APPLYING STEAM EDUCATION TO THE EARLY CHILDHOOD EDUCATION PROGRAM IN VIETNAM IN THE CURRENT PERIOD

Vu Thi Ha¹, Nguyen Thi Luyen*¹, Bui Minh Hai² and Dang Ut Phuong³
¹Faculty of Early Childhood Education, National College for Education
²Department of Education Quality Assurance, National College for Education
³Faculty of Education, Hanoi Metropolitan University

Abstract: The article provides an overview of STEAM education in early childhood education in Vietnam in recent years and proposes some effective approaches and methods to apply STEAM to the ECE (Early Childhood Education) program. The content includes (1) The theoretical issues of STEAM education in ECE, analyzing the concepts of S, T, E, A, M; (2) The characteristics of the current ECE program in Vietnam; (3) The existing problems of STEAM education in ECE institutions; (4) Proposing some forms of STEAM education, including the Engineering Design Process (EDP), the 5E teaching model (Engage, Explore, Explain, Elaborate, Evaluate), and the implementation of STEAM projects. For each form, the article analyzes the purpose of each stage and provides guidance on how to implement them for preschool children.

Keywords: Early Childhood Education Program, STEAM Education, Application.

1. Introduction

In recent years, the concept of STEM/STEAM education has become increasingly familiar in the field of education. In secondary schools, STEM is accessed quite early and strongly applied through the 2018 education program [1], [2], [3]. For preschool education in Vietnam, STEAM education is also a new and promising direction, promoting the development of necessary skills for children's future success, “a solution for the quality of preschool education” [4]. Since 2018, STEAM education in preschool has gradually attracted the attention and research of scientists with directions related to training and enhancing STEAM education capacity for preschool teachers in central provinces, Hanoi [5], [6]; the awareness of preschool teachers about STEAM education in major cities like Hanoi, Ho Chi Minh City, and in central provinces [7], [8], [9]; [10]; and the organization of STEAM education activities for preschool children [11], [12], [13], [14], [15]; Studies on STEAM education in the training program for preschool teachers [16], [17] have been conducted. However, domestic studies on the application of STEAM education in preschool education are still limited and have created many unclear debates. Therefore, in this study, we will clarify the concept, re-examine the current situation of applying STEAM education in preschool education, and propose some forms of applying STEAM education in the current preschool education curriculum.
2. Content

2.1. Overview of STEAM Education in Preschool Education

STEM is an abbreviation consisting of the first letters of four English words: Science, Technology, Engineering, and Math. STEM was born in the United States in the late 20th century and is closely associated with the third technological revolution, aiming to promote the development of human resources related to the fields of science, technology, and engineering. When applied to education, STEM becomes an educational orientation that has been recognized in many countries and has rapidly developed in all levels of education, including preschool education. For preschool education, STEM education is combined with an artistic element (Art) when in 2008, Yakman emphasized the integration of artistic and humanistic factors into STEM [18]. The concept of STEAM education was born and widely used in preschool education activities based on the previous STEM education concept. The STEAM educational elements for preschool children can be understood as follows:

S/Science: These are selected knowledge about the world around us that is suitable for the child's cognitive characteristics, helping them to understand the objective laws of the world. The concept of science in STEAM education also includes the formation of scientific thinking, working skills, and problem-solving abilities for children. It is curiosity, thirst for knowledge, interest in observation, asking questions, and finding answers to those questions [8], [4], [19].

T/Technology: Technology is hidden in all the products/tools that humans make and use. Teaching children about technology helps them develop skills to use toys, tools, and equipment correctly and efficiently to serve the process of exploring, learning, and solving problems in life [20], [19], [21].

E/Engineering: There are two approaches to engineering. The first approach focuses on developing children's fine motor skills to cut, mold, tear, and create a product. The second approach emphasizes the process of applying scientific knowledge to design, manufacture, or construct a product [22], [23], [24], [25]. STEAM education activities emphasize the technical aspect, helping children develop problem-solving skills, and creating products through a scientific process with stages such as asking, imagining, planning, designing, creating, and improving. STEAM education aims to gradually develop children's habit of working with a plan.

