly. After that, the child is asked to count the number of fingers on his hand.



Fig. 2. Finger Painting

Collage of butterfly pictures

The butterfly collage activity is basically to train children's fine motor skills, but this activity is also related to STEAM because it combines much knowledge in one activity. In this activity, children's science concepts are introduced through the concept of animals that live in the air, namely butterflies. In addition to the concept of technology, namely the use of tools and materials during activities, namely the use of glue, paper, scissors, and pieces of paper. The concept of the technique introduced to children is to free them to fill in patterns according to their respective creations. As for the concept of art, the child fills in the picture pattern neatly. In the mathematical concept, the child will be asked to name the color used during the activity, after which the child is asked to count the amount of paper used.



Fig. 3. Collage of Butterflies

Painting Using a Straw

This activity introduces children to the concept of science, namely when children know that straws can be used to produce works. Using tools and materials is one way to introduce the concept of technology in this activity. The tools and materials used are straws, water, colored paste, and glasses for the technical concept, freeing children to paint with a straw according to the desired creation. Elements of art will be introduced to children when they mix colors into water. Moreover, for mathematical concepts, children will be introduced to the concept of addition. Namely, children will be asked to calculate the number of materials and tools used.



Fig. 4. Painting Using A Straw

Experiment with Making A Simple Sailboat

Making simple sailboats invites children to learn science concepts because, through this activity, children can develop knowledge about sea vehicles. The technological concepts that will be introduced to children are the materials and tools used in the activity: sticks, color paste, styrofoam, and paper. Meanwhile, for the technical concept, children will explore water and air. In concept art, children will be given the freedom to decorate the boat as they wish. For mathematical concepts, children will learn the geometric concepts of the boats they have made, such as rectangular shapes on paper and triangular shapes on styrofoam.



Fig. 5. Experiment with Making A Simple Sailboat

Playing with Blocks

Playing activities contain STEAM because, in this activity, you will learn the concept of science through the shape of blocks to solve problems with building blocks being compiled. The concept of technology that children will obtain is that children know the various shapes and sizes of blocks they play with. Meanwhile, in the technical concept, children will arrange blocks with their creations. They can combine their ideas between one child and another to become a

diverse unit of blocks. In the concept of art, children will be given the freedom to decorate the miniature blocks that have been arranged. The last concept in the STEAM sequence, namely mathematics, is that children will learn many mathematical concepts, geometric concepts, numbers, size, and texture when children are creative.



Fig. 6. Playing Blocks

Learning Evaluation Of The Steam Approach

Based on the data obtained from conducting interviews and observations, it was found that teachers at TK IB Sungai Rumbai had evaluated the implementation of their learning. The evaluation technique is non-test techniques such as observation, annotation, and works. This activity is an evaluative assessment centered on aspects of child development achievements.

Discussion

Learning with STEAM provides many benefits for students, especially in early childhood. Many factors make STEAM very interesting in preschool learning. One is that children gain experience through direct interaction with the objects around them because STEAM combines a series of fields of scientific study in one unit. The learning carried out in various PAUD has almost entirely implemented STEAM. This can be seen from the activities held and the tools used. In addition, technology has also been used and is widely used in preschool institutions. Activities with STEAM are often associated with art-based activities that aim to hone children's imagination and creativity. In addition, cognitive aspects also affect STEAM learning. Children are invited to solve problems through the things they face. One type of activity that invites children to be able to solve problems is playing with blocks. Another benefit of playing with blocks is that children are also familiar with various shapes of blocks, ranging from their size and texture.

The second activity is finger painting. It is known that the scientific knowledge that children get is that they count their fingers. Technological knowledge acquired by children is the acquisition of information about the tools and materials used in activities. The technical knowledge children get is that they are free to be creative about their work. Meanwhile, for art and math, children can place their colored hands on paper and then count the number of fingers they have. The third activity that has been done is a collage of butterfly pictures. In this activity, children are invited to get to know animals in the air, namely butterflies. In this activity, children will learn about the tools and materials used to create a collage of butterfly images, namely using glue, paper, scissors, and pieces of paper. Through this activity, children are also taught to be able to fill in patterns neatly according to the order of colors. After that, the child will be invited to count the number of paper colors used in the activity.

The fourth activity is painting using straws. Here children are introduced to scientific knowledge that straws are usually used for drinks but can also be used to produce works of art. Children also know the materials and tools that can be used besides straws, namely water, colored paste, and glasses. Not only that but in this activity, children are given the freedom to make patterns and use colors according to their wishes. After the child has finished his work, the child will know the materials and tools used during the activity. The next activity is an experiment to make a sailboat. Children obtain science activities. Namely, children know sea vehicles through the simple works they make. In addition, children also know the tools and materials used in this activity, namely sticks, color paste, styrofoam, and paper. Children are also free to color the boats they have made with the colors provided. The last thing children can obtain is mathematical concepts; children know geometric shapes. The last activity is playing with blocks. The concept of science introduced is teaching children to be able to solve the problems they are facing through various shapes of blocks. The technology used in this activity is various sizes of blocks ranging from small to tiny. The concept of technique and art in this activity is that children are given the freedom to form the arrangement of blocks and decorations on the miniatures on the blocks that have been arranged. After that, to strengthen the child's mathematics concept, the child knows the geometric concepts, numbers, sizes, and textures in each block directly.

Conclusion

Based on the explanation above, it is known that learning with the STEAM approach has been carried out through various activities. This is not only applied to higher education institutions but has been applied to formal preschool institutions. Learning with the STEAM approach has many benefits because, in essence, STEAM is a field of study that combines various disciplines. Learning often associated with the STEAM approach involves cognitive development and creativity. However, if studied in more detail, all aspects of child development can be adequately stimulated through STEAM-based activities. It is known that from the activities carried out at TK IB Sungai Rumbai starting from the first activity, namely recreation to the goat kennels. In this activity, the science gained by children is the involvement of children

in direct interaction with nature; for technology. Namely, children can find out what objects are used to become containers for goats to supply drinking water. Whereas for engineering science, namely providing the opportunity directly to all children to be able to give grass directly into their cages while for art science is that children can color pictures of goats after seeing goats in absolute terms and mathematics, namely in goat kennels, children can directly count goats concretely.

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