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Implementation of STEAM project-based learning in developing early childhood cooperation

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Abstract

The 2013 curriculum for early childhood education with an integrative thematic and scientific approach is very suitable for integrating STEAM-based learning as it is carried out through various contexts to bring subject matter closer to everyday life or the themes are close to the world of children. However, children's social skills have not developed well; children have not been able to cooperate with their peers. The aim of this research was to develop early childhood cooperation by implementing STEAM project-based learning (PjBL). This study used classroom action research and it involved 15 children with an age range of 5-6 years in Salsabil Early Childhood Education, Telagawaru, West Nusa Tenggara. Data were obtained through observation regarding the activities of the teachers and children. The result showed that the cooperation among children improved significantly in cycle 1 to 3 after implementing STEAM PjBL. Therefore, the implication of STEAM PJBL can develop the ability to work together in early childhood.

A. INTRODUCTION

The curriculum is a set of plans and arrangements regarding the objectives, contents, and development of materials as well as the methods used as guidelines for the implementation of improvement activities to achieve certain educational goals. This application requires an approach that can integrate the theoretical and practical aspects. The learning process in the 2013 curriculum is carried out by using a scientific approach. This approach includes three domains namely attitudes, knowledge, and skills. From those various studies on learning

strategies, one of the appropriate learning strategies and approaches is science, technology, engineering, the arts, and mathematics (STEAM).

The 2013 Curriculum for Early Childhood Education with an integrative thematic and scientific approach is very suitable for integrating STEAM-based learning because it is carried out through various contexts to bring subject matter closer to everyday life or themes that are close to the world of children. This approach is currently being rebuilt in developed countries, one of which is the STEAM approach (Munawar et al., 2019). In line with this, the STEAM approach can help to develop knowledge, help to answer questions based on investigation, and it can help students to create new knowledge. Not only popularly used in higher education which emphasizes the formation of Higher Order Thinking Skills (HOTs), the STEAM has also been introduced since the elementary education level (Nasrah et al., 2021).

STEAM is an integrated learning approach that encourages students to think broadly about everyday life which is designed in fun, meaningful, and inspiring- integrated learning activities. The STEAM indicator is that the media can be obtained easily based on inquiry as a problem topic and easy to apply and cost-effective (Limbong et al., 2019). Besides, the STEAM approach is contextual learning where students are required to understand the phenomena in their environment. The STEAM approach encourages students to learn and explore all of their potential. This approach can make children think critically and comprehensively, and it stimulates children to be able to solve problems (Yakman & Lee, 2012).

The application of learning methods that contain STEAM for early childhood needs to be used to improve teaching and learning activities where children can interact directly by observing, asking, reasoning, gathering information, and communicating. In addition, in the learning method that contains STEAM, children can gain knowledge through mathematical logic and art which includes an understanding of numbers, blocks, shapes, classifications and works from the surrounding environment (Veryawan & Tursina, 2022).

The STEAM method is very well applied to early childhood, where it facilitates early childhood to be able to think critically and independently in various ways. In real life, children are able to explore themselves as they wish, what they feel, see, play, and they learn what they can remember until they grow up. An early age can absorb the activities that are taught because it is in the period of golden age. In this phase, children are trained to find the relationship between one discipline and others by fostering students' critical thinking skills and practice their independence (Septiani & Kasih, 2021).

There are six aspects of development in early childhood that must be developed optimally. One of them is the aspect of children's social emotional development. In fact, the children's social skills at Salsabil School have not developed well, the children have not been able to cooperate with their peers. Early childhood in the education unit emphasizes individual learning activities where group activities involving one child with other children are not carried out. So that this causes the sensitivity and communication of children with other people is less established.