M/Math: Math includes simple symbols about shape, size, and counting... The mathematical factor in STEAM is understood as children's ability to use mathematical symbols and thinking skills to solve problems in cognition and reality.

A/Art: Art includes elements related to beauty, culture, humanity, creativity... Incorporating art into STEM activities is especially meaningful for preschool children because art and creative arts are of the important contents of aesthetic education in the current Vietnamese preschool education program.

These fields are not mechanically combined but integrated, embedded, and complemented with each other to form a unified body with interrelated relationships throughout. In essence, STEAM education organizes learning activities for students to acquire knowledge and skills by mobilizing knowledge from the fields of science, technology, engineering, art, and mathematics into experiential activities related to practical issues. Through this, students can apply what they have learned to real-life situations.

Therefore, STEAM education is an educational model based on an approach that links knowledge from the fields of science, technology, engineering, mathematics, and art into experiential learning activities related to practical issues. Children learn scientific, technological, engineering, mathematical, and artistic knowledge through experiential and applied activities.

The main purpose of STEAM education is not to create excellent students in science and mathematics or young scientists but to equip children with the ability to think, discover problems,
Applying STEAM education to the early childhood education program in Vietnam in the current period

and solve problems like scientists. It also equips them with the ability to use knowledge from different fields to solve practical problems and adapt to the 4th technological revolution with basic qualities such as critical thinking, communication skills, collaboration, and creativity.

2.2. Vietnam's Early Childhood Education Program

Circular No. 01/VBHN-BGDDT issued on April 13, 2021, on Vietnam's Early Childhood Education Program aims to promote the comprehensive development of children, building towards a unified direction, development, and organization of activities based on the perspective of putting children at the center [26]. The program is designed as a framework program, providing a general direction for goals, expected outcomes, and requirements for basic and core content, and is flexible and adaptable, allowing specific early childhood education institutions to tailor content to the abilities, and needs of the children and cultural characteristics of the region. Based on the content of the framework program, groups of classes, and schools have the right to determine the goals and educational content that are suitable for their educational perspective and practical conditions. This characteristic of Vietnam's Early Childhood Education Program currently allows schools to flexibly apply different educational methods and perspectives, including STEAM education into their school curriculum, “ensuring that children have the opportunity to enjoy quality education and good development” [4].

2.3. Some notes on the current state of awareness among preschool teachers about STEAM education and the application of STEAM education in the Vietnamese preschool education program.

It is undeniable that the rate of application of STEAM education in preschool education institutions as well as the scope of impact of this educational approach [7]; [5]; [13], [6]. However, in practice, there are still some issues with applying STEAM education in activities for young children in preschool education institutions. We surveyed with 450 questionnaires sent to preschool teachers in three regions: the North, Central, and South of Vietnam. In each region, 75 questionnaires were randomly selected for 75 rural and 75 urban preschool teachers. The approach to the preschool teachers was through the Education and Training Department of the localities. Two topics were identified to ask preschool teachers: (1) The level of understanding of the application forms (5E Model; EDP Cycle; STEAM Project) of STEAM education in preschool teaching and (2) Barriers to implementing STEAM education in preschools (Facilities; Human resources; Teaching topics; Teaching organization procedures). In each question of both topics, there were 10 questions to evaluate the level of understanding and the level of barriers when applying STEAM education in preschool teaching. 428 questionnaires were collected and correspondingly evaluated on the 5 levels of the Likert scale. The score for each questionnaire was converted to a scale of 5 as follows:

- Scores from 1.00 - 1.79: “No knowledge” or “No barrier”
- Scores from 1.80 - 2.59: “Little knowledge” or “Few barriers”
- Scores from 2.60 - 3.39: “Partial knowledge” or “Some barriers”
- Scores from 3.40 - 4.19: “Basic knowledge” or “Many barriers”
- Scores from 4.20 - 5.00: “In-depth knowledge” or “Very large barriers”

The survey results are presented in Tables 1 and 2.

