Higher Order Thinking Skill (HOTS) through STEAM Learning for Early Childhood

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ABSTRACT:

The importance of Higher Order Thinking Skills (HOTS) in early childhood education is undeniable because it can to prepare early childhood to be able to think in applying and processing the information received to find solutions and even answers to problems that arise. This based on children's rights and Bloom's taxonomy theory regarding higher-order thinking. This study aimed to analyze Higher Order Thinking Skills through STEAM learning which implemented to early childhood in Kindergarten. This study using a qualitative approach use descriptive data in the form of written or oral sentences from observed behavior. Data were collected through in-depth interviews with kindergarten teachers and documentation of learning process. The data analysis techniques used are data reduction, data presentation and conclusions. The results of the study showed that Higher Order Thinking Skills (HOTS) through STEAM (Science, Technology, Engineering, Art, and Mathematics) learning has been carried out dan can encourage students to think creatively by creating media that is interesting for children and in accordance with their learning styles; designing STEAM activities or projects while playing so as to encourage students to develop problem-solving skills. STEAM learning can be done through direct experience and game-based learning. The conclusion of this study is that high order thinking skill learning through STEAM has begun to be carried out in early childhood. This study suggests that further researchers can to develop learning models and media through STEAM to improve high order thinking in early childhood.

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1. Introduction

HOTS (High Order Thinking Skills) or also known as the high level of thingking is something the concept of educational reform based on Bloom's Taxonomy with the purpose to prepare childs in facing the 21st century, including early childhood. In Indonesia, early childhood including in group ages 0-6 years as mentioned in Law of the Republic of Indonesia No. 20 of 2023 concerning the National Education System. At this period of time, it is called the golden age where child will experience extraordinary development, whether it is physique development nor the development of their brain. Therefore, it is necessary to provide stimulation that is useful for their future. HOTS is the ability to think critical, logical, reflective, metacognitive as well as creative which is a higher order thingking skill. HOT also covers the ability to analyze, evaluate, and create, as well as stimulating child for think critically (Haryati & Wangid, 2023).

It is important to give HOTS development to an early childhood as an effort to meet the demands of the 21st century so that it is hoped that the children will have thinking abilities that can apply and process the information they receive to find solutions and even answers to problems that arise. However, current conditions show that the implementation of HOTS in early childhood education is still minimal and has many obstacles (Nachiappan et al., 2018). Various problems that are difficult to solve are an important reason why high-level thinking skills are needed to solve them. Changes in the way of learning in early childhood are really needed and it is necessary to prepare skills for facing the 21st century, including (1) Learning independently, (2) Searching for information (3) Using real challenges (4) Using unstructured problems (5) Contextualizing information (6) Use higher order thinking skills (HOTS) (7) Students define the scope and questions of learning (8) Mutual learning (9) Actual assessment (10) Group work (11) Interdisciplinary studies (12) Assessment of process skills.

This high-level thinking process will refer to Bloom's taxonomy which is a level of cognitive thinking from low to high. Referring to Bloom 's taxonomy, development cognitive shared become six level. The first is ability to remember, the second is understanding, the third is implementation or application, the fourth is analysis, the fifth is evaluation or assessment, and the sixth is creation. In theory Bloom's cognition, the lowest level is memory and highest level is creation. This cognitive level devided into two levels which is the low-level thingking ability (LOTS) and high-level thingking ability (HOTS). LOTS is an area where somebody do thinking in a low level, covering remember C1, understand C2, and implement C3. While HOTS is a field of higher order thingking, that follows the skills of low level thingking and included in three field: C4 Analysis, Evaluation or Evaluation of C5, and Creation of C6. The bigger the cognitive level (C) then the higher the cognitive level require. The same thing applies on the contrary. The lower the cognitive level so the lower their level of thingking. It can also be said that level cognitive compare straight with the ability of someone when they thingking (Ariyana et al., 2018).

Bloom's Taxonomy consists of three domains namely related knowledge with mastery knowledge, attitudes related with mastery attitudes and behaviors, and related skills with mastery skills . Statement said in accordance with statement that besides There are 6 cognitive processes, Bloom's taxonomy has knowledge factual, conceptual, procedural , and metacognitive (Armstrong, 2017). Higher-order thinking skills provide many benefits for students. Students who have higher-order thinking skills will be better prepared to address difficulties in the twenty-first century (Brookhart, 2010; Moseley et al., 2005; Thompson, 2008).

