



Implementation of Learning with the Science Technology Engineering Art and Mathematics (STEAM) Approach in Bringing Up the Higher Order Thinking Skills (HOTS) Profile in Early Childhood

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Abstract .he Science Technology Engineering Arts Mathematics (STEAM) approach was present in the era of the industrial revolution 4.0, the STEAM approach was able to stimulate skills 21st century Technology and Engineering can be introduced by considering the stages of growth and development of early childhood. This study aims to describe the efforts of teachers in implementing STEAM which is able to construct gender equality in early childhood. This research method uses a qualitative method with a case study approach. Data collecting techniques were carried out by interview, observation, and documentation study. The research sample was conducted in groups B1 and B2 and two teachers were selected by purposive sampling technique. STEAM is able to bring up the HOTS profile in children, this result can be seen in (1) STEAM activities at the beam center, it can be seen that the ability of C4, C5 and C6 in children can appear when children have conversations between children in the presentation of the results of today's activities. (2) STEAM activities in the center of nature, HOTS thinking skills in children can be seen in the dancing corn experiment. Coaching teachers in the dancing corn experiment really trains children to be able to think up to C6 (3) STEAM activities in the preparation center, the HOTS profile is seen when children do weight-bearing activities, conversations between friends show how the HOTS mindset can develop. Some of these aspects can emerge through the stimulation of the STEAM approach which is transferred through the coaching in which there is an invitation sentence. The conclusion of this study is that the implementation of STEAM can maximize HOTS for early childhood. The implication of this research is that it can be used as a guideline in implementing STEAM by paying attention to the coaching and loose parts of the media.

Keywords: STEAM Approach, HOTS, Center, Early Childhood, Industrial Revolution 4.0.

1 Introduction

Indonesia in the Industrial Revolution era 4.0 has taken a stand by adapting digital-based information in line with the development of Industry 4.0 by increasing the competence of human resources through a link and match program between education and industry [1]. One form of link and match program in the world of education and industry in increasing the competitiveness of the workforce and industry is to implement learning that is integrated with the skills needed in the industrial era 4.0 and implements a number of learning strategies that can stimulate student skills. The implementation of industry 4.0 aims to increase sustainable economic growth. However, the current goal of implementing industry 4.0 has not been able to increase economic growth in Indonesia, as seen from the results of the global competitiveness index at the 2017-2018 World Economic Forum, Indonesia still occupies the 36th position, out of 137 countries [2].

In response to these problems, Indonesia focuses on four priority targets from all objectives Sustainable Development Goals (SDGs) that are related, either directly or indirectly, are quality education, better health, better job opportunities, honest and responsive governance. Quality education has become one of Indonesia's priority targets in the SDGs. It can be seen from the current decision of the Ministry of Education to have agreed and made the SDGs one of the government's focuses in improving education in Indonesia. Education is an inseparable part of the flow of globalization because it is closely related to the availability and preparation of Human Resources (HR) [3] (Ermalena, 2017).

Learning in the Industrial Revolution 4.0 era demands to produce students who are able to have 21st century skills [4]. The 21st century learning is marked by increasing public awareness and interest in science education [5]. To achieve this, Kindergarten is considered the most fundamental level in preparing students to be more prepared to enter higher education levels. This is in line with the results of research conducted [6] which states that the learning experience at the early childhood level is the foundation for the next learning experience.

The learning process with the STEAM approach in Kindergarten in an interdisciplinary manner is in line with the scientific process in learning contained in the 2013 Early childhood education curriculum, and the stages of child growth and development. The thematically implemented curriculum is integrated and presented in one theme [7]. Early childhood who learn with the STEAM approach are expected to be able to stimulate the stages of child development so that children have hard skills that are balanced with soft skills and are able to be globally competitive in the era of the Industrial Revolution 4.0. This can arise when the learning process with the STEAM approach is carried out using the active learning method, thus making the STEAM approach more interesting to learn [8].

The underlying premise of the project in this STEAM approach is that stimulating Higher Order Thinking Skills (HOTS) in early childhood has the potential to improve children's achievement in engineering and technology [9], and this can create an experience for students to choose and succeed in the STEAM field with a HOTS way of

thinking. In this regard, STEAM should be an important paradigm for creative and artistic teaching and learning embedded in science [10][11].

However, it is unfortunate that HOTS stimulation in early childhood is still considered skeptical by most teachers. This is in line with the results of research that has been carried out [12] which suggests that teachers have difficulty in determining teaching directions and methods to provide effective activities to stimulate HOTS. [13] identify barriers to teaching and assessing students' critical thinking. Several other studies have shown that teachers are less prepared in terms of knowledge, pedagogical skills and attitudes to teach HOTS [15][16][17].

