

Report on Training and Professional Development Competency STEAM Educational for Early Childhood Education Students Faculty of Pedagogy Thu Dau Mot University

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ABSTRACT: The growing adoption of STEAM education in early childhood education has highlighted the need to prepare pre-service teachers with interdisciplinary competencies required to design and implement integrated learning experiences. However, Vietnam has not yet established a comprehensive competency framework specifically for STEAM education in early childhood teacher preparation. This study aimed to develop a STEAM education competency framework for pre-service early childhood teachers and to report its implementation within the Early Childhood Education program at the Faculty of Education, Thu Dau Mot University. The study employed a qualitative approach based on document analysis, synthesis of international and national competency frameworks, and analysis of institutional implementation practices. The proposed framework consists of three core competency domains: cognitive competence, instructional competence, and affective competence, encompassing the essential knowledge, skills, and professional dispositions required for organizing STEAM educational activities. The study also documents the implementation of STEAM-oriented curriculum development, lecturer professional development, practical training activities, and institutional support mechanisms. Findings indicate that the competency-based training approach has created favorable conditions for enhancing students' professional readiness, interdisciplinary thinking, and confidence in implementing STEAM education. At the same time, challenges remain regarding facilities, instructional resources, interdisciplinary expertise, and continuous professional development. The study contributes a contextually appropriate competency framework that can support curriculum development, teacher education, and professional development for early childhood education in Vietnam while providing practical implications for institutions seeking to strengthen STEAM teacher preparation.

KEYWORDS: Competency, STEAM education, students, early childhood education (ECE).

I. INTRODUCTION

STEAM (Science, Technology, Engineering, Arts, and Mathematics) education has emerged as one of the most influential interdisciplinary approaches for preparing learners with the competencies required in the twenty-first century. While the initial development of STEAM focused primarily on primary and secondary education, increasing attention has recently been directed toward its application in early childhood education (ECE). Researchers argue that early childhood represents a critical period for cultivating curiosity, creativity, inquiry, problem-solving, and collaborative learning, making it an ideal stage for implementing integrated STEAM experiences (Monkevičienė et al., 2020; Țifrea, 2025).

Unlike traditional subject-based instruction, STEAM education in early childhood emphasizes integrated learning through authentic experiences in which science, mathematics, technology, engineering, and the arts are interconnected within meaningful contexts. Rather than teaching disciplinary knowledge separately, children are encouraged to explore real-world problems, design creative solutions, construct artifacts, communicate ideas, and reflect on their learning. This integrated approach aligns closely with constructivist and play-based learning theories, which recognize young children as active constructors of knowledge through exploration, experimentation, and social interaction (Țifrea, 2025). Consequently, STEAM education has been increasingly regarded as an effective pedagogical approach for promoting holistic child development instead of merely enhancing academic achievement.

Growing empirical evidence demonstrates the educational benefits of STEAM implementation in early childhood settings. Monkevičienė et al. (2020) reported that innovative STEAM practices significantly improved children's scientific inquiry, creativity, communication, collaboration, and problem-solving competencies while simultaneously enhancing teachers'

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professional development. Similarly, Silva-Hormazábal and Alsina (2023) found that integrated STEAM experiences positively influenced teachers' instructional practices by encouraging interdisciplinary lesson design, active learning strategies, and reflective teaching. Their findings suggest that the effectiveness of STEAM depends not only on curriculum design but also on teachers' capacity to facilitate inquiry-based learning environments that integrate multiple disciplines meaningfully.

Recent studies have therefore shifted attention from evaluating student outcomes toward examining teacher competence as the key determinant of successful STEAM implementation. Spyropoulou and Kameas (2023) argued that the complexity of interdisciplinary teaching requires educators to possess competencies beyond traditional pedagogical knowledge. To address this need, they developed the STEAMComp Edu framework, which identifies 41 competencies organized into 14 competence areas across five professional perspectives: educator, learning designer, facilitator and manager, community member, and professional learner. Unlike previous frameworks focusing primarily on technological or pedagogical knowledge, STEAMComp Edu conceptualizes STEAM teaching as an integrated professional competence involving curriculum design, interdisciplinary collaboration, digital competence, classroom facilitation, assessment, and continuous professional development. The framework has become one of the most comprehensive references for teacher education and professional learning in STEAM education.

