

# STEAM-PBL in Early Childhood Education: Optimization Strategies for Developing Communication Skills

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## ABSTRACT

Early childhood education in schools must be able to stimulate the development of communication skills as one of the most important aspects of development. Based on the results of preliminary observations, it was identified that the learning process in early childhood education is still dominated by the individual and paper-based strategy so that the development of children's communication is low. To optimize children's communication skills, Science Technology Engineering and Math-Project Based Learning (STEAM-PBL) is applied which in its stages provides more opportunities for children to express ideas verbally. STEAM-PBL was carried out in three series with a total of 8 meetings involving 14 children aged 4-5 years and observed using an observation sheet containing a number of indicators related to communication skills. Data were analyzed using descriptive statistics supported by narrative explanations. The results showed that children's communication skills developed very well until the end of learning.

**Keywords:** *component, STEAM, PBL, Early Childhood Education, Communication Skills.*

## 1. INTRODUCTION

Language is one of the children's development aspects that need to be optimally stimulated both in formal and informal learning situations. One of the children's language development can be shown by the communication skills of the children in their social environment. Communication is a way to expressing thoughts, feelings, and information that can be reflected in the development of language in the form of words, sentences, conversations that if not stimulated properly will hinder their ability to interact and make it difficult for children to fulfil their daily needs [1].

In the context of formal learning in schools, teachers are expected to be able to design learning activities that provide more opportunities for children to communicate their ideas. The design of learning activities that can develop communication skills can integrate mathematical and science elements because both of them are strongly connected with communication skills that can help children build essential academic skills and have confidence in interacting [2].

One of the appropriate learning strategies to develop communication which contains elements of mathematical and science is STEM. STEM is a learning approach that integrates the components of Science (S), Technology (T), Engineering (E) and Mathematics (M). The addition of Art elements in STEM so it becomes STEAM is done by considering that the value of "Art" can trigger the development of children's imagination which leads to the improvement of creativity [3]. Through STEM/STEAM, children learn to ask questions, work together, think creatively,

solve problems, explore, take calculated risks, test solutions, discover new ways of doing something [4].

STEAM will be more optimal if integrated with project-based learning. Project-Based Learning (PBL) is a learning strategy that involves students dominantly conducting constructive investigations of open questions in groups and applying their knowledge to produce authentic products to enable collaboration, communication, and reflection activities [5][6].

The combination of STEAM and PBL has the potential to stimulate all aspects of child development holistically, one of which is communication skills. This can occur because at every stage of learning in STEAM-PBL which consists of reflection, research, discovery, application, and communication [7], children will be directed to work collaboratively so the communication skills indirectly will be stimulated when children must convey their ideas and negotiate in agreeing on various things related to the project being undertaken.

The problems given to children in the reflection stage in STEAM-PBL must provide a concrete situation to children because, at an early age, children cannot think abstractly [8]. Contextual problems will trigger the development of children thinking and make it easier for children to convey their ideas. This, of course, can stimulate the development of children given that at this stage, the development of children's imaginations, thinking, and language develops very quickly [8][9][10]. In addition, the existence of communicating stage in the STEAM-PBL series has the potential to stimulate communication skills because at this stage, children are directed to develop various language skills and communicate with others, work individually or in groups, and share and discuss the ideas through conversational activities, listening, and writing [11].

Based on the description above, the application of STEAM-PBL needs to be done and examined more deeply to analyze the effectiveness of its implementation on the development of children's communication skills. The advantage of doing this research is to provide references to Early Child Education (ECD) teachers in Indonesia about the innovative learning strategies that are relevant to the learning needs in the 21<sup>st</sup> century so that they can realize a progressive generation in facing the advances in technology and science.

## **2. LITERATURE REVIEW**

STEAM project based learning is a combination of the STEAM (Science, Technology, Engineering and Math) approach with the Project based Learning model to combine the potential or strength between STEAM and Project based learning in order to develop students' abilities and skills.

### **2.1. STEAM for Early Childhood**

STEAM (Science, Technology, Art, and Math), is a learning strategy that develops from the STEM (Science, Technology, Engineering, and Math) approach. The emergence of STEM in the field of education occurred in America, which began with a scientific crisis because young people are more interested in becoming entrepreneurs or business people than becoming scientists. Meanwhile, conditions in this century are needed by individuals who can adapt to the advances in technology and science that are developing very rapidly. Under these conditions, the American government took the initiative to integrate the focus on the fields of science, technology, engineering, and math in the school curriculum. The development of this curriculum aims to prepare a generation that can create technology products for the future.

Related to the development of STEM, at the level of early childhood added the element of "Art" so that STEAM's development strategy emerged which included the focus of the fields of Science, Technology, Engineering, Art and Math. The addition of the element of "Art" to this STEM is in addition to understanding the concept of science, early childhood is also creative and imaginative. Nowadays, early childhood more often develops their creative skills through playing drama, building blocks, manipulating clay, coloring, and dancing to the beat of music. These activities can be integrated in the STEAM learning process so that children can be more imaginative, creative, and help them develop their spatial skills and perspectives [3].