The ability to cooperate is behavior that is based on efforts to make himself able to create relationships with others in carrying out actions and work (Mulyasa, 2014). In line with this opinion, cooperation is doing a job together sincerely (Rosyadi, 2013). In the Minister of Education and Culture of the Republic of Indonesia Number 137 of 2014 concerning National Standards for Early Childhood Education, it is stated that the ability to cooperate is included in the aspect of social emotional development of children aged 5-6 years which can be seen in the form of being cooperative with friends; obeying class rules, being responsible; playing with peers; knowing the feelings of his friends, sharing with others; respecting the rights/opinions/works of others; using socially acceptable means to solve problems; and showing tolerance (Prabandari & Fidesrinur, 2021).

The ability to cooperate needs to be instilled in early childhood so that after adulthood children have the ability to cooperate in groups. The purpose of cooperation is to get the expected and profitable results. Likewise with children, that the expected ability to cooperate with peers in a group will produce something. So it can be concluded that the ability to cooperate can be developed in children from an early age. The goal is for children to have discipline in dealing with the external environment and in facing challenges in the future. Then the cooperative ability referred to here is that the child is able to complete the activities given by the teacher to him and his friends so that the activity is completed quickly (Ramelan & Suryana, 2021).

The social abilities possessed by each child include several things, namely caring, loving, peers, sharing, obeying the rules, being responsible, interacting with others, sympathy, and cooperation. This is also in line with the opinion (Resmasari, 2020) that social skills include communication skills, being part of a group, self-control, empathy, responsibility, and cooperation. Cooperation is very important for early childhood. Through those activities, children can develop their sensitivity and ability to communicate and socialize as well as teach them to respect others. The ability to adapt is one of the abilities that children should have. For children after an early age, in general, children have started to get to know the outside environment other than their family environment. Early childhood is a time when a child gets to know the outside environment, peers, and activities outside the home. So that the child will begin to learn to adapt to the surrounding environment such as values, rules, and norms (Nurhani & Atika Putri, 2020).

One of the newest learning strategies is STEAM which is a learning strategy that can develop various skills possessed by children, such as creativity, critical analysis, group work, independent thinking, initiative, and communication. In STEAM learning, there are several aspects that need to be considered, one of which is communicating, namely developing various language skills and communicating with other people; work individually or in groups and discuss ideas through speaking, listening and writing activities.

The STEAM method can be integrated into PjBL learning or a project-based learning model is one way to present a learning experience by confronting children with problems of daily activities that must be solved in groups. PjBL is a learning approach that allows them to develop their own collaboration and demonstrate new experiences through various forms of

representation. Learning in early childhood, in addition, is to emphasize play-oriented learning and the development of oriented learning. Development-oriented learning means that the approach used by teachers to carry out learning is child-oriented learning itself (Nuraeni, 2014). There are several things that must be done in stimulating the development of child-oriented learning including; 1) helping children in asking and answering questions using children's imagination and curiosity, 2) helping children in developing concepts consisting of the concepts of shape, color, sizes, patterns and numbers, and 3) helping children learn the world around them by providing hands-on experience, learning by hand on experience (Novita, 2018). In line with this, through oriented learning, children can easily explore according to their imagination and creativity and they can also develop three areas of development in acquiring knowledge, namely physical knowledge, mathematical logic knowledge which is closely related to children's cognitive and social knowledge (Hasibuan et al., 2021).

The Project Based Learning (PjBL) model is inseparable from the theoretical principles put forward by early childhood education leaders. Piaget and Vygotsky say that knowledge will develop when it is faced with new experiences that will build and modify initial knowledge. Vygotsky is known for social constructivism theory where the individual thinking is formed and influenced by their social environment with scaffolding and ZPD theory. Vygotsky in identifiying ZPD as the distance/gap between the potential level of development shown by problem solving through adult guidance or the cooperation of more capable peers (Ibda, 2015).

John Dewey also propounds project-based learning. He coined the concept of "learning by doing". This form of learning is Dewey's extrusion to preschool institutions which are frequently passive, lazy to work, and unproductive. In line with those facts, Kilpatrick proposes a concept of project learning through the provision of various learning materials which encourage interactions among children. Project-based learning is a learning model that is carried out by the teacher through learning materials that allow students to arrange the materials by themselves (Sujiono, 2009).