The development of HOTS can be stimulated by parents, especially teachers, through Early Childhood Education. One of the reasons why HOTS can be implemented in PAUD is because children have the ability to build their own knowledge, such as when they are playing, where children can explore so that they can play meaningfully (not just playing but also learn from it). Children have a great curiosity about things, when children see the things around them, they will try to discover that new things from their environment. Children are excellent learners, they can easily imitate whatever is around them, with several characters possessed by children as mentioned previously, HOTS development can be carried out for early childhood, one of which is STEAM learning (Rachmah et al., 2022).

The term STEAM was first launched in the 1990s by the National Science Foundation. (NSF) United States with the name SMET, but this word not enough approved a number of party Because heard like SMUT so appear the term STEM (Science, Technology, Engineering and Mathematics) which represents field each of their knowledge in it (Sanders, 2009). Approach STEAM learning can develop interdisciplinary the science of designing transformative pedagogy for develop knowledge, skills and discipline participant educate (Taylor & Taylor, 2020). Approach STEAM learning combines various multidisciplinary, children Study science and mathematics with apply variation materials and sources Power technology, as well as engineering through realistic and meaningful way (Belbase et al., 2022).

STEAM is a learning content that includes knowledge, technology, engineering techniques, arts and mathematics. This aspect is a systematic way of thinking to be able to understand knowledge and apply it in everyday life as problem solving,

creative and analytical thinking. STEAM learning needs to be introduced to early childhood because it teaches children skills such as cooperation, perseverance, creativity and intelligence, children who understand STEAM will become innovators and think critically (Hasbi et al., 2022). The formulation of the problem in this research is how to develop HOTS in early childhood using the STEAM approach and how to implement it in the classroom. Results evaluation participant educate in a way international show that Trends International Mathematics and Science Survey (TIMSS) And Program for International Student Assessment (PISA) participant educate Korea show performance in field mathematics and science. Korea Also emphasize use technology in in class. All room class in Korea full of technology like computer, Internet, screen LCD And board clever, Which very useful in process learning And give chance to participant educate For get more Lots knowledge. On the side others, government Malaysia launch STEAM (Science, Technology, Engineering, Art, Mathematics) with method prepare talent participant educate in science, technology and mathematics with give chance for compete with countries with ability global (Chien & Lajium, 2016).

HOTS development can be developed since early through classroom learning because the teacher will train and get used to it in accordance with the child characters that can push child to think at a higher level. A number of study Previously also supported that STEAM learning can developing HOTS in children age early. Study Purnamasari, I., Handayani, D., & Formen, A. stated that STEAM learning can increase HOTS skills in children age early. The use of STEAM learning helps an early childhood does an analysis from problems encountered using the approach of science, technology, engineering, art, mathematics and so on, it is become a defensive strategy to survive in the changing times. (Purnamasari et al., 2020). STEAM learning is related to the ability to solve problems in the real world (Hong, 2017) and application of learning models using STEAM approach in a way that students are invited to learn the process by observing, playing, recognizing patterns and practicing creative thinking as well as collaboration and communication skills in completing a task (Guyotte et al., 2014) . HOTS success rate of children who take part learning based project is 63.7 % Skills acquired covers Skills select, organize, combine, justify, select, differentiate, analyze, create, combine, discover, collect, conclude, and classify (Wijayanti, 2023). Research result learning-based STEAM projects can used for developing various Skills of an early childhood by connecting with the element of science, technology, engineering, arts and mathematics as well as apply some strategies included reflection, discovery, application, and communication in learning (Wulandani et al., 2022). Therefore, this research will be carried out to develop HOTS uses STEAM-laden learning which will be linked to the use of local conditions and also linked to learning themes in PAUD or Kindergarten.

2. Method

This research is a descriptive analysis research with the research objective being to describe developing HOTS for early childhood using a STEAM learning approach. The qualitative method used is a research procedure that produces descriptive data in the form of written and spoken sentences from the people and behavior observed. To select research informants using a purposive method, namely determining informants based on their field of expertise, in this case those who will be used as informants are 20 Kindergarten teachers.

The data collection techniques used in this research are interviews (in-dept interviews) and documentation which aims to find problems in a more open manner where during the interview they are asked for opinions and ideas as well as related information about developing HOTS with a STEAM approach. Interviews are a process for collecting data that can be interacted with and confirmed with each other which then becomes an analysis scheme. After the data is collected through interviews and documentation, this data as a whole is continued with data analysis techniques with the following steps: (Creswell, 2012).

1. Processing and preparing data for analysis, namely developing HOTS for early childhood with STEAM learning.
2. Analyze in detail by coding the data, namely indicating the data being analyzed.
3. Applying the coding process to describe the setting, people, categories and themes analyzed, namely after indicating the STEAM-laden learning indicator data to develop HOST in children and then applying it according to the existing themes in the school.
4. Describing and connecting themes in narratives or qualitative reports, after obtaining the development of early childhood HOTS with STEAM content, it is analyzed into a qualitative report.
5. Interpreting data, namely providing a clear relationship between the development of HOTS for early childhood with STEAM content from data collection and interpretation so that the data obtained is synchronous.