There are several research related to STEM and STEAM for early childhood. Research on the design and validation of classroom observation protocols used to capture aspects of STEM learning for early childhood education and help teachers make decisions in designing STEM learning [12]. Other research on STEM for young children proves that the application of STEM in English learning shows that STEM-based learning is very possible to be done in children at a very early age, the limitations of children in English are not a barrier to learning at the time of STEM and the application of STEM can improve children's English skills [13]. In addition, the integration of technology in STEM with the use of interactive and non-interactive videos can help children to more easily transfer

knowledge gained from video into new situations compared to children in the control class (Alade, Lauricella, Ryan, Wartella, 2016) [14]. The results of this study indicate that PBL has great potential to influence children's development on various aspects.

### **2.2. Project Based Learning for Early Childhood**

In the context of early childhood education, Project Based Learning can provide freedom for children to develop ideas so as to enable creative thoughts to emerge [15]. In addition, children will have experience in varied investigative activities in which intense social interaction processes occur and the acquisition of intact knowledge. From this definition, the application of PBL for early childhood has the potential to be able to develop various aspects of child development which include cognitive, social emotional, language and creativity aspects. Moreover, if the application of this Act is accompanied by the establishment of divine values, developments in moral and religious aspects will also be achieved..

Research on PBL in early childhood education indicate that PjBL can effectively improve children's speaking skills, attitude of curiosity, creative, critical and responsibility [16][17][18]. In other studies, the application of PjBL has proven to be successful in improving children's fine motoric skills after being applied for 4 projects [19]. Based on these results, it can be concluded that PjBL is able to provide appropriate stimulus to children to develop various aspects including cognitive, social-emotional, language, art, and physical-motor. Therefore, this potential will be greater if combined with STEAM.

### **2.3. Communication Skills**

Communication skills in early childhood are related to the speaking ability. Speaking is the ability to say articulation sounds or words to express, express or convey thoughts, ideas, and feelings [20]. Learning to speak includes three separate but interconnected processes [21], which include:

#### **1. Pronunciation**

The main task in speaking is to learn to say the word. Pronouns are learned by imitating. The whole pattern of the child's pronunciation will change quickly if the child is placed in a new environment where people in the environment say different words.

#### **2. Vocabulary Development**

The second task in learning to speak is to develop the amount of vocabulary. In developing vocabulary, children must learn to associate meaning with sound. Because many words have more than one meaning and because some words sound almost the same, but have different meanings.

#### **3. Sentence Formation**

The third task in learning to speak, namely combining words into sentences whose grammar is correct and can be understood by others, is the most difficult of the three tasks. In the beginning the child uses a one-word sentence, noun or verb, which is then combined with a gesture, to express a whole thought.

From the description above, it can be concluded that speaking skills cover a number of processes that must be passed in order for children's speech skills to develop properly. The three processes

are used as indicators of the development of children's communication skills that will be measured in this study as the impact of the application of STEAM-PJBL.

### 3. RESEARCH METHOD

This research involved 14 children who were observed using the communication skills observation sheet during their involvement in the whole STEAM-PBL learning process. Learning activities carried out three times a series of STEAM-PBL consisting of STEAM-PBL 1 (Urban theme), STEAM-PBL 2 (Rural theme), and STEAM-PBL 3 (Traditional Game theme) with each series consisting of reflection, research, discovery, application, and communication and a total of 8 meetings. In the reflection stage, children were invited to explore early knowledge through conversational activities about contextual matters related to the theme being studied (Science). At the research stage, the teacher used media in the form of learning videos (Technology) that can help children gather information about themes and then raise problems in the form of questions (Science). In the third stage, discovery, children were asked to make a sketch of the product (Engineering) that will be made in the form of a sketch of the building (STEAM-PBL 1), a sketch of a pet cage (STEAM-PBL 2), and a sketch of a *wayang* puppet (STEAM-PBL 3). Sketches that were made could be coloured using a colouring tool or decorated with other materials based on the wishes of the children (Art). The next step was to create projects in groups at the application stage using tools and materials that have been selected in the previous stage. At the stage of sketching and building projects, children estimated the length, width, height, area and how many tools and materials are needed to complete the project (Math). When the project was finished, children were then asked to tell about the project they have made and asked to respond to the work of their friends and express their feelings after being involved in learning. The whole series of learning activities were oriented by the teacher to develop children's communication skills.