Within the context of early childhood education, teacher competence has become an increasingly important research focus. Empirical evidence from Vietnam indicates that pre-service early childhood teachers generally recognize the importance of STEAM education but demonstrate only moderate levels of competence in organizing integrated STEAM learning activities (Cherkas Global University, 2023). The study identified notable limitations in designing interdisciplinary learning experiences, selecting appropriate materials, integrating artistic elements, and assessing children's learning outcomes. These findings suggest that although STEAM has gained considerable attention in teacher education programs, significant gaps remain between theoretical understanding and practical implementation.

Responding to this challenge, Anh (2024) proposed a competency framework specifically designed for early childhood education students in Vietnam. The framework emphasizes the competencies required to organize STEAM educational activities, including curriculum planning, learning environment design, implementation of integrated learning activities, assessment of children's development, reflective practice, and professional collaboration. Compared with broader international frameworks such as STEAMComp Edu, this framework contextualizes competency development within Vietnamese teacher education while maintaining alignment with international perspectives on interdisciplinary teaching. Its development reflects the growing recognition that teacher preparation programs should systematically cultivate STEAM-specific competencies before graduates enter professional practice.

In addition to competence frameworks, recent qualitative research has highlighted the importance of teachers' beliefs and perceptions in determining the successful adoption of STEAM education. Munyif (2025) found that early childhood educators generally held positive attitudes toward STEAM because it encourages creativity, exploration, and active learning. However, participants also reported numerous implementation barriers, including insufficient professional training, limited instructional resources, inadequate institutional support, and uncertainty regarding interdisciplinary curriculum design. Similar challenges have been reported across different educational systems, suggesting that successful STEAM implementation requires comprehensive support extending beyond individual teacher motivation.

The pedagogical foundations of STEAM have also been examined extensively in recent literature. According to Țifrea (2025), effective STEAM education in early childhood should be grounded in child-centered, inquiry-based, experiential, and play-oriented pedagogies. These approaches encourage children to investigate authentic problems, collaborate with peers, experiment with materials, and express ideas creatively through multiple representations. Rather than emphasizing content acquisition, STEAM learning environments should foster curiosity, creativity, critical thinking, communication, and socio-emotional development simultaneously. Such pedagogical principles align closely with contemporary theories of early childhood education that emphasize integrated competency development through meaningful experiences.

Despite the expanding body of literature, several research gaps remain. First, although numerous studies have confirmed the educational value of STEAM, much of the existing research has concentrated on evaluating children's learning outcomes rather than systematically identifying the professional competencies required for teachers to organize high-quality STEAM activities. Second, while comprehensive competency frameworks such as STEAMComp Edu have been proposed internationally, relatively few studies have adapted or validated these frameworks within specific national contexts, particularly in developing countries. Third, research focusing on pre-service early childhood teachers remains limited, despite the importance of preparing future educators before they enter professional practice. Furthermore, empirical evidence regarding competency assessment, competency standards, and competency-based teacher education in STEAM remains insufficient.

Collectively, previous studies indicate that teacher competence constitutes the cornerstone of effective STEAM implementation in early childhood education. Developing a comprehensive competency framework that reflects both international perspectives and

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local educational contexts therefore represents a critical step toward improving teacher preparation, supporting professional development, and ultimately enhancing the quality of STEAM education for young children.

