

STEAM IN EARLY CHILDHOOD: A QUANTITATIVE STUDY OF COGNITIVE DEVELOPMENT IN CHILDREN AGED 4-5 YEARS

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ABSTRAK

Metode Sains, Teknologi, Teknik, Seni, dan Matematika (STEAM) adalah metode pembelajaran yang menekankan hubungan antara pengetahuan dan keterampilan. Penelitian ini bertujuan untuk mengetahui perkembangan kognitif anak usia 4-5 tahun sebelum dan sesudah menggunakan metode STEAM di Kober Al Hidayah, serta untuk mengetahui efek sebelum dan sesudah menggunakan metode STEAM terhadap perkembangan kognitif anak usia 4-5 tahun di Kober Al Hidayah. Metode yang digunakan dalam penelitian ini adalah metode kuantitatif dengan desain pra-eksperimental. Hasil penelitian ini menunjukkan bahwa sebelum diberikan pengobatan berupa penggunaan metode STEAM, perkembangan kognitif anak usia 4-5 tahun di Kober Al Hidayah menunjukkan hasil yang cukup baik. Adapun setelah diberikan pengobatan berupa menggunakan metode STEAM, perkembangan kognitif anak usia 4-5 tahun di Kober Al Hidayah menunjukkan hasil yang sangat baik. Sedangkan berdasarkan hasil uji-t dinyatakan bahwa $t_{hitung} > t_{tabel}$, yaitu $9,347 > 2,145$ pada taraf signifikansi 5%, yang mana H_0 ditolak dan H_1 diterima. Hal ini bermakna bahwa penggunaan metode STEAM berpengaruh signifikan terhadap perkembangan kognitif anak usia 4-5 tahun di Kober Al Hidayah.

Kata Kunci: Anak Usia Dini; Metode STEAM; Kognitif

ABSTRACT

The Science, Technology, Engineering, Art, and Mathematics (STEAM) method is a learning method that emphasises the relationship between knowledge and skills. This study aims to determine the cognitive development of children aged 4-5 years before and after using the STEAM method in Kober Al Hidayah, and to determine the effect before and after using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah. The method used in this study is a quantitative method with a pre-experimental design. The results of this study show that before being given treatment in the form of using the STEAM method, the cognitive development of children aged 4-5 years in Kober Al Hidayah showed quite good results. As for after being given treatment in the form of using the STEAM method, the cognitive development of children aged 4-5 years in Kober Al Hidayah showed very good results. Meanwhile, based on the results of the t-test, it was stated that the t-calculation $>$ the t-table was $9.347 > 2.145$ at the level of significance of 5%, of which H_0 was rejected, and H_1 was accepted. It means that using the STEAM method has a significant effect on the cognitive development of children aged 4-5 years in Kober Al Hidayah.

Keywords: Early Childhood; STEAM Method; Cognitive

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I. INTRODUCTION

Early childhood education has a focus on optimizing children's spiritual and physical growth and development which is in accordance with the Early Childhood Development Achievement Level Standards (STPPA), which include: (1) aspects of religious and moral scores, (2) aspects of Pancasila scores, (3) physical motor aspects, (4) cognitive aspects, (5) language aspects, and (6) social-emotional aspects (Hidayat & Nurlatifah, 2023, p. 31). Referring to the six abilities of children that have been regulated in the STPPA as described, one of them is the child's cognitive ability. As for the indicators of children's cognitive ability, especially children aged 4-5 years must meet the following indicators: (1) recognize objects based on functions (knives for cutting, pencils for writing), (2) use objects as symbolic games (chairs as cars), (3) recognize simple concepts in daily life (drizzle, rain, dark, light, dim, etc.) (4) know the concepts of many and little (5) create something according to their own related ideas with various problem solving, (6) observing objects and symptoms with a sense of wanting to be yearly, (7) recognizing activity patterns and realizing the importance of time, (8). Understand the position/position in the family, space, social environment (e.g. as a student/child/friend) (Peraturan Menteri Pendidikan dan Kebudayaan Nomor 137 Tahun 2014).