In Table 1, it can be seen that the percentage of teachers who have a deep understanding of the STEAM project is the lowest (2.10%), while the percentage of teachers who have a partial understanding of the 5E model is the highest (57.94%). Overall, the percentages of teachers who have a deep understanding and basic understanding of the three forms of STEAM education are the lowest. However, these are the two levels of understanding that can be mastered in applying the models/cycles in teaching. Meanwhile, the percentage of teachers who have a partial
understanding and little understanding is the highest. Teachers cannot confidently apply their knowledge in teaching with these two levels of understanding.

**Table 1. The level of understanding of the use of STEAM education forms in preschool teaching**

<table>
<thead>
<tr>
<th>No.</th>
<th>Forms of applying STEAM education in preschool education</th>
<th>Percentage of knowledge level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deep understanding</td>
<td>Basic understanding</td>
</tr>
<tr>
<td>1</td>
<td>EDP cycle</td>
<td>6.07</td>
</tr>
<tr>
<td>2</td>
<td>5E model</td>
<td>2.80</td>
</tr>
<tr>
<td>3</td>
<td>STEAM project</td>
<td>2.10</td>
</tr>
</tbody>
</table>

**Table 2. Some barriers when implementing STEAM education in preschools**

<table>
<thead>
<tr>
<th>No.</th>
<th>Types of barriers</th>
<th>Percentage of barrier levels (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Significant barriers</td>
<td>Many barriers</td>
</tr>
<tr>
<td>1</td>
<td>Infrastructure (tools, equipment, teaching materials, space, ...)</td>
<td>11.45</td>
</tr>
<tr>
<td>2</td>
<td>Human resources (teachers)</td>
<td>38.32</td>
</tr>
<tr>
<td>3</td>
<td>Teaching topics</td>
<td>20.79</td>
</tr>
<tr>
<td>4</td>
<td>Teaching organization process</td>
<td>17.29</td>
</tr>
</tbody>
</table>

The data presented in Table 2 shows that, in terms of human resources, the 'Very high barriers' (38.32%) and 'Many barriers' (30.37%) have the highest percentages in the two columns of these barriers. This indicates the importance and impact of well-trained preschool teachers with teaching competency in STEAM. Ranked second in the 'Very high barriers' and 'Many barriers' categories are the 'Choice of teaching topics' (20.79%) and 'Teaching organization process' (19.39%).

It can be said that to effectively apply STEAM education in teaching, preschool teachers need to be trained with the fundamental knowledge and equipped with the necessary skills to carry out appropriate activities. These survey results and assessments are consistent with the findings of other research groups [5], [27].

In another study on the awareness of preschool teachers in STEAM education for preschool children [7], [5], [8], [9], [10], [6], it was noted that preschool teachers still do not have a comprehensive and clear understanding of STEAM education for preschool children. They still choose based on their understanding when they have heard about STEAM education from somewhere. There is a need for basic and in-depth training courses for preschool teachers in
STEAM education at the preschool level, standardized reference materials on STEAM education, and specific steps in a STEAM activity design and organization for children.

2.4. Some procedures used in STEAM education for preschool children

Based on some limitations mentioned in section 2.3, the article proposes some STEAM education procedures for preschool children as follows, implementing the early childhood education program as follows.

2.4.1. STEAM education according to the Engineering Design Process (EDP)

The engineering design process is a series of steps that engineers use to guide the development of products that serve human life. This process is iterative, meaning that it will be repeated many times and failure is part of it [28], [29], [30]. At the preschool level, the engineering design cycle is the working process of children, which is a process in which children/groups of children sequence activities to solve a problem, or task during the learning process, especially the activity of creating products. For children at this age and early elementary school, the engineering design cycle is often carried out in the following 5 steps [31]:

Ask
Imagine
Plan
Create
Improve

Ask In this step, the teacher needs to use different forms to create a situation with a problem to help children recognize the problem, the task that needs to be solved; and the criteria that the product/innovation needs to achieve.

