



# STEAM For Early Children's Development Domains

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## ABSTRACT.

STEAM-based curriculum in early childhood can motivate children to conceptualize and explore as well as develop and use existing APE, hone knowledge or cognitive abilities, children's manipulative and affective development, and apply knowledge simply. This study examines the STEAM learning approach that can stimulate three domains of child development (the cognitive, affective, and psychomotor domains). This study uses a literature review method. In a conceptual review, the researcher aims to provide an overview of the literature in a particular field, including the main ideas, models and debates. The main questions in this study are: How does the STEAM Learning Approach Stimulate the domains of (1) Cognitive, (2) Affective, and (3) Psychomotor in Early Childhood. The results of the review, it was found that in the first stage, children begin to learn knowledge (cognitive domain), and high/low cognitive load levels will affect the psychomotor domain. In the psychomotor domain, a heavy cognitive load can have a negative impact on learning performance because individuals cannot handle the complexity and infinity of abundant information as input. In the affective domain, the experience of implementing successful STEAM activities in the second phase will increase positive attitudes and increase motivation towards continuous learning intentions.

**Keywords:** STEAM, PAUD, Early Childhood, Education

## 1. INTRODUCTION

Currently, the development of learning in PAUD is very rapid. Teachers begin to know that learning that must be given to early childhood is meaningful learning. Likewise with the government in Indonesia, which currently has provided a frame of reference in implementing learning at the PAUD level to facilitate children's freedom to learn and freedom to play. This independent learning curriculum was developed to anticipate learning loss in PAUD in current and future situations.

The curriculum is an important reference for the teaching and learning process at every level of education. The curriculum in PAUD consists of all the activities and experiences that early childhood participates in in parenting. The scope of physical/motor, social-emotional, cognitive development, religious moral values and the arts is the complete curriculum content and the curriculum is designed according to development [1]. As we all know

that changes in the government system are not uncommon, the curriculum planned by the government for the education process will also change. This is indeed good as an update for the education system which is always evolving with the times. Indeed, changes will also change the approach, learning and assessment systems in the curriculum.

In the structure of the PAUD curriculum, the essence of intracurricular learning activities is meaningful play as the embodiment of "Freedom of Learning-Freedom of Playing". In addition to Merdeka Learning, the Merdeka Curriculum at PAUD also emphasizes the formation of a Pancasila student profile which is carried out in the context of celebrating local traditions, national and international holidays.

Efforts to emphasize independent learning are based on various reasons. First, there are still academic learning practices in Kindergarten [2]. Of course this is contrary to the characteristics of children who still need a lot of playing

activities rather than academic learning activities. Second, the essence of the PAUD learning assessment has lost or changed its meaning. The concept of Independent Learning is to restore the national education system to conform to the essence of the law to provide responsible freedom (independence) to schools in interpreting the basic competencies of the curriculum into their assessment. The Minister of Education and Culture in his speech commemorating National Teacher's Day on November 25, 2019, said that the essence of Merdeka Learning is freedom in the sense of being free to innovate, free to learn independently and creatively for schools, teachers and students.[3].

The Merdeka Curriculum is an intracurricular learning planning document that optimizes content so that students have enough time and opportunity to explore concepts and strengthen competencies. In the independent curriculum, teachers have the flexibility to determine various learning tools so that learning can be in accordance with the learning needs and interests of students. Thus, the learning crisis that has occurred can be handled. We want to make schools a safe, inclusive and fun place to learn.

Actually, changes to the national curriculum in Indonesia will only occur in 2024. At that time, the Merdeka Curriculum had been through improvements for 3 years in various schools and regions. In 2024 there will be quite a number of schools in each region that have studied the Independent Curriculum and can later become learning partners for other schools. Seeing these conditions, it is very important for teachers to find effective learning references to realize the goal of independent learning in Early Childhood Education institutions.