In collaborative learning, therefore, there is a collaboration between teacher and students, which means the teaching and learning process are not teacher-centered learning. This opinion is also in line with (Katz, 2011), the key of project is that it is a research effort deliberately focused on finding answer to questions about a topic posed either by the children, the teacher, or the teacher working with the children. Project-based learning approach is one of the approaches that can be chosen to develop the principle of playing while learning and requiring pupils to be the center of early childhood learning. Literature review suggests that project-based teaching method can be applied to all levels of education, from early childhood to tertiary level (Katz, 2011). The use of PjBL is based on the assumption that problem-solving will not be achieved if it is not viewed from various aspects.

The implementation of STEAM-PjBL for early childhood is carried out through the following steps: 1) reflection is the stage where children assimilate what will be learned with what they have already known; 2) research is the activity of collecting information needed to complete the project. In this stage, the teacher may propose problems that have to be solved by pupils; 3) discovery is a stage of formulating or finding solutions to solve the problems; 4)

application is an activity of formulating and revising a model or product as the solution for the problems; 5) communication is presenting the model or product that has been made (Izzati et al., 2019). Based on those steps, it can be concluded that STEAM PjBL learning provides an opportunity to explore, learn, and develop in solving the problems. The characteristics of STEAM learning can stimulate children's interest and ability to collaborate (Prameswari & Anik Lestariningrum, 2020).

The implementation of STEAM PjBL in Indonesia at the early childhood level is still very rarely done. Some studies on STEAM PjBL have been carried out such as research on the development of STEAM PjBL based science learning models on Islamic themes (Imaduddin, 2017). Most of the research on the implementation of STEAM and PjBL is done separately without integrating them. Several studies on STEAM for early childhood were conducted qualitatively to describe the characteristics of implementation and development of a STEAM-based curriculum (Munawar et al., 2019). In another study, it was found that the application of STEAM in early childhood has the potential to develop children's creativity (Wahyuningsih et al., 2020). On the other hand, the results of research on PjBL for early childhood students show that the application of PjBL can stimulate motor skills, problem-solving abilities, and prosocial skills (Herawati et al., 2020). The lack of research on the implementation of STEAM-PjBL in early childhood and the potential for STEAM and PjBL learning in developing children's abilities have become a strong basis for the implementation of STEAM-PjBL. This study examines STEAM-PjBL in early childhood which aims to provide an overview of the implementation process and its effectiveness in developing cooperative behavior in early childhood.

The implementation of STEAM and PjBL are the focus of this study. In applying STEAM, children are stimulated in every aspect of their development. One of the articles written by (Aghnaita et al., 2020) concluded that children's social development can be stimulated by the existence of various interesting activities. They begin to show a desire related to what to do and do the activities in groups with other children. In addition, the application of the STEAM method in learning is able to train students both cognitively, skills, and affectively. This shows that by implementing interesting learning activities, one of which is by implementing STEAM and PjBL which can develop cooperation in early childhood. The combination of STEAM and PjBL aims to develop children's cooperation, therefore, researchers will review the research entitled Implementation of STEAM PjBL in developing early childhood cooperation. This is also related to the focus area that is the reference for researchers, namely the IPNG strategic plan which produces research that qualified, relevant and competitive.

B. METHOD

This study applied classroom action research utilizing a mixed method to gain the data which combines qualitative (primary data) in form of the description of the STEAM-PjBL learning process to the students at the age of 5-6 to stimulate children's collaborative behavior with quantitative data (secondary data) in form of collaborative behavior development that involved in this study. This method is chosen because it can help the researcher to reveal things

related to the activities of teachers and students completely and the development shown by pupils as the effect of the STEAM-PjBL learning strategy (Sugiyono, 2011).

