Edutec
Journal of Education And Technology
2597-9221 (Online)
Volume 7 Number 1 September 2023

Increasing Children's Intelligence through the STEAM Learning Model in Elementary School

Gusmaniarti[1], berda asmara[2]*, mochamad nursalim[3], diana rahmasari[4]
Universitas Muhammadiyah Surabaya
Universitas Nahdlatul Ulama Surabaya,
Universitas Negeri Surabaya

gusmaniarti@um-surabaya.ac.id., gusmaniarti.2207@mhs.unesa.ac.id
asmaraberda@unusa.ac.id, berda.22007@mhs.unesa.ac.id.,
mochamadnursalim@unesa.ac.id., dianarahmasari@unesa.ac.id

Article History	Received : June 18th 2023
	Revision :August 19th 2023
	Publication : Sept 30th 2023

ABSTRACT
STEAM, an acronym for Science, Technology, Engineering, Arts, and Mathematics, represents an instructional approach closely linked to children's cognitive abilities. The combination of science, technology, engineering, mathematics, and arts in the learning process can prepare students with 21st-century skills. The objective of this study is to examine the STEAM learning model in primary education through a literature review, aiming to enhance students' intelligence. This research is qualitative in nature, utilizing a literature review to connect existing research and fill gaps in prior studies. The findings of this study reveal that the STEAM learning model for children can be implemented by creating a safe and enjoyable learning environment. It provides children with opportunities for exploration, discovery, construction, experimentation, prediction, seeking answers to complex questions, and connecting knowledge to real-life situations, thereby stimulating their intelligence.

Keywords: Intelligence, Primary Education, STEAM

INTRODUCTION

The rapid advancement of technology is a consequence of the industrial revolution, leading to various changes in all aspects of human life, including the field of education. This has necessitated the equipping of students with a range of skills known as 21st-century skills. One movement that has emerged to address this need is a pedagogical model known as STEM (Science, Technology, Engineering, and Mathematics) education, which later evolved into STEAM with the addition of "Arts." The aim of this research is to examine the STEAM learning model in primary education through a literature review, focusing on its potential to enhance students' intelligence.

STEAM, an acronym encompassing Science, Technology, Engineering, Arts, and Mathematics, is an instructional approach that integrates these disciplines into the learning process. The STEAM approach aims to enable students to comprehend complex concepts and apply them to everyday life while exploring and harnessing their inherent potential. It goes beyond strengthening knowledge in various disciplines, allowing students to explore and establish connections between art, cognition, music, science, and more.

Furthermore, the STEAM model is designed to equip students with the skills and talents needed to tackle the challenges of the 21st century. It emphasizes the relationship between knowledge and skills for problem-solving and places great importance on cognitive development, particularly in the fields of science and mathematics.

Cognitive development is a crucial aspect that needs to be nurtured and developed, and it is a fundamental goal in early childhood education, such as in kindergarten. Cognitive abilities involve reasoning, thinking, language, social-emotional skills, moral development, and religious understanding. A well-developed cognitive ability allows individuals to distinguish between right and wrong, make informed decisions, and address challenges in their daily lives. Therefore, early development of cognitive skills is of paramount importance.

In the current educational landscape, many schools still employ monotonous teaching methods, predominantly focused on reading, memorization, and note-taking. In today's technologically advanced era, educators are expected to create innovative and creative teaching methods and utilize dynamic teaching media. This is especially relevant when applying cognitive skills through the STEAM learning model in primary education.

If students become disinterested in traditional cognitive learning approaches, it can lead to passive engagement. Such disinterest can potentially hinder students' intellectual development. Therefore, enhancing intelligence through the STEAM learning model in primary education represents a promising new beginning and a positive transformation in the learning experiences of students and educational institutions alike.

METHOD

The research approach used in this study is qualitative research, a method that generates descriptive data. Qualitative research is aimed at describing the true state of the object or phenomenon under investigation and then comparing it with existing theories (Sumanto, 1996:51).

This research takes the form of qualitative research, which is a method used to study natural conditions inductively based on factors discovered in the field and then

construct them into theories. The research method used is library research, where data is collected from scientific books, journals, regulations, newspapers, seminars, or other sources related to the issue in question, and data is analyzed from these existing data sources (Sugiono, 2007:15).

The research is entirely based on a literature review and field research. The approach used includes a literature review to gather data or information using a variety of materials available in the library, such as books, magazines, history, and other sources relevant to the researched methodology. The field research, on the other hand, uses a descriptive qualitative approach with a correlational model. The descriptive qualitative approach aims to uncover phenomena in a holistic and contextual manner, resulting in descriptive data in the form of written or oral words from people and observable behaviors.