Recently, the world of education, especially in kindergarten led by Nadzim Makrim Mendikbud, has initiated a learning model for early childhood, namely learning that contains STEAM (Science, Technology, Art, and Math) [4]. This is to answer the challenges of the world of education which currently cannot be separated from the world of science and technology. The application of a STEAM-based curriculum (Science, Technology, Engineering, Arts and Mathematics) provides many benefits for children, because the STEAM-based curriculum is part of a curriculum that develops children's creativity with an emphasis on collaboration, creativity, verbal and non-verbal communication, research, problem solving and critical thinking. Through this learning approach, children are not only strived to be smart in academic aspects but also social and emotional aspects [5]. Through the STEAM approach, of course, it is hoped that children can more easily understand the concepts presented and can implement them in everyday life and explore the potential that exists within themselves to the fullest.

STEAM-based curriculum in early childhood can motivate children to conceptualize and explore as well as develop and use existing APE, hone knowledge or cognitive abilities, develop manipulative and affective

children, and apply knowledge simply [6]. STEAM-based learning can train children to implement their knowledge as a form of problem solving related to the surrounding environment. The STEAM approach as part of the result of learning innovation that combines science and mathematics to direct students to have a logical and rational basis for thinking, while specifically in PAUD there is art that can accommodate the value of art in aspects of early childhood development which are important as well in diversity of learning according to the curriculum in PAUD [3].

The main concept in STEAM learning applies theory and practice together. STEAM is not only a learning method, but also a way of thinking. Through this approach, it is hoped that children will be able to solve problems with the various knowledge they have and cooperate fully, not only relying on the knowledge they have. Through STEAM learning, children will be better trained to quickly analyze problems with various approaches, be it science, technology, engineering, art or mathematics. In addition, children are also trained to think critically, innovatively, and creatively, and can express their opinions both orally and in writing[7].

Unfortunately, the knowledge of STEAM implementation in the PAUD curriculum is still not widely known by teachers. Especially the implementation of STEAM learning to stimulate children's development domains The results of interviews with 50 teachers in Yogyakarta showed that in implementing learning, teachers followed the national curriculum without being modified according to the needs of the institution. The teacher admitted that he did not have a construct to develop a curriculum in accordance with the institution's potential. This is of course worrying, considering that the needs of children in each region are of course different. Seeing the problems above, teachers need a construct in the development of learning that contains STEAM in accordance with the potential of the institutional environment. This construct can make it easier for teachers to develop school operational curricula. Through a clear construct, teachers can recognize the potential of their institutions and can modify the national curriculum according to the needs of children in their respective environments

## 2. METHOD

This study uses a literature review method. Conceptually, the researcher aims to provide an overview of the literature in the STEAM field, including the main ideas, models and debates on topics in the child development domain (Petticrew & Roberts, 2006). The main questions in this research are: How does the STEAM Learning Approach Stimulate (1) Cognitive, (2) Affective, and (3) Psychomotor in Early Childhood? The literature was selected from online sources of 30 articles, in the form

of scientific journal articles, both national and international, then reduced, adjusted to the needs of research questions. The sources identified were mostly published between 2019 and 2022; this timeframe was not specifically chosen by the researcher. Researchers used the publish or perish 8 applications by writing keywords: STEAM for cognitive development, STEAM for affective development and STEAM for psychomotor development.

### 3. RESULTS AND DISCUSSION

This study examines the STEAM learning approach that can stimulate three domains of child development, namely

the cognitive, affective, and psychomotor domains. Relevant studies that qualify for the review process are carefully vetted and summarized in the prescribed categories. References are evaluated for appropriateness and relevance based on predefined categories, such as STEAM, learning, developmental domains and early childhood education. Found 30 research articles that meet the requirements for review. The following are the results of several examples of articles that have been reviewed.