This study consisted of 15 students at Salsabil Telagawaru Kindergarten at aged 5-6 years old. The data were gained through observation with the following instruments: 1) observation sheets for teachers and students in every stage of STEAM-PjBL including the indicators of collaborative behavior such as reflection, research, discovery, application, and communication (Izzati et al., 2019). According to Maria (Syaodih et al., 2018) those abilities contain: 1) responsibility; 2) sharing; 3) helping each other; 4) connecting to solve problems or assignments in the group. The documentation in form of a learning video was used to complete the lack of observation data related to teachers and students activity during the learning process. The research instrument used has been validated by two experts consisting of an expert in learning science and education for early childhood. Observational data in form of the activities of teachers and children are described descriptively in each series of STEAM learning which is carried out starting from STEAM-PjBL. Meanwhile, the development of problem solving abilities of each child is identified by certain criteria, then counted the number of children who include into the criteria consisting of; Not Developed (BB), Starting to Develop (MB), Developed as Expected (BSH), and Very Well Developed (BSB).

C. RESULT AND DISCUSSION

The learning process of STEAM-Project Based Learning in phase I is carried out for 3 days with the theme of the universe and the sub-theme 'water'. On the first day of the reflection stage, children watched videos about fish living in the sea and in rivers which were aimed to stimulate children's responses to develop and maintain a relationship with their friends. This activity was also carried out to attract children's attention, so they followed the project from beginning to end. At the research stage, the teacher rose a problem by bringing fish in plastic. Then, on the second day at the discovery stage, the teacher gave an illustration to the children by showing several containers for saving the fish. This activity was done to give an illustration to the children for making a design. However, the indicator had been stated by the teacher, whether or not the children wanted to face the problem together with their friends by designing the containers for saving the fish ended with playing a cat and mouse game to get the materials and equipment needed. This activity was carried out to stimulate the indicator of wanting to wait their turn when other children took turns to get the materials and equipment needed. At the third meeting of the application stage, the teacher repeated the previous activity by asking the question, sharing the design that has been made, and asking children to make a product from the design they made.

However, the indicator that had to be fulfilled was the will of sharing materials and equipment with their friend during making a product. After making a product, the teacher then asked them to test the product by filling the fish container with water. This activity was done for seeing their responses when others have advice or opinion. This activity related to the indicator of self-control ended with telling a story about products that have been repaired at the communication stage. At this stage, one child was categorized as starting to develop (MB), two children were categorized as developed as expected (BSB), and one child was categorized as very well developed (BSB). The result of the research in stage 1 was in line with the opinion stated by (Johnson, 2011), learning activities given to children aimed at providing knowledge,

skills, character, and sense. Every learning activity given by the teacher elevated a sense in every child. In this stage, moreover, STEAM and PjBL give a positive sense to the children that they tend to do work in a group, share, queue, and have self-control.

The STEAM-Project Based Learning in phase II is carried out for 3 days on the theme of natural phenomenon, sub-theme 'rain'. The activity is starting by doing questions and answers about traditional games. On the first day at the reflection stage, children watched videos about the process of rain. This activity was carried out to invite children to foster and maintain a good relationship with their peers, so they can follow the learning activity from beginning to end. The teacher then conveyed the issue about a married couple living in an unlivable old hut illustrated by a puppet. After that, in the second stage, the teacher showed a video about a husband and wife who live in an unlivable old hut and invited children to observe the hut. In the designing process, children were invited to work together to know whether or not they want to face the problems together and ended with playing engklek. This activity was done for knowing children's patience in the queue when other children took turns to get the tools and materials needed. The application stage was done on day 3 when the teacher repeated the previous activity by asking questions, sharing the design that has been made, and asking the children to make the product. The goal of this activity was to know whether or not children wantd to share the tools and materials during making a product. The teacher then invited the children to test the product by putting the puppet into the house that had been made and pouring the water little by little to see whether the house was leaking or not. This action was carried out to find out the children's responses toward others' opinions and suggestions which indicates self-control ended with storytelling about the product that had been reconstructed at the communication stage. The level of the children's development was categorized developed as expected and very well developed. There is a collaboration among children as the result of STEAM-PjBL learning. This is proven by the children's ability to accomplish the task. The development was categorized developed as expected (BSH). In the second phase of STEAM activities, children were given the task of doing certain tests on the product they have made. This activity was carried out to know whether the product is leaking or not. Moeslichatoen (Mulyasa, 2017) states that a project is a process of giving experience to the students by exposing them to everyday problems that must be done in a group, so they can manage themselves as well as adjust to others. It means STEAM learning can invite them to collaborate.