During the data analysis process, data collection and analysis are performed simultaneously. In broad strokes, data analysis involves three steps: preparation, tabulation, and data application according to the research approach (Arikunto 2022). The data analysis technique used in this study is content analysis, which involves analyzing various elements within the issue at hand (Sudijono, 2002:177-178). Data analysis is the process of simplifying data into a more readable and interpretable form (Singarimbun and Effendi, 1999:263). The steps in data analysis include data reduction, data presentation, and drawing conclusions.

RESULT AND DISCUSSION

STEAM (Science, Technology, Engineering, Arts, and Mathematics) is becoming increasingly popular in education as it helps students to understand subjects and solve problems creatively (Nurwulan, 2020). STEAM is an educational approach that allows students to expand their knowledge in science and the humanities while developing skills needed for success in the 21st century, such as communication, critical thinking, leadership, teamwork, creativity, flexibility, and more (Zubaidah, 2019).

A study (Fatimah, 2022) related to the implementation of STEAM in early childhood education institutions shows that the implementation of STEAM in early childhood education reaches 63%. This data was obtained through the analysis of 20 lesson plans used by teachers during the teaching process. Considering the importance of STEAM in equipping children to think systematically and critically in solving future problems, the achievement of STEAM implementation still needs improvement.

On the other hand, a study by Nuragnia (2021) regarding the implementation of STEAM in elementary schools obtained data that indicates teachers' classroom practices have already moved towards STEAM-based learning. This is reflected in the percentage

of teachers who conduct student-centered learning. Teachers are also applying various teaching models, such as inquiry-based learning, project-based learning, and problem-solving. The 2013 curriculum implemented in schools trains teachers to use mixed learning, both in terms of content and skills. This shows that STEAM learning can be applied in elementary education in Indonesia.

Initially, STEAM only consisted of four elements, often abbreviated as STEM (Science, Technology, Engineering, and Mathematics). However, education experts have included Arts in STEAM-based learning, and that's why it is known as STEAM (Lestari: 2018).

Science represents a way of thinking, involving observing, experimenting, making predictions, sharing discoveries, asking questions, and thinking about how things work. The scope of science includes life science (life cycles, living organisms, environment), physical science (understanding objects, size, shape, texture), color, position, change, heat, light, electricity, magnetism, earth and space science (celestial bodies), changes in the sky and on the earth (rocks, soil, water, air, sun, moon, weather, and more) (Wahyuningsih: 2018, 19).

Technology is about how things are done, using tools, becoming an inventor, identifying problems, and making things work. Engineering is the art of problem-solving using various materials, designing and creating, and building something that works well. Engineering refers to how things function, with a process for producing something better. To produce a better product, an engineer must be creative to solve problems and create efficient, effective, and creative designs. The connection between technology and engineering occurs when children explore materials, such as building blocks, playing with liquid and solid materials, using glue, insulation, staples, and even nails. The objects children explore are closely related to geometry. Shape and position are essential components in building the stability of a structure (Wahyuningsih: 2018).

Art offers children the opportunity to express STEAM concepts in creative and imaginative ways, such as (Lestari: 2018):

a. Expressing ideas about the world through music and dance. b. Communicating with descriptive language. c. Illustrating ideas with crayons and markers. d. Creating graphics. e. Building models.

Art is not just limited to visual arts, dramatic arts, dancing, and music. In this concept, children are given an open opportunity to experience the artistic process rather than just producing a product. Children are provided with the open opportunity to choose and explore media, and it's even possible for children to retell a story in a different format, such as a song or dance (Lestari: 2018).

Mathematics involves measurement, ordering, creating patterns, exploring various shapes (triangles, squares, circles), volume (more or less), and size (bigger, smaller), logical cause and effect, comparisons, and classifications. Mathematics is more than just counting; it invites children to think mathematically. Language also plays a role in

mathematics when children use comparative words like bigger, thicker, smaller, and more. Higher-level mathematical thinking emerges when children are assisted in understanding that comparisons are relative, depending on what they are comparing at that moment (Wahyuningsih: 2018).