However, the reality in the field, based on the results of initial observations, the cognitive ability of children, especially children aged 4-5 years in Kober Al Hidayah, has not been in accordance with the indicators mandated in the STPPA above. It can be seen that children still experience obstacles in indicators: (1) learning and solving problems, especially in the aspects: (a) solving simple problems in daily life, (b) showing a creative attitude in solving problems (ideas, ideas out of habit). (2) Thinking logically, especially in the aspects: (a) classifying objects based on function, shape, colour or size, (b) recognising patterns (e.g., AB-AB and ABC-ABC) and repeating them, (c) sorting objects based on 5 serialisations of size or colour. (3) Symbolic thinking, especially in the aspect: (a) counting many objects from one to ten, (b) recognising numbers. These children's cognitive obstacles can be caused by the absence of practice or habituation carried out by parents at home, teachers at school, and a lack of interaction between children and the environment. This phenomenon is in line with the results of previous research conducted by Shaka et al., (2024); Sari & Anto (2022).

To overcome the obstacles to cognitive development of children aged 4-5 years as mentioned above, real solutions are needed to overcome them. One of the solutions used by the researchers is using the STEAM method. The STEAM method is a comprehensive combination of various subjects such as Science, Technology, Engineering, Arts, and Mathematics as a problem-solving pattern that is expected to be achieved by children in the direct learning process. Children get new experiences and can survive when solving problems, collaborating, and working with creativity (Sari & Anto, 2022, p. 35). This is in line with the opinion of Shaka et al., (2024, p. 60) that the STEAM method is a method used in learning where children present their thoughts critically and solve problems creatively in the fields of science, technology, engineering, art and mathematics. Furthermore, Muawanah & Harjani (2024, p. 446) emphasized that the STEAM method is a learning method that invites children to learn the concepts of Science, Technology, Engineering, Arts, and Mathematics as a whole. This approach is designed to make learning feel entertaining and meaningful, inspiring children by integrating these concepts into everyday life.

Furthermore, this research is supported by three previous studies. The previous research was conducted by Shaka et al., (2024). This study uses a quantitative method with a pre-experiment design. The results of this study show that $t\text{-count} = 26.741$ while $t\text{-table} = 2.178$, where H_a is accepted, and H_0 is rejected. Thus, there is a significant

influence of the application of the STEAM learning approach on children's numeracy skills. The previous research was conducted by Syam et al., (2024). The research method used is a quantitative method with a quasi-experiment design. The results of the study show that there is a positive influence of using logico game media on the cognitive development of children aged 5-6 years. Furthermore, the third previous research was conducted by Muawanah & Harjani (2024). This study uses a quantitative method with a pre-experimental research design. The results showed that before the implementation of the STEAM method, 95% of children were in the poor category and 5% in the adequate category. However, after applying the STEAM method, there was an increase in science skills to 60% in the good category.

Based on the three previous studies above, the researchers use them as support for the present study. The research conducted by Shaka et al., (2024) has similarity with the present study, which examines using the STEAM methods to develop children's cognitive development from an early age. Meanwhile, the studies conducted by Syam et al., (2024) and Muawanah & Harjani (2024) are different from the present study because those only focuses on examining using STEAM methods in general or logico-scientific game media, without focusing on the development of children's cognitive development after early childhood specifically. Thus, this study is going to contribute to the STEAM learning method for early childhood education.

Based on the background of the problems described above, the hypotheses in this study are: H_0 : "There is no effect of using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah", H_1 : "There is an effect of using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah". Based on the hypothesis that has been formulated, the formulation of the problem in this study is: (1) How is the cognitive development of children aged 4-5 years before using the STEAM method in Kober Al Hidayah?; (2) How is the cognitive development of children aged 4-5 years after using the STEAM method in Kober Al Hidayah?; (3) How is the effect before and after using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah? Based on the research problems that have been formulated, the objectives of this study are: (1) To determine the cognitive development of children aged 4-5 years before using the STEAM method in Kober Al Hidayah; (2) To determine the cognitive development of children aged 4-5 years after using the STEAM method in Kober Al Hidayah; (3) To determine the effect before and after using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah.

II. LITERATURE REVIEW

In this literature review section, the researchers discuss two sub-discussions. The two sub-discussions include defining the STEAM Method, and the cognitive development of children aged 4-5 years. Furthermore, those sub-discussions are described as follows.