Imagine The teacher guides the children to think, and imagine in their heads the product they will create, discuss, exchange, and propose ideas to solve the task mentioned earlier and choose the optimal solution for the product/innovation.

Plan In this stage, depending on the children's abilities, the teacher guides the children to start the process of diagramming ideas by designing drawings, diagrams for the product/innovation to be created (shape, color, structural characteristics…); Choosing materials that meet the requirements of the product, suitable for the design purpose; Choose the way to manufacture the product.

Create Based on the previous design, the children create the product/innovation. In the process of creating the product, children can adjust the initial design to make the product better, more suitable for the criteria and design purposes. After completing the product, the children conduct tests to evaluate the level of product responsiveness to the criteria set.

Improve Children are allowed to change and improve the product many times according to their needs and abilities.

2.4.2. The 5E teaching process in education

The 5E teaching process is an abbreviation for 5 words in English: Engage, Explore, Explain, Elaborate, and Evaluate. The 5E process is based on the cognitive constructivism theory of the learning process, in which children construct new knowledge based on prior knowledge or experiences [32], [24].

Engage: The purpose of this step is to help children become enthusiastic about exploring the content of the lesson, stimulate curiosity, and attention, create a desire to learn about the lesson content, and help children connect with prior knowledge or experiences. Activities that teachers can use to engage children include observing objects or phenomena in the environment, watching videos, telling stories, and using problem situations.
Explore: In this step, children directly and actively collect knowledge and skills through various rich and diverse experiential activities under the guidance of the teacher. Teachers can engage children in activities such as observing, conducting experiments, testing, and reading books. The results of the information-gathering process are recorded by children using symbols, models, diagrams, etc.

Explain: After exploring and experiencing directly, children are supported by the teacher to summarize new knowledge and clarify the concepts being learned. Teachers allow children to present, describe, or analyze the experiences gathered in the exploration step through words and visual representations.

Elaborate: This stage focuses on creating opportunities for children to apply what they have learned to solve tasks. Teachers allow children to practice and apply the knowledge they have learned in the Explore and Explain steps, helping children deepen their knowledge and develop their skills by applying their understanding to real-life situations. With such an application to verify knowledge, children's knowledge and skills become more solid and profound.

Evaluate: The evaluation activity is carried out throughout the process of children performing the stages of the 5E lesson and is carried out by both teachers and children.

2.4.3. Project STEAM organization

In some well-equipped schools, it is possible to design STEAM education projects for children to experience. A high-quality STEAM education project, besides ensuring integration, also needs to design a rich operating environment that helps children have the opportunity to experience, master, and deeply research a practical issue (the project's name). STEAM education projects are usually organized through three stages:

Opening the project: Teachers carry out project opening activities to attract the attention and stimulate the interest of children in the project, learn about children's experience with the project, and identify the content that most children do not know, are interested in, and want to learn. From there, a content network is established for the project.

Project deployment: During the project deployment phase, teachers organize a variety of planned activities for children to participate in such as learning activities, play activities, leisure activities, visits, labor activities, association activities, and festivals. These activities aim to solve the content network that the teacher and children identified earlier. In this stage, teachers need to create maximum conditions for children to participate in activities, experience, search for information, and create project products.

Project completion: Teachers should end the project when children's interest has decreased, they show interest and excitement about new issues, and their exploratory activities related to the project have ceased. Teachers help children write invitation letters to invite their parents, guests, and friends to attend the closing ceremony to see the children demonstrate their understanding of the project.

When closing the project, teachers create opportunities for children to share and summarize what they have discovered and learned about the project with their teacher, friends, and guests through different ways such as displaying products (paintings, models, charts, videos...), presenting the products they created, reading poems, telling stories, singing, dancing, performing dramas, and fashion shows. This leaves a deep impression on the children about the project, creates self-confidence and pride in the children's abilities, and stimulates their curiosity and interest in exploring and discovering the next projects.