There are several principles that characterize STEAM learning (Lestari: 2018, 21):

1. STEAM Learning Starts with Empathy. STEAM education fosters the development of empathy in children. Every STEAM activity should begin with a genuine concern for issues or challenges that arise from the child's everyday world. STEAM nurtures the desired characteristics in children. Empathy is the initial step in the design thinking process or the STEAM framework. In essence, the design thinking process within STEAM follows the following pattern:
   a) In the design thinking process within STEAM, empathy serves as the initial step in problem-solving efforts. Through empathy, we seek to understand the problems faced and work towards finding solutions.
   b) Errors in the Learning Process are Essential for Improvement and Optimal Results (Fail Fast, Learn Faster) It's not easy to instill in children the courage to embrace mistakes in the process of problem-solving. However, the normalization of making mistakes is a crucial aspect of the learning process to find solutions. More than that, mistakes allow children to learn from their errors and make the learning process more optimal. Making mistakes early on helps us learn more quickly.
   c) Children are Young Problem Solvers A renowned engineer is known for their problem-solving skills and the ability to find solutions to problems, often referred to as a problem solver. Being a problem solver is a mindset that should be instilled from an early age. This aims to enable children to become individuals who are ready to face the challenges of the world in the future. Having a caring and highly empathetic character, technological literacy, and using it to seek solutions will lead to the creation of a competent generation in the future.
   d) Children Learn through Collaboration One of the principles of STEAM education is to train children to collaborate from a young age. Collaboration goes beyond mere cooperation; it involves intensive involvement and concentration on finding solutions or problem-solving together. Every stage leading to problem-solving is essential, and the mistakes made are opportunities for learning and improvement. There is no perfect outcome; what exists is a more optimal result. The paradigm that every task or answer from a child must be correct and perfect is shifted to a process of finding the most optimal result or solution. When a child is given a project or problem, as an educator, one should always appreciate every effort made to improve the results. As a problem solver (engineer), the expected solution is the most

beneficial and optimal compared to other solutions that may emerge as the problem-solving process progresses. STEAM-integrated curricula often revolve around scientific inquiry. Therefore, STEAM should be built upon a child's curiosity. From this curiosity, children will ask questions, explore, and draw conclusions, much like a scientist. As facilitators, educators need to provide materials that capture a child's attention and challenge them to explore and learn. Educators should also delve deeper into a child's questions, expanding them to find answers to the child's questions. When children ask questions and are encouraged to find answers, they become actively engaged in the process of searching for these answers.

As a result, children gain new experiences as additional knowledge and understanding to what they already know. The components of scientific inquiry are as follows (Lestari: 2018):

a. Predicting: Forming ideas or expectations based on previous knowledge that guide scientific investigations.
b. Observing: Carefully examining the characteristics of an object, whether in a natural environment or an experimental setting.
c. Experimenting: Creating situations to investigate a prediction or manipulate an object to gain knowledge.
d. Comparing: Establishing relationships through observations or experiments with objects.
e. Measuring: Using methods to compare or measure specific attributes of an object, such as length, weight, distance, and speed.
f. Inferring: Making assumptions (opinions) based on repeated observations or experiments.
g. Communicating: Sharing the knowledge obtained through inquiry by conversing, writing, drawing, or presenting a situation experienced. Children can engage in scientific inquiry by exploring objects in their surrounding environment. STEAM learning can be a major component of classroom projects and the focus of field trip activities.

According to Jean Piaget's model of cognitive abilities, based on Jean Piaget's theory, cognitive abilities are not simply miniature replicas of those of adults, and the way children think is different from that of adults. Cognitive development has four aspects, namely (Waseso: 2018):

a. Maturity: This pertains to the development of the nervous system. For example, the ability to see or hear is due to the maturity of the relevant nervous system.
b. Experience: This involves the mutual relationship between organisms and their environment, within their own world.

c. Social transmission: This refers to the influences gained from interactions with the social environment, such as parenting and education provided by others to the child. d. Equilibration: This pertains to the ability to regulate oneself to maintain balance and adapt to the environment.

Children who are of school age, that is, between six and 12 years old, begin to use logical thinking and problem-solving. These children are also capable of learning from their mistakes and explaining cause and effect relationships. A person's cognitive ability is a manifestation of basic or primary abilities, according to the National Department of Education, which includes the following (Depdiknas, 2014):

a. Language skills: Cognitive abilities in the language aspect include aspects such as reading, speaking, listening, and writing. All of these are closely related and cannot be separated from each other.
b. Memory skills: Cognitive abilities in the memory aspect come into play when a person recalls information. This includes everything an individual has learned in the past.
c. Reasoning skills: Cognitive abilities in the reasoning aspect are vital and related to logic. Through logic, one can distinguish between right and wrong.
d. Spatial relation skills: Cognitive abilities in the spatial relation aspect involve a person's ability to imagine objects constructed in a pattern through images.
e. Numerical skills: Cognitive abilities in the numerical aspect encompass an individual's ability to understand shapes, sequences, and numbers in solving problems.
f. Word usage skills: Cognitive abilities in the word usage aspect encompass a person's ability to construct words in an orderly and comprehensible manner when speaking.
g. Quick and precise observation skills: Cognitive abilities in the aspect of quick and precise observation involve an individual's ability to understand a problem by first observing or examining it carefully and making precise judgments.