**TABLE 1.** Results for STEAM in Stimulating Children's Cognitive Domain

Author	year	Context	Data Collection	Play Finding
Tracey Hunter-Doniger To	2021	Germany and the Netherlands	Case (Observation) Study	creativity (a form of child cognitive development), autonomy, and play (CAP) are constant in the child-centered approach and rarely occur in isolation because there are continuous seamless interconnections that occur between themes. Deep and unexpected learning methods occur in the child-centered learning approach through CAP; similar practices are found in STEAM education [8].
Ona Monkeviciene, Birute Autukeviciene, Lina Kaminskiene, & Justinas Monkevicius	2020	Lithuania	Survey	There is a significant effect of implementing innovative STEAM education practices on the development of all children's competencies. The impact value on the development of cognitive and artistic competence is slightly higher, while the impact value on health and social competence is lower. Thus, a broad and integral impact on all child achievement can be assumed [9]
Ahmad Tabi'in	2019	Indonesia	qualitative descriptive	STEAM is changing the education system especially in the early childhood education system, it is still more focused on the cognitive aspect at first. This means that STEAM has been proven to have an influence on the cognitive aspects of early childhood. Later in this article it is hoped that using this method will change, because STEAM emphasizes the importance of hands-on practice, so students must show their determination, creativity, flexibility and cooperation [6].
Jung Hoon Choi & Book Kee Hwang	2017	Korea	Design concept	This STEAM education emphasizes convergent thinking in addition to integrated thinking. Through convergent thinking aims to foster creativity Talent which can create completely new things that are not which exists. And STEAM education also emphasizes the ability to create value through entrepreneurship by connecting with social systems and drawing empathy from society with design thinking and liberal arts. STEAM education is considered a world education leading education system outside of STEM education. And STEAM education is the most efficient methodology for driving the true scientists and engineers of tomorrow. However, it is not easy to develop excellent STEAM educational content because textbook developers are required to have broad knowledge and abilities to

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connect with each other in science, technology, engineering and the arts, as well as humanities and social sciences. To develop science, technology [10].

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STEAM for cognitive is no doubt. Experimental activities, simple science and the use of technology make children learn new things in interesting ways. Cognitive is often referred to as intelligence or thought processes. Cognitive development shows the development of a child's way of thinking. Intelligence can be measured through observing how children can solve problems. Along with getting older, children will continue to learn about new things until they become a standard of behavior for children[11]. One of the media that can be used to develop

cognitive is loose media[12]. Loose use of STEAM's part in early childhood cognitive development. First, the natural environment is an environment that is largely an important part of providing a play environment for children. Loose parts presented to early childhood will provide opportunities for children to explore with natural, synthetic, and recyclable materials. Loose sections can be an incentive to have meaningful conversations and encourage interaction between students.

**TABLE 2.** Results for STEAM in Stimulating Children's Affective Domain

Author	year	Context	Data Collection	Play Finding
Marja G. Bertrand, Immaculate K. Namukasa	2020	Canada	Case Study	The STEAM Program in this study teaches character building skills, such as "critical thinking and problem solving; collaboration and communication, creativity and innovation, that can be transferred to another context, such as in the home, in the school etc [13].
Chih-Hung Wu, Chih-Hsing Liu, and Yuch-Min Huang	2022	China	Survey	This study found that in ARCS and perceived usability, the influence of students' learning attention was mediated by learning attitudes. A similar observation was made regarding ARCS; that is, ARCS positively significantly influenced perceived usability and strengthened its effects on learning attitudes. Our research results supported ARCS learning, which reflects several critical characteristics of STEAM, including cross-domain and hands-on learning, life application, problem solving, and sense learning, and applied such concepts to an AI-based task [14].
Valeria M. Cabello & Solange Armijo	2021	Chile	a cross-sectional design (observation)	However, it is important to note Students are actively involved in STEAM-based learning. Students are enthusiastic about the process and at the time show off their products at the end of the lesson. The high level of involvement and cooperation of children found by this study is a strength of the program. Unfortunately, the short duration of the program has not shown any other examples of direct collaboration with parents. . This may be an aspect to strengthen to maintain the program's effect over time. Despite being a self-selected group, many of the children in the sample were not exposed to this experience at home, as reflected by their responses to the survey (e.g., disagreement with "I like talking about science with my family"). We consider that families' attitudes and experiences with science are important issues when designing interventions for the general school population. This may be an aspect that needs to be strengthened in order to maintain the program's effect over time. Despite being a self-selected group, many of the children in the sample were not exposed to this experience at home, as reflected by their responses to the survey (e.g., disagreement with "I like talking about science with my family"). We consider that families' attitudes and experiences with science are important issues when designing interventions for the general school population. This may be an aspect that

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F. Javier Perales & José Luis Aróstegui	2021	Spain		There is a tendency to link the humanities with science and technology as one of the keys to human development in accordance with the needs of society which cannot be based on economic justification alone. In the STEAM curriculum scientific and humanistic aspects have been integrated [16].