Defining the STEAM Method

The STEAM method is an integration of various disciplines such as Science, Technology, Engineering, Arts, and Mathematics, which aims to train children to think and solve daily problems and can be used as a reference in making a variety of learning activities to develop children's cognitive development (Amelia & Nuraeni, 2021, p. 152). Furthermore, Maarang et al., (2023, p. 313) stated that the STEAM method is a composition that can form scientific thinking skills in children through the practice of comparing, grouping, sorting, and making patterns. In line with the previous two opinions, Septiani & Kasih (2021, p. 197) argue that the STEAM method is an approach

to learning that uses Science, Technology, Engineering, Arts, and Mathematics as an entrance for children to cooperate with each other, discuss, collaborate, and think critically. STEAM activities can be done naturally by children through play activities by trying various new things from their own perspective, so that they can grow critical thinking skills and can solve problems.

Based on the three experts on the STEAM Method above, it can be elaborated that the STEAM method is an integrated learning approach that includes Science, Technology, Engineering, Arts, and Mathematics, which aims to develop children's cognitive abilities, especially in daily problem solving. In line with this view, the STEAM method plays an important role in stimulating scientific thinking skills through the activities of comparison, classification, sequencing, and pattern identification. Furthermore, the STEAM Method is a pedagogical framework that facilitates collaboration, discussion, and development of critical thinking skills in children. Thus, the implementation of STEAM through exploratory and child-centered play activities empirically encourages the development of children's cognitive skills and problem-solving skills (Amelia & Nuraeni, 2021; Maarang et al., 2023; Septiani & Kasih, 2021).

In the context of current research, the implementation of the STEAM Method in PAUD currently focuses on the introduction of basic concepts of Science, Technology, Engineering, Arts, and Mathematics through play activities that aim to stimulate scientific thinking skills, simple problem-solving skills, and children's exploratory power, which, as a whole, contributes to the improvement of cognitive abilities. The stages of implementation include introduction to concepts, integration of disciplines in learning themes, facilitation of scientific thinking through questions, giving simple challenges, as well as reflection and discussion after activities, as supported by various studies on the implementation of STEAM in early childhood education.

Based on the results of the elaboration above, it can be concluded that the STEAM Method is an integrated learning approach that combines Science, Technology, Engineering, Arts, and Mathematics to develop children's cognitive abilities, especially in problem solving and stimulating scientific thinking skills through exploratory activities and play. In the context of the latest research in early childhood education, the implementation of STEAM is still in the introduction stage of basic concepts, with stages including concept introduction, integration of disciplines, facilitation of scientific thinking, provision of challenges, and reflection, which overall aims to improve early childhood cognitive development.

The Cognitive Development of Children Aged 4-5 Years

According to Annisa et al., (2023, p. 84), cognitive development is divided into 3 aspects, namely learning and problem solving, logical thinking and symbolic thinking. Those included in learning and problem solving include: (1) children can see and touch objects shown by others; (2) the child can imitate the way an adult or friend solves; (3) concentration in doing something without the help of parents; (4) exploring cause and effect; (5) following daily habits (bathing, eating, going to school). Furthermore, logical thinking includes: (1) the child can name parts of an image, such as pictures of people's faces, cars, animals, etc.; (2) the child knows the parts of the body; (3) understand the concept of size (big-small, long-short); (4) recognize three kinds of forms; (5) begin to recognize patterns; (6) understand the symbol of numbers and their meaning. Then, in the aspect of symbolic thinking includes: (1) imitating the behaviour of others in using goods, (2) giving a name to the work made, (3) performing activities under real conditions (e.g., holding a phone). Furthermore, Nurlela & Fidesrinur (2025, p. 91) argue that children's cognitive development after 4-5 years includes: (1) children can pronounce letter

symbols; (2) the child can show the letter symbol; and (3) the child can associate letter symbols with pictures. The ability to recognise letter symbols is the ability of children to recognise the characteristics, signs, and sounds of a letter symbol. In line with the previous opinion, [Imamah & Farida \(2024, p. 13\)](#) stated that the cognitive development of children aged 4-5 years includes: (1) children can show the symbols of numbers; (2) the child can say the order of numbers; (3) the child can match the symbols of the numbers 1-10.