Research conducted by (Fauziah, 2022) shows that STEAM-based loose part model learning has a positive influence on the independence of children in TK Masyithoh II Sanansari. This can be seen from the comparison between pre-tests and post-tests, where the percentage of children with a high level of independence reached 56.25%, and the percentage of children with a "sufficient" level of independence before learning with the STEAM model was 75.00%. This aligns with the findings of (Kurniawati, 2022), which showed that STEAM significantly influenced children's cognitive development. The experimental group in the study demonstrated significant changes in critical thinking, creative processes, collaborative spirit, and communicative abilities. Primary education is where children acquire knowledge and values that will be useful in their lives. This development is gradual and adapted to children's understanding at that time.

Introducing STEAM to children can be done by creating a safe and enjoyable learning environment. Providing opportunities for children to explore, discover, build, experiment, predict, seek answers to difficult questions, and connect knowledge to real life are the main activities that can be carried out in the implementation of STEAM. The 2013 curriculum with a thematic and scientific integrative approach is very suitable for integrating STEAM-based learning, as learning is done in different contexts that can bring subjects closer to daily life or subjects that are close to children's world.

CONCLUSION

The research results demonstrate that the Enhancement of Children's Intelligence through the STEAM Learning Model in Primary Education is in line with the existing concept of STEAM. This is evident through a variety of cognitive activities applied within the STEAM concept, including children's ability to think critically, engage in creative processes, foster collaborative spirit, and enhance communicative skills. In addition, children gain knowledge and instill values in their everyday lives. The STEAM method provides opportunities for children to explore, discover, build, experiment, predict, seek answers to complex questions, and connect knowledge to real life. All of these activities can be effectively implemented by learners in accordance with the 2013 curriculum, which employs a thematic and scientific integrative approach that aligns well with STEAM-based learning. This learning is conducted in different contexts, bringing subjects closer to daily life or subjects that are relevant to children's world.

REFERENCES

Aristantia, G. (2017). Penerapan Science Technology Engineering Art Mathematics Pada Tema Air Dan Kita Untuk Meningkatkan Penguasaan Konsep Dan Mengetahui Profil Karakter Peserta Didik SMP Universitas Pendidikan Indonesia.

Fatimah, F., Ulfa, N. M., & Aprianti, H. (2022). Studi Implementasi STEAM (Science, Technology, Engineering, Art, and Mathematics) dalam Pembelajaran di Jenjang PAUD Kabupaten Jember. Jurnal Pendidikan Dan Kewirausahaan, 10(2), 392–402. https://doi.org/10.47668/pkwu.v10i2.385

Fauziah, N., Ichsan, I., & Irbah, A. N. (2022). Pengaruh Model Pembelajaran Steam Berbasis Loose Part Terhadap Kemandirian Anak Usia Dini. Jurnal PG-PAUD Trunojoyo: Jurnal Pendidikan Dan Pembelajaran Anak Usia Dini, 9(2), 18–27. https://doi.org/10.21107/pgpaudtrunojoyo.v9i2.14746

Kurniawati, M., Arkam, R., & Lestari, E. (2022). PENGARUH PENERAPAN STEAM TERHADAP PERKEMBANGAN KOGNITIF

Kamus Besar Bahasa Indonesia. app V1.1 Tahun 2015.

Marsi Singarimbun & Sofyan Efendi. (1999). Metode Penelitian dan Survey. Jakarta: LP3ES.

Nurwulan, N. R. (2020). Pengenalan Metode Pembelajaran STEAM Kepada Para Siswa Tingkat Sekolah Dasar Kelas 1 Sampai 3. Jurnal Madaniya, 1(3), 140–146.

Peraturan Menteri Pendidikan Dan Kebudayaan Republik Indonesia No. 146 Tahun 2014.

Salim, D., & Haidir, D. (2019). Penelitian Pendidikan: Metode, Pendekatan, dan Jenis. Jakarta: Kencana.

Suharsimi Arikunto. (2002). Prosedur Penelitian Suatu Pendekatan Praktek. Jakarta: Rineka Cipta.

Sugiyono. (2017). Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Sumanto MA. (1996). Metodologi Penelitian Sosial dan Pendidikan. Yogyakarta: Andi Offset.

Wahyuningsih, S. (2018). Modul 4: Cara Belajar Anak Usia Dini. Kemdikbud.

Waseso, H. P. (2018). Kurikulum 2013 Dalam Perspektif Teori Pembelajaran Konstruktivis. TA'LIM: Jurnal Studi Pendidikan Islam, 1(1), 59-72.

Zubaidah, S. (2019). STEAM (Science, Technology, Engineering, Art, Mathematics): Pembelajaran untuk Memberdayakan Keterampilan Abad Ke-21