The STEAM-Project Based Learning in phase III is done for 3 days on the theme homeland, sub-theme 'arts and culture traditional game'. In the first stage, children watched videos about various traditional games which are aimed at inviting them to build and maintain relationships with friends as well as to attract them to follow the project from beginning to end. The teacher then showed the performance of wayang and its pictures at the research stage. After that, the teacher raised problems for children by telling a story about Pak Raden, who did not have a "wayang" to perform, and asking them to design it. The indicator that had to be achieved by the children was the will of doing something together, in this case designing the wayang in a group ended with a zigzag game. This activity was done for knowing children's queue behavior related to turn-taking the necessary equipment and materials. The teacher then repeated the previous activity by questioning, sharing the design that has been made, and asking the children to make a product from it. The indicator that has to be achieved is the will of doing the task with other friends in the group as well as sharing the equipment and materials. After creating the product, the teacher invited children to test the product by trying to make it stand up. It was aimed to know whether the wayang was limp or not, whether it had been handled or not. That

activity was carried out to know the children's responses to others' opinions and advice as well as to meet the indicator of self-control ended with telling stories about a product that has been repaired at the communication stage. The result of those stages showed the level of children's development was categorized developed as expected (BSH) and very well developed (BSB). The teaching and learning process using STEAM-PjBL is given discovery learning to the children. The discovery approach carried out in learning activities can sharpen children's mentality in their interactions with other people (Mursid, 2018). In line with this opinion, according to the results of the STEAM-BjBL activity in stage III, the children were on the developed as expected and developed very well criteria.

Based on the result of the research, the STEAM-Project Based Learning was categorized as very well developed related to the indicator of collaborative ability in early childhood. It can be seen from the development of children's behavior to do the certain task together. The indicator observed were children want to build and maintain a relationship with others, sharing, solving problems together, queuing, and having self-control. Furthermore, all of those five indicators were increased after STEAM-PjBL was applied in a learning activity, which is proven by the following criteria: BB becomes MB, MB becomes BSH, and BSH becomes BSB.

The result of the data indicated that there was an improvement toward children's collaborative abilities after applying STEAM-PjBL. The improvement can be seen from the pre-experimental stage that all of the children were categorized starting to develop (MB). Then, after STEAM-PjBL was applied at stage I, there was 25% fell into starting to develop (MB), 50% developed as expected (BSH), and 25% very well developed (BSB). At the stage II, furthermore, there was 50% fell into developed as expected (BSH) and 50% was very well developed (BSB). In a nutshell, the research on the STEAM-PjBL model could develop collaborative ability in early childhood. The result of the study is in line with the statement proposed by (Farhati, 2020) that the STEAM approach can drill and develop children's creativity so that the 6 aspects of children's development can be sharpened including children's ability to collaborate. This is in accordance with the results of the study (Guyotte et al., 2015) that the STEAM model can teach children to process through observing, playing, recognizing patterns, and practicing creative thinking skills as well as collaboration and communication skills between children in completing a task or project given by the teacher.

D. CONCLUSION

The conclusions from the results of this study are: first, the PjBL STEAM learning model invites children to do everything together in accordance with every step of learning. Social development is seen when children design and make products. It can be found in the discovery and application stage. The aspect of social development appeared along with children's ability to collaborate with others or their groups. Second, the STEAM-PjBL model can also be used to enhance children's speaking ability. This improvement can be seen in the reflection stage when they are required to answer the basic question from the teacher. Besides, children can express their opinion as well as presenting or telling the output of the product they have made with their groups in front of their friends and teacher. Third, the STEAM-PjBL model can develop children's problem-solving ability in early childhood. In the reflection stage, children are invited to observe something real, pictures, or videos. In addition, the discovery stage is

done along with the teacher inviting children to solve the problem that appeared in the project to develop children's cognitive ability.

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