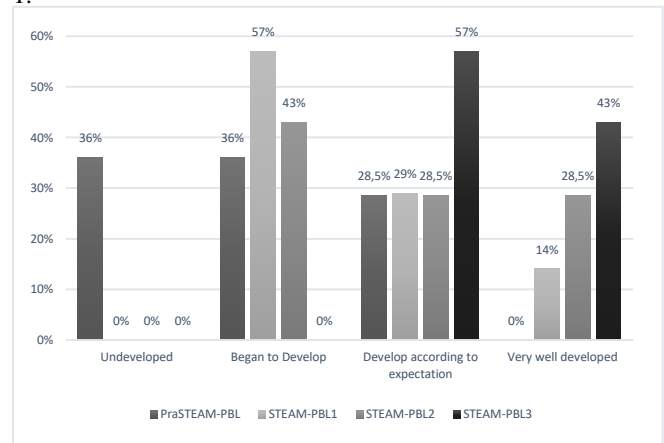
Communication skills in this research refer to children's speaking skills which consist of three aspects: pronunciation, vocabulary development, and sentence formation [21]. Early communication skills are identified prior to the application of STEAM-PBL to be used as a basis for analyzing subsequent development when children are involved in learning with STEAM-PBL. Data on communication skills are analyzed using descriptive statistics by calculating the percentage of communication skills development in each aspect that falls into the undeveloped, began to develop, develop according to expectation, and very well developed criteria.

### 4. RESULT AND DISCUSSION

Children's communication skills which consist of pronunciation, vocabulary development, and sentence formation aspects tend to increase during involvement in the learning process using STEAM-PBL both in the first, second, and third projects. The overview of each development in each aspect of communication skills can be seen as follows.

#### 4.1. Pronunciation Aspect

The indicators of communication skills in this aspect are shown by the ability of children to make conversations with teachers and peers and able to answer questions from teachers or friends with the clear and precise pronunciation of Indonesian. In previous learning, children were still stammering, slurred and some syllables were pronounced upside down. But after engaging in learning with STEAM-PBL, children's abilities are better as shown in Figure 1.



**Figure 1.** Diagram of the development of communication skills on the pronunciation aspect

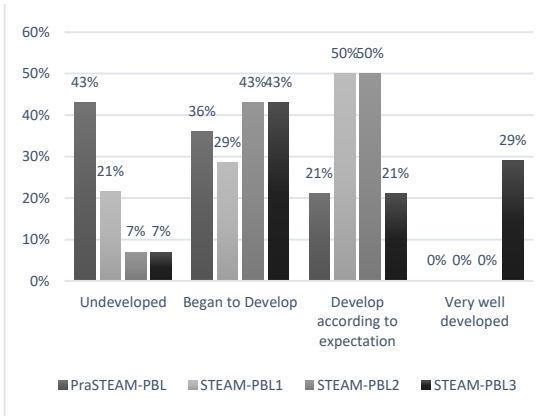
Figure 1 describing that the percentage of children who are in the undeveloped criteria has increased towards better criteria in each STEAM-PBL activity undertaken. This increase occurred because teachers provided a stimulus for children to do many conversational activities both with the teacher or with their peers during the learning process. For example in the reflection stage, children were asked to name objects or events that occur in urban areas (STEAM-PBL1), rural areas (STEAM-PBL2) and some traditional playing instruments such as *wayang* puppets, *congklak*, *bekel balls* (jacks), and stilts (STEAM-PBL3). Besides that, at the research stage, children were often invited to imitate the teacher's words about the objects shown on the learning media they used. The last was the communication stage when children were asked to tell about the projects that have been completed. At all stages, the teacher would correct the children's pronunciation that was not right and asked the children to repeat the word in question until they were really able to pronounce it correctly.

The conversational activities carried out in almost all STEAM-PBL activities aim to build a conducive social environment so that children are encouraged to express their opinions or ideas. An environment is an accepting place where teachers encourage young children to talk, and they exemplify the use of emphasis, regulation, and dialect to help children develop and hone their language skills [22]. The more children are encouraged to talk by inviting them to talk and encouraged to respond to them, the earlier they learn to talk and the quality of their speech increases [21].

#### 4.2. Vocabulary Development Aspect

STEAM-PBL gives children the opportunity to explore information about the theme being studied and gives a lot of time for children to communicate and interact with their environment that enables

children to get new vocabulary from the learning experience. The development of a children's vocabulary can be demonstrated when the children are able to mention question words (what, how, why, who, when and where) when asking questions about the theme being studied. In addition, the ability of children to mention things around or that is shown by the teacher and mention the name of a friend when invited to speak is one indicator of development in aspects of vocabulary development. The results of research related to aspects of vocabulary development can be seen in Figure 2.