3. Result And Discussion

3.1. Result

High Order Thinking Skill (HOTS)

The way teachers design STEAM activities or projects that encourage students to think creatively is by: creating media that is interesting to children and suits their learning styles and prioritizes their respective talents and interests (P1); Sparking questions, using various activities and learning media, observing the process and providing opportunities for collaboration (P2); designing activities using observation, questioning, experimentation and discussion methods (P3); as well as asking questions and explaining problems, developing and using models, designing and carrying out research, interpreting and analyzing data, so that children can improve their creative thinking (P4). Respondents also stated that efforts were made to measure and evaluate student creativity in STEAM

projects or activities by: using assessment in the form of direct observation during the teaching and learning process and making small notes about the progress that children had achieved during the activity (P1) ; Analyzing results (P2); Measuring and evaluating student creativity is seen in how the "process" of their activities is (P3); Observing children when doing activities (P4); and carrying out a summative assessment which is the final evaluation in measuring the achievement of learning objectives (P5).

The steps taken by teachers to overcome challenges that may arise when encouraging students to think creatively in STEAM learning are using reflection on the ongoing activity process (P1), increasing maximum learning (P2); keep believing in yourself that every process is good (P3); encourage children to show their abilities (P4); and encourage students to look for unique solutions, think outside conventional boundaries, and apply their knowledge creatively. These creativity and innovation skills give students an edge in finding new solutions and adapting to rapid change.

(P5)   strategies used by teachers to encourage students to be able to identify problems and find solutions critically in STEAM learning are making observations during activities, carrying out game activities in learning, making a project in groups, and making experiments (P1), by means of provide interesting facilities for learning (P2), provide stimulating questions, foster self-confidence, and help children to explore (P3), provide guidance to children (P4), find problems and solutions, imagine products, plan products, create and test products (P5).

The way to measure and evaluate students' critical thinking abilities in STEAM projects or activities is to do evaluation through assigned tasks , carry out Evaluation in a way qualitative / quantitative in accordance with rubric to ability participant students (P1), analyzing learning outcomes (P2), measuring and evaluating students' creativity by looking at the "process" of their activities (P3), organizing the environment so that they can increase children's knowledge (P4), and carrying out performance-based assessments in STEM/ STEAM involves evaluating students' skills through tasks such as demonstrations, presentations, simulations, models, and experiments (P5). Efforts to help students develop critical thinking skills when they face complex or contradictory information in STEAM learning, which include sharpening their thinking through designed activities, creating interesting experiments for children, collaborating with children during activities, and always applying STEAM in their daily lives. (P1), explaining in detail (P2), asking questions and asking children to collaborate (P3), correcting mistakes made by children and expanding their thinking (P4), and giving students insight into the problems that exist in STEAM learning (P1). P5)

How to design STEAM activities or projects that encourage students to develop problem solving skills, namely developing innovation (P1), determining the concept they want to create related to STEAM, determining learning objectives, developing project ideas that have been designed, collecting equipment/materials to be used, determining learning methods, and making assessments (P2), planning projects, forming teams, asking stimulating questions, implementing projects, collaborative problem solving (P3), helping children find out what they can get from learning on their own (P4), and planning, implementation, observation and reflection (P5). Efforts to support students in developing problem solving skills when they face obstacles or challenges in STEAM learning include holding discussions with students, collaborating well and creating a pleasant relationship/atmosphere in the class, as well as reflecting (P1), providing maximum facilities in learning (P2), giving children a sense of self-confidence, providing temporary evaluations or further questions (P3), helping them by providing support to encourage their

curiosity (P4), and providing knowledge and encouraging them to think critically and creatively so that students in facing challenges in STEAM (P5).

Science, Technology, Engineering, Art, Mathematics (STEAM)

The efforts that made by teachers to integrate knowledge about the surrounding environment into STEAM learning in the classroom are using project-based learning, collaborating well in every problem solving, using technology, good with collaborating, and developing skills well (P1), making learning more appropriate to life (P2), making learning interesting and fun related to the topic taken (P3), using tools and materials from the surrounding environment (P4), and encouraging students to think more broadly about problems in the real world (P5). Furthermore, the types of STEAM activities or projects that are most effective in fostering student creativity and innovation are making their own toys and using used materials found around the environment, creating works of art from recycled materials, carrying out simple experiments, and developing skills or projects by building using blocks/ lego (P1), carrying out continuous improvements and testing (P2), using interesting and fun learning media, and using technology (P3), learning that involves direct experience (P4), and utilizing types of technology that are able to make students think critically (P5).