Seeing this phenomenon, the researcher also analyzed a number of other authors such as [18][19][20][21] who have shown the importance of teaching HOTS skills directly in the classroom. [22] teaching HOTS is necessary to prepare students to take the initiative to "conduct reasoned assessments in real-life contexts". Critical thinking skills are able to stimulate students to use their minds in finding meaning and understanding about various things, exploring possibilities, making decisions, solving problems, and making reflections on the self-thinking process [23]. Thus the teacher can be said to be the center of encouragement for students who learn to think at higher levels.

The various examples of research that have been described above have been carried out in several European countries which are certainly different from those in Indonesia [24]. But in this case, Indonesia must also be able to prepare students who have 21st century skills and are able to compete globally. In line with the appeal of the Minister of Education and Culture which states that in preparing students who are ready to compete in the era of the Industrial Revolution 4.0, teachers must be able to direct students to be able to think critically, analytically, and be able to provide conclusions or problem solving. Furthermore, the Minister of Education and Culture welcomed the Industrial Revolution 4.0 through STEM and HOTS good practices. This was conveyed by the Head of the Research and Development Agency of the Ministry of Education and Culture (Balitbang Kemendikbud), Totok Suprayitno, when opening the STEM and Industrial Revolution 4.0 Workshop, at the Ministry of Education and Culture office, Senayan, Jakarta, Thursday (12/13/2018).

There are still limitations in research references that discuss the implementation of the STEAM approach, especially in Kindergartens in Indonesia. Research that is more specific about STEAM in Indonesia is found in upper-class basic education and secondary education [25]. Learning practices have also used the STEAM approach with project activities and at the end of the theme learning, students demonstrate all the results of projects carried out by Langgeng Garjita's Kindergarten students at each peak of the theme. This study is expected to describe the implementation of learning with the STEAM approach in Early Childhood Education and the impact of the STEAM approach on children's ability to show the HOTS thinking profile. Because basically learning in early childhood education must really meet the needs of children according to their stage of development. It is not the child that must be adapted to the program, but the program that must be adapted to the child. This study aims to describe the efforts of teachers in implementing STEAM which is able to construct gender equality in early childhood.

2 Methods

This study uses qualitative research methods. [26]. using a case study approach is to be able to study complex phenomena using various data sources. The case studied in this study is about the unpreparedness of Early Childhood Education, in implementing STEAM learning and stimulating HOTS in early childhood. The samples in this study were the principal, teachers and children of group B 1. This sample was selected through the Snowball Sampling where the intended sample was the sample needed to see the ability of HOTS. Data collecting techniques through unstructured interviews that only contain an outline of the topic of the question [27]. Observations were made in the learning process from the beginning to the end of the activity, while the observation tools used were field notes. Documentation studies were conducted to test the accuracy of the interviews and observations made, while the documents collected were school programs, Weekly of Lesson Plan, Daily of Lesson Plan, Assessment Lists, anecdotal notes, portfolios and checklists.

The data analysis technique of case study research begins with a description of the results of data collection, focusing on a number of small problems (theme analysis), and interpreting the data. Furthermore, [28] also added a strategy in case study data analysis, namely analyzing data through descriptions of cases and themes from cases as well as cross-case themes. The procedure carried out is the thematic analysis [29], namely 1. Understanding the data, 2. Compiling code, 3. Description, 4. Coding, 5. Selective coding, 6. Formation of themes, 7. Validating research results with stages of member check, triangulation, and report writing.

3 Results and Discussion

3.1 STEAM Activities in the Beam Center

The activities of the beam center are always set with 13 STEAM activities provided by the school for children in daily activities. The activity of arranging blocks is the activity that children like the most when they are in the center of the beam. The HOTS profile in STEAM activities at the beam center can be seen in the presentation of the results of children's play activities which are always carried out by the teacher during the evaluation of playing activities every day. Invitation sentences conveyed by children during presentation activities have shown C4's ability by analyzing the story that their friend is telling, C5 by providing an argument about the questions submitted by his friend while listening to his friend's presentation, C6 by creating a miniature bridge using many bridge legs. An example of an investment sentence that a child makes is:

"A: Can you build a bridge on the beach? It won't be strong because it's blown by the waves."

"B: Yes, because I made this bridge using a lot of cement and so many bridge legs that I made."



Fig. 1. Children are making miniature bridges with blocks

The conversations between children show that children are able to C4 analyze the possibilities that will occur if a bridge is built on the surface of the beach, arguing about the phenomena that will occur on the bridge they make. C5 and C6 is able to provide arguments and defend the bridge design that has been made by building a bridge by paying attention to good materials so that the bridge can withstand the waves. STEAM activities using invitation sentences are very helpful for teachers to be able to have guidelines in practicing HOTS skills. The results of this study are in line with the results of the study [30] The HOTS abilities that appear in this block activity can be seen in 21st century skills providing knowledge of receptive and expressive vocabulary independently. [31] classifies Bloom's thinking skills into HOTS which consists of analysis, synthesis and evaluation.