In addition to the aforementioned procedures, preschool teachers can completely use other procedures such as the 3E, 6E, 7E, TRIAL, inquiry, problem-solving... What is important is that in that educational activity, children are placed at the center of the education process, given opportunities to practice, experience, and relate to situations that are meaningful in their lives.
2.5. Application of STEAM education in preschool education program

The application of STEAM education in preschool education programs can be classified in many ways, based on the activities of children in the preschool education program. STEAM education can be applied in the form of learning activities, play activities, and club activities. In the form of learning activities, the emphasis is on science exploration (applying the 5E, 6E process) and integrating technology/engineering/art/mathematics based on the natural logic of solving practical problems, ensuring that children learn through specific situations and have many opportunities for positive experiences [4], [32], [13].

In the form of play activities, children like to play, and they usually play naturally anywhere with any game. STEM-designed games can help children learn scientific and technical concepts in a fun way. In a study by Nagel et al. (2020), it was demonstrated that the use of electronic games helps to enhance STEM skills and improve social interaction in preschool children. Children often ask questions about the world around them, such as “Why are there tornadoes in bottles?” “How do you create a rainbow?” “How do leaves breathe?” and “How does a boat run by itself?” These questions suggest play ideas, and children play to find answers in games. When designing STEAM education games, teachers need to ensure the following core features: STEAM games need to be designed to match children's interests, knowledge, and abilities; STEAM games must always create challenges to stimulate children's thinking and apply STEAM knowledge to solve situations that arise in the game, thereby helping children understand the significance of applying STEAM knowledge to life and promoting good learning of these subjects [34], [35].

During the play process, to solve arising situations, children need to combine skills in science, technology, engineering, art, and mathematics to observe, compare, analyze data, and find answers. Initially, children may encounter difficulties in applying STEAM knowledge to the game, but as STEAM games always create challenges, children are easily drawn into the game and play actively, enthusiastically, and wholeheartedly. Under the guidance of teachers, after just a few games, children will grasp how to play and can apply interdisciplinary STEAM knowledge to the game. The result of STEAM games is often new, beautiful, and attractive products, which encourage children to play more actively. STEAM games put children at the center and the more actively they play, the more they learn STEAM skills. STEAM games put children at the center and require them to actively apply STEAM knowledge and skills to solve complex problems. By focusing on the problem-solving process, children are encouraged to explore and research various aspects of the world around them, helping them develop logical thinking, analysis, and creativity skills and feel confident in solving difficult problems. In addition, STEAM games also help children develop social skills, such as teamwork, communication, respecting others' opinions, and developing a sense of self-discipline and responsibility.

Application of STEAM education in the form of a club: In the process of organizing STEAM club activities, teachers can follow the following steps:

**Step 1: Plan and prepare resources**

Teachers need to develop a detailed plan for the STEAM club activities. This plan should include specific activities, timeframes, locations, necessary resources, and materials. At the same time, teachers need to ensure safety and comply with safety regulations during the activities.

**Step 2: Introduce STEAM to children**

Before starting the STEAM activities, teachers need to introduce STEAM to the children. Teachers can use visual aids such as pictures, videos, or simple demonstrations to introduce the STEAM fields. This helps children to understand more about STEAM and develop curiosity in activities related to STEAM.

**Step 3: Implement STEAM activities**
After introducing STEAM, teachers can start implementing STEAM activities for the children. These activities can be designed to encourage creativity, logical thinking, learning from mistakes, and developing soft skills such as collaboration, communication, problem-solving, and teamwork.

3. Conclusion

In summary, integrating STEAM into early childhood education programs has become an essential requirement for education in the 4.0 era. Depending on their conditions, early childhood education institutions can flexibly and effectively apply some of the STEAM education forms mentioned above, which are suitable for the actual situation of each school, including the conditions of facilities, the teaching staff, and the needs and abilities of children at each age, avoiding rigid and obstructive forms that hinder the development of children.

REFERENCES