The affective domain is usually defined as the ability to prioritize feelings, emotions, and reactions that are different from reasoning. This domain is related to emotional aspects such as feelings, interests, attitudes and so on [17]. Positive experiences in activities that contain STEAM encourage students' interest in learning [18]. In the STEAM learning approach, children are accustomed to feeling natural phenomena that arise from the results of

their experiments. Aspects that are important to increase student engagement include: children's natural curiosity, encouragement of family education, and fun science, also play an important role in program implementation [19]. STEAM also teaches how to build good character in life such as enthusiasm, responsibility, discipline, cheerfulness, concentration and so on. So, the STEAM curriculum directly affects human behavior according to the needs of the world.

**TABLE 3.** Results for STEAM in Stimulating the Psychomotor Domain of Children

Author	year	Context	Data Collection	Play Finding
Zhang Mengmeng, Yang Xiantong, Wang Xinghua	2019	China	Literature Review	Implementation model of STEAM curriculum, and through the activities of the specific case to elaborate the process of its activities. Its purpose is to help novice teachers quickly master the basic process of implementing STEAM curricula, so as to improve teachers' ability to organize and design STEAM activities. On the other hand, the purpose of implement provide children with multiple ways to be creative and cooperation within the context of real-world experiences. The form of interdisciplinary integration can effectively cultivate children's approaches to learning which include curiosity, interest, initiative, persistence, attentiveness and creativity [20].
Wahyuningsih, S1, Nurjanah, N.E2, Rasmani, UEE3, Hafidah, R4, Pudyaningtyas, A.R5, Syamsuddin,	2020	Indonesia	Literature Review	STEAM learning is considered to integrate the skills needed by children. STEM encourages children to build knowledge about the world around them by observing, investigating and asking questions. The addition of 'Arts' (leading to the STEAM acronym), will give children the opportunity to describe the STEM concept in creative and imaginative ways. This review finds a definition for 'A' or 'Arts' in STEAM showing that the making of art and the creative process is overshadowed by the emphasis on the final result or product. The impact of this learning is that STEAM makes children more active and able to take initiatives with their own knowledge, and teachers who are influenced by the integrated professional development of STEM prompt children to be positively influenced by their teacher's professional learning. Another finding from this review is that experience of STEAM can increase self-confidence in children [12].

Areej ElSayary, Rana Zein, Lani San Antonio	2022	United Arab Emirates	Survey	Psychomotor can also be seen in the child's ability to interact with learning. One of them is by using interactive technology to develop their STEAM competencies, including critical thinking, collaboration, communication, creativity and innovation, self-direction, connection, and the effective use of interactive technology tools. The results of the study revealed a significant positive impact on the development of pre-service teacher STEAM competencies after using interactive technology [21].
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From the results of the review, it was found that in the first stage, children begin to learn knowledge (cognitive domain), and high/low cognitive load levels will affect the psychomotor domain. In the cognitive domain, cognitive development can be seen as the allocation of resources from the knowledge development process [22]. In the psychomotor domain, a heavy cognitive load can have a negative impact on learning performance because individuals cannot handle the complexity and infinity of abundant information as input [23]. In the affective domain, the experience of implementing successful STEAM activities in the second phase will increase positive attitudes and increase motivation towards continuous learning intentions.

#### 4. CONCLUSION

The data shows, STEAM-based learning does not only stimulate cognitive aspects, but also psychomotor and affective aspects. Behavior and attitude to be critical and enthusiastic finding out new things is emphasized in this study. STEAM-based learning is very far from a mythical approach that cannot be accounted for because of its origins and consequences. This is important for children to have from an early age, so that they do not receive information haphazardly, but are processed scientifically.

The emphasis of STEAM learning activities on learning-by-doing requires students to complete certain tasks that take longer to assimilate new things learned and apply them in daily life practices. Therefore, affective factors such as attitudes or motivation to increase students' patience in order to successfully complete learning tasks need to be clarified. In the psychomotor domain, learning objectives focus on behavior change and skill development. Skills indicate the ability to manipulate physical or instrumentation to complete a particular task. We believe that psychomotor domain assessment, such as adoption of STEAM activities, also plays an important role in continuing learning intentions in STEAM education.

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