Based on the opinions of the experts above, the researchers elaborated that the classification of early childhood cognitive development consists of learning and problem-solving (the ability to respond to objects, imitate problem-solving, focus independently, understand cause and effect, and follow routines), logical thinking (the ability to identify parts, understand the concept of size and shape, recognize patterns, and understand number symbols), and symbolic thinking (the ability to imitate using objects, name the work, and role-play). In addition, children's cognitive development is directed towards early literacy skills such as recognising and connecting letter symbols. In addition, children are also trained to be able to recognize early numeracy such as recognizing number symbols, sequencing numbers, and matching numbers to quantities, which as a whole illustrate the multidimensional development of concrete understanding towards abstract and representational thinking, as well as an important foundation for literacy and early numeracy ([Annisa et al., 2023](#); [Imamah & Farida, 2024](#); [Nurlela & Fidesrinur, 2025](#)).

In the context of current research, the cognitive development of children aged 4-5 years can be carried out through structured and fun play activities, including the development of learning and problem solving through object exploration, imitation, increased concentration, understanding of cause and effect, and following routines; development of logical thinking through part identification, understanding of the concept of size and shape, pattern recognition, and understanding of number symbols; the development of symbolic thinking through role-playing and naming works; and stimulation of early literacy skills through the recognition and association of letter symbols with pictures, and early numeracy skills through the recognition of number symbols, number sequencing, and matching numbers with quantity, with the principles of play while learning, concrete to abstract, repetition, individualization, positive interaction, active engagement, and variety of activities.

From the above elaboration, it can be concluded that early childhood cognitive development includes aspects of learning and problem solving, logical thinking, symbolic thinking, and early literacy and numeracy skills. In the context of current research, children's cognitive development can be carried out through fun, structured play activities to stimulate these cognitive aspects, with learning principles centred on concrete experiences, repetition, individualisation, positive interactions, active engagement, and variation, to optimise the cognitive development of children aged 4-5 years.

III. METHOD

Research Type and Approach

This study uses a quantitative method with a pre-experimental approach. Quantitative research means research that has met scientific principles, empirical, objective, measurable, rational, and systematic ([Balaka, 2022, p. 11](#)). In pre-experimental study, researchers only involved one experimental group without a control class, in this present study pre-experimental research used the One Group Pre-test & Post-test Design. Thus, the results of treatment can be known more accurately because they can compare

with the situation before being treated and after being treated (Cahyaninati & Prystiananta, 2019, p. 38). Furthermore, the design of this study is described as follows.

Table 1. One Group Pre-test & Post-test Design

Pre-test	Treatment	Post-test
O ₁	X	O ₂

Description:

X: Treatment using the STEAM method

O₁: Pre-test

O₂: Post-test

Source: (Nurhayati et al., 2024, p. 48)

Research Time and Place

This study was conducted for 2 weeks, beginning on May 12-24, 2025. Furthermore, this study was conducted in Kober Al Hidayah, RT 08, RW 03, Kertajaga, Sukajaya village, Pamarican subdistrict, Ciamis regency.

Research Subject

The subject in this study is 15 children aged 4-5 years, consisting of 5 boys and 10 girls. The whole of the children is in Group B in Kober Al Hidayah.

Procedure

In this study, the researchers acted as teachers and also as observers (participant observers) who researched using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah. Before being given treatment, it begins with giving a pre-test. Then, children are given treatment in the form of learning using the STEAM method. Finally, after being given treatment, the children are given a post-test.

Data, Instruments, and Data Collection Techniques

The instruments used were in the form of observation sheet and observation assessment guidelines that were carried out twice. The first is when given a pre-test before being given treatment using the STEAM method, and the second when given a post-test after being given treatment in the form of using the STEAM method. The STEAM method is carried out based on indicators of thinking ability, including: (1) recognising objects based on functions, (2) recognising simple concepts, (3) recognising concepts of many and few, (4) recognising various patterns, and (5) learning to solve problems. Furthermore, the measurement scale used is Not Developing (BB) with a score of 1, Starting to Develop (MB) with a score of 2, Developing as Expected (BSH) with a score of 3, and Developing Very Good (BSB) with a score of 4 (Ernasari et al., 2025, p. 250).