The way to provide space for students to experiment and try new things in STEAM learning is to create a safe and conducive classroom environment for students, prepare the equipment needed during the activity process, collaborate and communicate with each other, and have sufficient time; help students to build self-concept actively; I provide the facilities needed to experiment, help if needed, and ask them to collaborate with friends, and remain under the supervision of the teacher; using scientific methods; and provide time for critical and open thinking. The steps that involve students in the STEAM learning planning process are developing a curriculum that is interesting and fun for children, using a project approach, using technology; increasing students' literacy regarding STEAM; see problems and find solutions together in class; create an exciting, enjoyable learning atmosphere that is active and creative; and group students so they can work together to solve problems.

The challenges faced in implementing STEAM-based learning are related to time, limited space, lack of knowledge; parental support, as well as limitations in terms of facilities at school. Furthermore, the way teachers can assess the success of the project-based learning method in STEAM is through direct observation, documentation, results of learning, assessing the process that occurs, when children successfully work on the project with the results of their own work, as well as independent assessment and rubric. The way to encourage students to develop inquiry skills in STEAM learning is by providing a brief explanation about learning steam, using loose parts, developing communication skills, developing systematic, logical and critical thinking skills using the child's potential; search for and find their own learning materials, and often exchange opinions in learning

To train students to communicate their findings effectively in STEAM learning, namely when carrying out activities, accompany them by providing or asking several stimulating questions related to the activities carried out. Aims to hone how they can communicate about the discovery process they are undergoing (P1); has a goal, is in harmony with the goal, is systematic, has evaluation activities, and is fun (P2); provide a sense of trust in children (P3); giving appreciation to children for their involvement in STEAM learning (P4); and through presentations in a learning group (P5). The way to evaluate students' inquiry abilities in observing and communicating the results of STEAM projects, namely using the inquiry method, will put more emphasis on their ability to think more critically and the ability to solve problems through observation and investigation. And this method can help them develop skills in learning Steam (P1); critical thinking; see how the child processes; assess their activeness in learning; and present in front of the class. Furthermore, respondents also stated that various things could be done to identify and facilitate students' individual interests and talents in the process of creating a STEAM project, including making observations first regarding their different talents and interests. After that, group them according to their talents and interests during the activity process; prove that there has been an increase in student activity, such as students becoming active during the learning process, being able to think actively and creatively; facilitate as needed; giving rewards to children; and provide a pretest before creating a STEAM project.

3.2. Discussion

The research results show that Higher Order Thinking Skills (HOTS) can be developed through STEAM (Science, Technology, Engineering, Art, and Mathematics) learning which is fun for young children in Aisyiyah Kindergartens throughout Pekanbaru City. The results of this research are in line with the results of research (Hermita et al., 2023) which shows that there are differences in critical thinking skills between students who were given STEAM learning experiences and those who were not given STEAM learning, namely that critical thinking skills in experimental class students increased by 23.7% compared to the control class and also the experimental class showed a more positive attitude towards STEAM learning experiences. Higher order thinking skills (HOTS) in early childhood can be stimulated by developing play and learning activities that are well managed, fun, and it also need to consider the interests of early childhood (Aisyah et al., 2024) . Furthermore, there is an influence of the interaction of learning models and critical thinking skills on understanding physical science (Dewi et al., 2019) . Teachers need to play a role in accompanying, supervising and directing children in carrying out learning activities, especially children who are less active so that the concept of playing while learning is observed (Aryani et al., 2020) . Apart from that, the use of learning media, learning resources and the environment around the school is also important to make learning more meaningful (Suryana & Rizka, 2019) . Research (Hapidin et al., 2020) designed and modified STEAM (Science, Technology, Engineering, Art, Mathematics) learning into R-SLAMET (Religion, Science Literacy, Art, Mathematics, Engineering, Technology), and the results of the research showed that R-SLAMET learning can provide early childhood experience of playing with nature and can be used as a source of inspiration to discover marine literacy. Furthermore, the use of technology in learning, which is an indicator of STEAM learning, also shows that there is an increase in children's reading abilities when learning using Android-based educational games (Rakimahwati et al., 2022)

4. Conclusion

Higher Order Thinking Skills (HOTS) can be developed through STEAM (Science, Technology, Engineering, Art, and Mathematics) learning which encourages students to think creatively by creating media that is interesting to children and suits their learning style; designing STEAM activities or projects that encourage students to develop problem solving skills, train students to communicate their findings effectively in STEAM learning and carry out activities by accompanying them and providing or asking several stimulating questions related to the activities carried out.

5. Acknowledgement

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