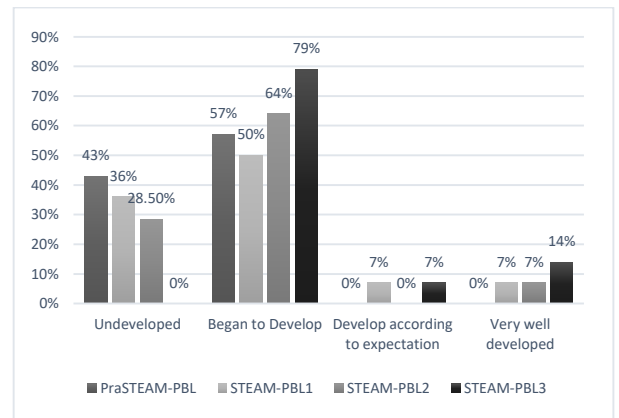
**Figure 2.** Diagram of the development of communication skills on the vocabulary development aspect

The development of children's vocabulary has increased significantly during STEAM-PBL showed by most children have entered the criteria of develop according to expectations and very well developed. This shows that the stimulus made by the teacher proved effective in increasing the development of children's vocabulary. To improve vocabulary development, children were asked to ask questions to their friends by using the words Ask What, Where, Who, When, How and Why when there are friends who tell about experiences related to learning themes or activities. For example, at the research stage when there were children who would tell about their experiences visiting urban areas, rural areas or using simple playing tools, then other children were asked to ask about where the city or village that has been visited? With whom they visit? When they visit it? Why choose that place? How do you feel when visiting the place? In addition, at the research and discovery stage, the teacher asked the children to mention objects related to the learning theme that the teacher had shown through the media and to name the tools and materials needed to make sketches and projects to be completed. At the application stage, children were invited to mention the parts of the project that would be completed and told the project that they had made in front of friends at the communication stage. Throughout the whole learning process, children were accustomed to mentioning the name of a friend when asking questions or inviting certain learning activities. These activities in the form of asking questions, telling stories and conversing can provide stimulus to children to train their thinking ability, train their courage to raise their opinions and have the potential to develop children's vocabulary [23][24].

**4.3. Sentence Forming Aspect**

The ability to form sentences in children is the most difficult aspect compared to other aspects because children must construct

sentences from the vocabulary they already have. Sentences used by children at this stage are still in the form of short sentences with a simple structure. An increase in the aspect of sentence formation can be seen in Figure 3.



**Figure 3.** Diagram of the development of communication skills on the sentence forming aspect

Figure 3 shows that the eight learning meetings with STEAM-PBL that have been carried out are only able to shift the children's ability to form sentences as much as one level from undeveloped to began to develop. The children development ability diagram shown in the picture is fluctuating and most of it is concentrated on the criteria of began to develop even though there are a small number of children who have entered the criteria develop according to the expectation and very well developed. This shows that providing a stimulus for the development of children's ability to form sentences must be done in a relatively long and intensive time because children's cognitive development at an early age is still very limited. Children's language development will develop well if children are involved in learning activities that can encourage communication activities with more frequent frequencies [25].

**5. CONCLUSION**

The results of the study prove that STEAM-PBL effectively develops children's speech skills. This is because in STEAM-PBL learning, children are given more stimulus in the aspects of pronunciation, vocabulary, and sentence formation through conversation, question and answer, and discussion activities integrated in the STEAM PBL stages include reflection, research, discovery, application, communication. The activity aims to give children the opportunity to pronounce words correctly, enrich vocabulary and improve their ability to compose simple sentences. The responses and interactions that occur in the activities of conversation, question and answer and discussion indirectly train children to express ideas, opinions, explanations and even questions through their own language style. When children find difficulties, the teacher must immediately help by improving pronunciation techniques, providing simple choice of words when the child stammers express something or provide follow-up questions to direct the child to precisely convey the intent in the conversation.

Children's communication skills can develop well in STEAM PBL because children are given more opportunities to be actively and interactively involved in learning. Problems that arise at the beginning of learning will provoke children to tell something relevant in accordance with what is already known. In addition, the challenges given to solve problems through the activities of making creative work in groups will force children to interact and communicate with each other so that they get optimal results according to their version. In the final stages of learning, children are asked to explain their learning experiences using the child's language style and are certainly directed by the teacher.

Development of children's communication skills that develop through STEAM PBL shows that this ability can develop through learning by doing, oriented to children development holistically, based on games, cooperative/collaborative, and are flexible in the sense that children can determine their own learning activities to be carried out [26][27]. STEM-PBL or STEAM-PBL as a relevant strategy to the characteristics of 21<sup>st</sup> century learning able to develop basic science process skills, one of which is communication skills [28]. Communication skills can be improved if the children are in a heterogeneous learning group that will encourage them to share different opinions, develop listening skills that are supported by eye contact and body language, ask lots of questions and is project-based [29]. The results of the study can be used as a reference for teachers, practitioners, and even policymakers to develop an ECD-oriented STEAM-PBL curriculum as an effort to build a progressive alpha generation of rapidly developing technology and science.

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