Data Analysis Techniques

Furthermore, the data analysis techniques used to analyse the data of the research results are descriptive statistical analysis techniques and inferential statistical analysis techniques. Activities that include descriptive statistical analysis include determining the mean and standard deviation. Activities that include inferential statistical analysis are used to determine hypothesis tests using t-tests. The t-test is used to find out the answer to the hypothesis, whether or not using the STEAM method has an effect on the cognitive development of children aged 4-5 years in Kober Al Hidayah. The data analysis techniques are presented in the following formula.

1. Average Difference (df)

$$\bar{D} = \frac{\sum D}{N}$$

Description:

$\sum D$: Total score D

N : Number of samples

\bar{D} : Average difference

2. Counting t-table:

$$t_{\text{table}} = \frac{\bar{D}}{\sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{N}}{N(N-1)}}$$

Description:

\bar{D} : Average difference

$\sum D^2$: Total squared difference score

$\sum D$: Total score difference

N : Number of samples

Sources: (Hidayat, 2010 in Ernasari et al., 2025, p. 251)

IV. RESULTS AND DISCUSSION

Results

In this study, the researchers obtained data from the results of the pre-test and post-test conducted in the experimental class. The pre-test is an ability test given to the child before being treated, while the post-test is given after the student is given treatment. Both tests function to measure the effect of using the STEAM method on children's cognitive development. The results of the pre-test and post-test are presented in the following table.

Tabel 2. Description of Pre-Test Results

No.	Subject	Pre-test					Score	Predicate
		Knowing objects by function.	Getting to know the simple concept	Getting to know the concept of many and little	Getting to know the various pattern tigers	Learning to solve problems		
1.	001	3	3	2	3	2	3	Good
2.	002	2	2	3	3	3	3	Good
3.	003	1	3	2	3	2	3	Good
4.	004	2	1	2	2	2	2	quite good
5.	005	2	2	1	2	2	2	quite good
6.	006	2	2	2	3	3	2	quite good
7.	007	1	3	2	3	3	3	Baik
8.	008	3	1	2	2	2	2	quite good
9.	009	3	2	2	3	2	2	quite good
10.	010	2	3	3	2	3	3	Baik
11.	011	2	2	1	2	2	1	quite good
12.	012	3	2	2	3	2	2	quite good
13.	013	3	3	2	2	3	2	quite good
14.	014	1	2	2	1	2	1	quite good
15.	015	2	1	2	2	2	1	quite good

Sources: (Data, 2024)

In addition, a table of post-test results after receiving treatment using the STEAM method is also presented. The post-test table is shown in the following table 3.

Table 3. Description of Post-Test Results

No.	Subject	Post-test					Score	Predicate
		Knowing objects by function.	Getting to know the simple concept	Getting to know the concept of many and little	Getting to know the various pattern tigers	Learning to solve problems		
1.	001	4	4	3	4	4	4	very good
2.	002	3	2	4	4	4	4	very good
3.	003	3	3	2	3	4	4	very good
4.	004	3	2	3	3	3	3	Good
5.	005	2	3	4	4	3	4	very good
6.	006	3	3	3	4	4	4	very good
7.	007	3	4	3	4	4	4	very good
8.	008	4	3	4	3	3	3	Good
9.	009	3	3	3	3	3	3	Good
10.	010	3	3	3	4	4	4	very good
11.	011	3	3	3	3	4	3	Good
12.	012	4	3	3	4	4	4	very good
13.	013	3	4	2	3	4	4	very good
14.	014	3	3	3	4	3	4	very good
15.	015	3	4	3	3	3	3	Good

Sources: (Data, 2024)

Regarding the two pre-test and post-test data above, the researcher then conducts data analysis and computation, interpretation of computational results, and hypothesis testing. The results of the pre-test and post-test are presented in Table 4 below.