3.2 STEAM Activities in Natural Centers

The center activities are set with locations that are carried out in the open and closed by taking into account the 14 STEAM activities provided by the teacher. Activities at the nature center focus on experiments that children can do by considering loose parts. Coaching is an approach that is emphasized in this center and is played by many teachers who become facilitators in this activity. Coaching is carried out to explore the HOTS in the child. As for the example Coaching carried out by the teacher in the activity of playing dancing corn in the natural center, it can be explained;

“G; what would happen to this corn if R followed the steps in this picture?”

“R; if I look at this stage picture, these corns will rise to the surface one by one, I can't wait to test it.”

“G; please try it out, I can't wait to see it.”

“R; wow... this soda shows a reaction, look! The corn is like dancing. ooh, this is the meaning of the name of this activity, dancing corn, isn't it true, teacher?”

"G; Yes, this corn can dance in this water because there is a reaction from the soda that is poured."

"R; if I add this vinegar, is it okay?"

"G; Please, go ahead."

"R; woowow.. can dance again Mam! It turns out that it's not just soda, you can use vinegar, too."



Fig. 2. Children are experimenting with dancing corn

The HOTS profile on the dancing corn activity that the children chose in the natural center can show their C4 ability where the child has the desire to test the materials available in the dancing corn activity. C5 children are able to give an assessment and test with different materials on the dancing corn testing activity. C6 children are able to formulate the results of their experiments by combining soda water with vinegar water.

One of the important roles in bringing up the HOTS profile is the process of coaching activities. Coaching becomes an important tool in the process of developing a person's personality so that they can develop an understanding of HOTS in themselves [32]. Activities of Coaching can run well based on the expertise of a coach in packaging coaching [33]. STEAM activities with regard to coaching have been implemented. As a result, children are able to show their HOTS profile naturally and are adapted to activities. This finding is consistent with [34], who show that coaching really needs to be considered in an activity to achieve goals. Coaching helps students solve problems and learn strategies on how to deal with problems being discovered [35]. In line with the results of [32], this coaching is carried out according to the needs of college graduates.

3.3 STEAM Activities in the Preparation

The preparation center provides a choice of activities for children as many as 14 STEAM activities. This activity varies from activities that hone fine motor and gross motor skills. One of the activities chosen by the children is weighing the load. This activity is carried out using group play procedures. Playing in this group requires children to be able to carry out collaborative activities with their group friends, amounting to two people in each group who want to play weighing activities. The HOTS profile in the weighing activities carried out can be described in the conversations and observations that the researchers carried out as follows;

"C: I'm the one who puts the weight and you are the one who sees the movement of this needle."

"L: OK. But we put the load between the right and left sides in a balanced way, so as not to fall the load that we put here"

"C: okay I use the blue plate, and you use the yellow plate, so we don't fight hehehe.:

"L: Well."

"C: look! You have arranged 5 plates, I have only 3 plates but our burden is balanced."

"L: it turns out that your plate is thicker than my plate, so your third plate is the same weight as you."



Fig. 3. Children are presenting the results of playing.

Invitation sentences made by children with children in conversations about weighing activities have been able to show their HOTS abilities with conversations that are able to show C4's ability to compare the weight of the plates used by C and the plates used by L, C5 provides an assessment of the balance between the right and left sides of the load does not have to be the same amount. C6 designs weighing activities according to their respective colors in order to minimize the struggle in choosing plates.

Playing STEAM conducted in the preparation center can also stimulate the HOTS profile. Seen in children's conversations with children who use open invitation sentences. In line with research [25] open invitation sentences can be developed in every STEAM activity design. Conversation habituation using invitation sentences can train children to always have conversations [36]. Conversation in activities playing naturally sharpens children in HOTS thinking. So that the writing of invitation sentences in each lesson plan is very much needed [37]. The determination of the invitation sentence used is adjusted to the theme of the activity. This is supported by the results of [38] adjustment of activity theme invitation sentences can bring up HOTS. STEAM research in constructing gender equality in early childhood is a research that has not been done much. so that the results of this study can be used as a good reference for teachers in constructing gender equality in children.

4 Conclusion

The implementation of the STEAM approach in bringing up HOTS in children can run well if it is supported by several items that are able to stimulate HOTS thinking in children. Stimulation by teachers in stimulating HOTS in children is by designing center activities varied and capable of digging inquiry. STEAM playing media based on loose parts. In addition to the varied STEAM play activities, there are two factors that have a major influence in bringing up the HOTS profile in children, (1) There is an invitation sentence included in the planning of playing activities. (2) The process of playing STEAM activities is carried out on the basis of choosing children, playing activities are also free to be in groups or independently. (3) The method Coaching teachers with children, Coaching children with children, is done naturally while children are playing. (4) The activity of presenting the results of children's playing activities is able to show a varied HOTS profile from C4, C5, and C6, and each child has a different HOTS profile. So it can be concluded that the implementation of STEAM can bring up the HOTS profile in early childhood. This research has limitations on the implementation of STEAM which takes place in the setting of center activities. Therefore, the recommendation for further researchers is to conduct research that is set in STEAM activities in the area activity model.

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