Table 4. Score Students Pre-Test & Post-Test

No.	Subject	Pre-test	Post-test	Difference (D)	D ²
1.	001	3	4	+1	1
2.	002	3	4	+1	1
3.	003	3	4	+1	1
4.	004	2	4	+2	4
5.	005	2	3	+1	1
6.	006	2	4	+2	4
7.	007	3	4	+1	1
8.	008	2	3	+1	1
9.	009	2	3	+1	1
10.	010	3	4	+1	1
11.	011	1	3	+2	4
12.	012	2	4	+2	4
13.	013	2	4	+2	4
14.	014	1	4	+3	9
15.	015	1	3	+2	4
AMOUNT Σ		32	55	23	41
N = 15		X ₁ = 2,133	X ₂ = 3,667	$\Sigma D = 1,533$	$\Sigma D^2 = 2, 733$

Sources: (Data, 2024)

Description:

1. Children are categorized to be very good and get a score of 4 if they know objects based on functions, know simple concepts, know many and little concepts, know various patterns, and learn to solve problems without being exemplified by teachers.

2. Children are categorized to be good and get a score of 3 if they know objects based on functions, know simple concepts, know many and little concepts, know various patterns, and learn to solve problems without being reminded.
3. Children are categorized to be quite good and get a score of 2 if they know objects based on functions, know simple concepts, know many and little concepts, know various patterns, and learn to solve problems with help.
4. Children are categorized to be not good and get a score of 1 if they do not know objects based on functions, do not know simple concepts, do not know the concepts of many and little, do not know various patterns, and do not know learning in solving problems with help.

Sources: (Nurhayati et al., 2024, pp. 53–54)

Concerning the table above, the researchers drew several conclusions to find out the scores needed in the t-test. Some of these conclusions are outlined as follows:

1. Average Pre-test and Post-test Students

$$\bar{X} \text{ (Average)} = \frac{\sum X}{N}$$

Description:

$\sum X$: Total score

N: Number of tests

$$\bar{X}_1: \text{(Average Pre-test)} = \frac{32}{15} = 2,133$$

$$\bar{X}_2: \text{(Average Post-test)} = \frac{55}{15} = 3,667$$

2. Average Difference (D)

$$\bar{D} = \frac{\sum D}{N}$$

$$\bar{D} = \frac{23}{15} = 1,533$$

Description:

$\sum D$: Total Score

DN: Number of Samples

3. Standard Error of Difference:

$$SD = \frac{\sqrt{\sum D^2 - \frac{(\sum D)^2}{N}}}{N(N-1)}$$

$$= \frac{\sqrt{41 - \frac{23}{15}}}{15(15-1)}$$

$$= \frac{\sqrt{41 - 1,533}}{15 \times 14}$$

$$= \frac{\sqrt{39,467}}{210}$$

$$= \sqrt{0,1879}$$

$$= 0,433$$

4. Counting t-account

$$t_{\text{account}} = \frac{\bar{D}}{\frac{\sqrt{\sum D^2 - \frac{(\sum D)^2}{N}}}{N(N-1)}}$$

$$\begin{aligned} &= \frac{1,533}{\sqrt{\frac{41 - \frac{(23)^2}{15}}{15(15-1)}}} \\ &= \frac{1,533}{\sqrt{\frac{41 - \frac{529}{15}}{15 \times 14}}} \\ &= \frac{1,533}{\sqrt{\frac{41 - 35,266}{210}}} \\ &= \frac{1,533}{\sqrt{\frac{5,734}{210}}} \\ &= \frac{1,533}{\sqrt{0,027}} \\ &= \frac{1,533}{0,164} \\ &= 9,347 \end{aligned}$$

5. Calculating the Degree of Freedom (df)

$$\begin{aligned} \text{df} &= N - 1 \\ &= 15 - 1 \\ &= 14 \end{aligned}$$

After determining the Degree of Freedom (df), the researchers obtained the data from the calculation. The data from the calculation is described as follows:

1. Average Pre-test $\bar{X}_1 = 2,133$
2. Average Post-test $\bar{X}_2 = 3,667$
3. Average Difference $\bar{D} = 1,466$
4. Average Standard Error (SD) = 0,433
5. $t_{\text{account}} = 9,347$
6. Degrees of Freedom (df) = 14

Based on the data presented in the table above, the score of the degree of freedom (df) = 14 was obtained. Based on the Pearson product-moment correlation coefficient table with column 0.05 with (df) = 14, the t_{table} of 2.145 is obtained. Furthermore, the results of the Pre-test and Post-test were used to answer the hypothesis in this study. The hypothesis of this study is:

H_0 : There is no effect of using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah.

H_1 : There is an effect of using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah.

The results of the t-test stated that the t-count > of the t-table was $9.347 > 2.145$ at the level of significance of 5%, so H_0 was rejected, and H_1 was accepted. Thus, it can be concluded that there is an influence of using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah.

Discussion

After discussing the results of the study, the researchers then answered three problem formulations that had been proposed in the introduction. The first research problem is: “**How is the cognitive development of children aged 4- 5 years before using the STEAM method in Kober Al Hidayah?**” Based on the data obtained from

the pre-test results, it is known that the child's cognitive development before receiving treatment using the STEAM method is included in the predicate and is quite good, with the average value of the pre-test result being 2.133. Thus, based on this data, the researchers answered the formulation of the first problem that before being given treatment in the form of using the STEAM method, the cognitive development of children aged 4-5 years in Kober Al Hidayah showed “quite good” results $\frac{32}{15}$.

This baseline condition can be theoretically explained through Jean Piaget's Theory of Cognitive Development, which asserts that children in this age group are at the preoperational stage, where their cognitive intention actively drives them to explore and make sense of their environment through emerging symbolic thought (Andersen & Kiverstein, 2024). Furthermore, viewed through the lens of Lev Vygotsky's Sociocultural Theory, this pre-test score represents the children's actual developmental level within their Zone of Proximal Development (ZPD). It indicates a solid cognitive readiness to reach a higher potential level when provided with appropriate educational scaffolding, such as the STEAM method (Rigopouli et al., 2025). Thus, based on this data, the researchers answered the formulation of the first problem that, before being given treatment in the form of using the STEAM method, the cognitive development of children aged 4-5 years in Kober Al Hidayah.

The second research problem is: **“How is the cognitive development of children aged 4-5 years after using the STEAM method in Kober Al Hidayah?”** Based on the data obtained from the post-test results, it is known that the cognitive development of children after receiving treatment using the STEAM method is included in the very good category, with the average value of the post-test results being. Thus, based on these data, the researchers answered the formulation of the second problem that after being given treatment in the form of using the STEAM method, the cognitive development of children aged 4-5 years in Kober Al Hidayah showed “very good” results $\frac{55}{15} = 3,667$.

This significant improvement can be theoretically explained through the grand theory of Constructivism, primarily founded in Jean Piaget's Theory of Cognitive Development and Lev Vygotsky's Sociocultural Theory. According to these frameworks, early childhood cognitive development is not a passive reception of facts, but an active construction of knowledge through experiential interaction and social mediation. The STEAM method acts as a comprehensive educational scaffolding tool within the children's Zone of Proximal Development (ZPD). Through integrating science, technology, engineering, arts, and mathematics into meaningful, play-based inquiries, STEAM effectively transforms initial curiosity into authentic, sustained interest, therefore promoting deep cognitive ontogenesis and enhanced conceptual awareness (van Aswegen & Pendergast, 2023). Furthermore, this interdisciplinary, practical approach continuously stimulates critical thinking and problem-solving skills, allowing children to reach their highest potential cognitive level, which fundamentally justifies the “very good” post-test outcome (Rodrigues-Silva & Alsina, 2023).

Next, the last research problem is: **“How is the effect before and after using the STEAM method on the cognitive development of children aged 4-5 years in Kober Al Hidayah?”** Based on the results of the t-test, it was stated that the t_{count} produced a number of 9.347, and the t_{table} produced a number of 2.145 at a significance level of 5%. By comparing the $t_{\text{count}} > t_{\text{table}}$ score, which is $9.347 > 2.145$, where H_0 is rejected, and H_1 is accepted. Thus, based on these data, the researchers answered the formulation of the last problem that using the STEAM method has a significant effect on the cognitive development of children aged 4-5 years in Kober Al Hidayah.

The profound statistical significance of this effect can be theoretically underpinned in Experiential Learning Theory and Cognitive Constructivism. According to these grand theories, early childhood cognitive structures are optimally developed when learning is active, multi-sensory, and experiential. The STEAM method fundamentally reflects this constructivist approach by synthesising science, technology, engineering, arts, and mathematics into cohesive, project-based activities. This interdisciplinary integration provides children with rich, practical stimuli that actively forge new neural pathways, therefore accelerating higher-order cognitive functions such as spatial reasoning, problem-solving, and symbolic thinking (Başaran & Bay, 2023). Consequently, because STEAM requires children to continuously experiment, observe, and construct their own understanding of the world, the cognitive growth from the pre-test to the post-test becomes highly significant, strongly validating the method's transformative pedagogical impact (Rodrigues-Silva & Alsina, 2023).

The answers to the three research problems above are the results of the present study, where using the STEAM method, given as a treatment, has a significant effect on the cognitive development of children aged 4-5 years in Kober Al Hidayah. The results of this study have similarities with the results of previous research conducted by Shaka et al., (2024), where using the STEAM method affects numeracy skills as part of the cognitive development of children aged 4-5 years. The difference from the previous research, in addition to examining children's numeracy skills, also examined children's language skills, so that the results of the previous research were quite broad and not in-depth in terms of children's cognitive abilities. Furthermore, the results of the study now have similarities with the results of the second previous research conducted by Syam et al., (2024). These two studies both examined the STEAM method in improving the cognitive development of children aged 4-5 years. The difference with the current research lies in the variety of indicators that are being studied, so that the results of the research are now more in-depth compared to the results of the previous research. Finally, the results of the research now have similarities with the results of the previous research conducted by Muawanah & Harjani (2024). The results of this study examine the application of the STEAM method in improving children's science skills, where science is one part of children's cognitive development. The difference with the current research is in harmony with the variety of indicators that are being studied, including: (1) knowing objects based on functions, (2) knowing simple concepts, (3) knowing the concepts of many and little, (4) knowing various pattern types, and (5) learning to solve problems. Thus, using the STEAM method has a significant effect on the cognitive development of children aged 4-5 years in Kober Al Hidayah, including the ability to recognise objects based on functions, recognise simple concepts, recognise concepts of many and little, recognise various patterns, and learn to solve problems with the achievement of Developing Very Good (BSB).

Furthermore, in the current study, the researchers also found new findings as the novelties of the present study, including: (1) using the STEAM method not only affects children's cognitive intelligence, but also affects children's language intelligence, which helps children in expressing answers from various The questions given, (2) children are helped in developing the ability to imagine and think logically, which can hone children's cognitive development, (3) children are helped in developing physical motor skills. These three new findings are also novelties in the present study. However, it is important to remember that children's cognitive development needs to be honed regularly with guidance from teachers at school and from parents at home, so that the intended use of STEAM methods can produce measurable, targeted children's abilities that do not cause negative effects on children in the future.

V. CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the results of the research and discussion that have been described, this study concludes that before being given treatment in the form of using the STEAM method, the cognitive development of children aged 4-5 years in Kober Al Hidayah showed “quite good” results. As for after being given treatment in the form of using the STEAM method, the cognitive development of children aged 4-5 years in Kober Al Hidayah showed “very good” results. Meanwhile, based on the results of the t-test, it was stated that the $t_{\text{calculation}} > t_{\text{table}}$, which was $9.347 > 2.145$ at the level of significance of 5%, of which H_0 was rejected and H_1 was accepted. This means that using the STEAM method has a significant effect on the cognitive development of children aged 4-5 years in Kober Al Hidayah.

Suggestions

Based on the conclusions obtained, the researchers then provide suggestions to teachers to master and understand various types of teaching and learning methods to be applied to students of early childhood education. In addition, it is also recommended that the school provide training or assign teachers to participate in training and workshops on using the latest teaching and learning methods that are needed by children as students of early childhood education in accordance with the demands of the times. Finally, for future researchers to research methods, strategies, and other approaches that can be used collaboratively for teaching and learning in early childhood education units. Thus, the results of the research will be more comprehensive and more in-depth.

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