Resolution No. 29/NQ-TW of the Central Committee of the 11th Party Congress on fundamental and comprehensive reform of education and training to meet the requirements of industrialization and modernization in the context of a socialist-oriented market economy and international integration affirmed: “Developing the teaching staff and management staff to meet the requirements of educational reform. Building plans and training programs for the teaching staff and education management staff in line with the needs of socio-economic development, ensuring national security and defense, and international integration. Standardizing the teaching staff according to each educational level and training qualification...” Central committee of the party, 2013). Strongly reforming the objectives, content, methods of training, retraining, professional development, and evaluation of the learning and training results of teachers according to the requirements of improving quality, responsibility, ethics, and professional competence...” (Ministry of Education and Training, 2018a).

Currently, Vietnam does not have a competency framework for preschool teachers, but the Ministry of Education and Training has issued Circular No. 26/2018/TT-BGDĐT stipulating the professional standards for preschool teachers with 5 required professional standards at different levels and evaluating preschool teachers according to these standards. In the context of current globalization, training a team of preschool teachers with the qualities and competencies to meet the requirements of innovation in the education sector is an inevitable trend to improve the quality of preschool education (Ministry of Education and Training, 2018b).

Therefore, defining a STEAM education competency framework for preschool education students and implementing training and professional development will help learners become confident and proactive in their studies, especially in adapting to the requirements of educational innovation and the development of modern society.

II. THEORETICAL BASIS

“STEM education is an interdisciplinary approach to teaching science, technology, engineering, and mathematics. STEM teaching integrates concepts from two or more STEM fields, helping students develop scientific and technological practices aimed at solving real-life problems.” (Weld, 2017)

According to Huynh Lam Anh Chuong et al, “Competence is a combination of attributes of an individual, whether existing or acquired, that demonstrate the ability to perform and meet the requirements of a specific activity, ensuring that the activity is carried out effectively.” Based on research into the perspectives on competence, we believe that: Competence is the ability to perform a task effectively and responsibly in a given context by mobilizing all understanding, knowledge, and skills with a ready attitude (Huynh et al, 2023).

Based on the above concepts of competence and STEAM education, we define: STEAM educational competence is the ability of an educator to harmoniously apply a combination of knowledge and skills from two or more fields of science, technology, engineering, mathematics, and art, meeting the requirements of STEAM educational activities to ensure effective implementation and flexible application in various work situations to create products. STEAM competence includes: specialized knowledge, organizational skills, and professional qualities (Dang, 2012; Nguyen, 2014).

III. RESULTS AND DISCUSSION

The work of building output standards for STEAM education competencies for students

Through research, in our opinion, to determine the STEAM competency framework for early childhood education students today, we rely on a number of competencies of early childhood teachers in and outside the country. The following are the common frameworks:

(1) Based on the Southeast Asian Early Childhood Teacher Competency Framework

The Southeast Asian Early Childhood Teacher Competency Framework includes 7 core competencies corresponding to 72 supporting competencies for early childhood teachers. This competency framework is divided into 4 groups (UNESCO Bangkok & SEAMEO, 2018)

- Framework 1: Knowledge of teaching content, pedagogical practice and assessment of early childhood teachers
- Framework 2: Learning environment group
- Framework 3: Participation and cooperation
- Framework 4: Professional development

The competency framework has also considered Aspects include (1) National context, encompassing socio-economic and political context and cultural values and norms; (2) National policies related to early childhood education; and (3) Resources supporting early childhood education, including state, private, and other partner resources.

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(2) Based on the STEM competency structure of AP Carnevale, M. Melton, N. Smith (USA, 2011):

According to AP Carnevale, M. Melton, and N. Smith, STEM competency is defined as a set of fundamental cognitive and non-cognitive competencies related to STEM occupations (Carnevale, Smith & Melton, 2011, p. 99). The components of STEM competency, according to the proposed structure in (Carnevale, Smith & Melton, 2011, p. 8) STEM: Science Technology Engineering Mathematics. Executive Summary. Center for Education and Workforce, Georgetown University (USA), 2011 (Figure 1):

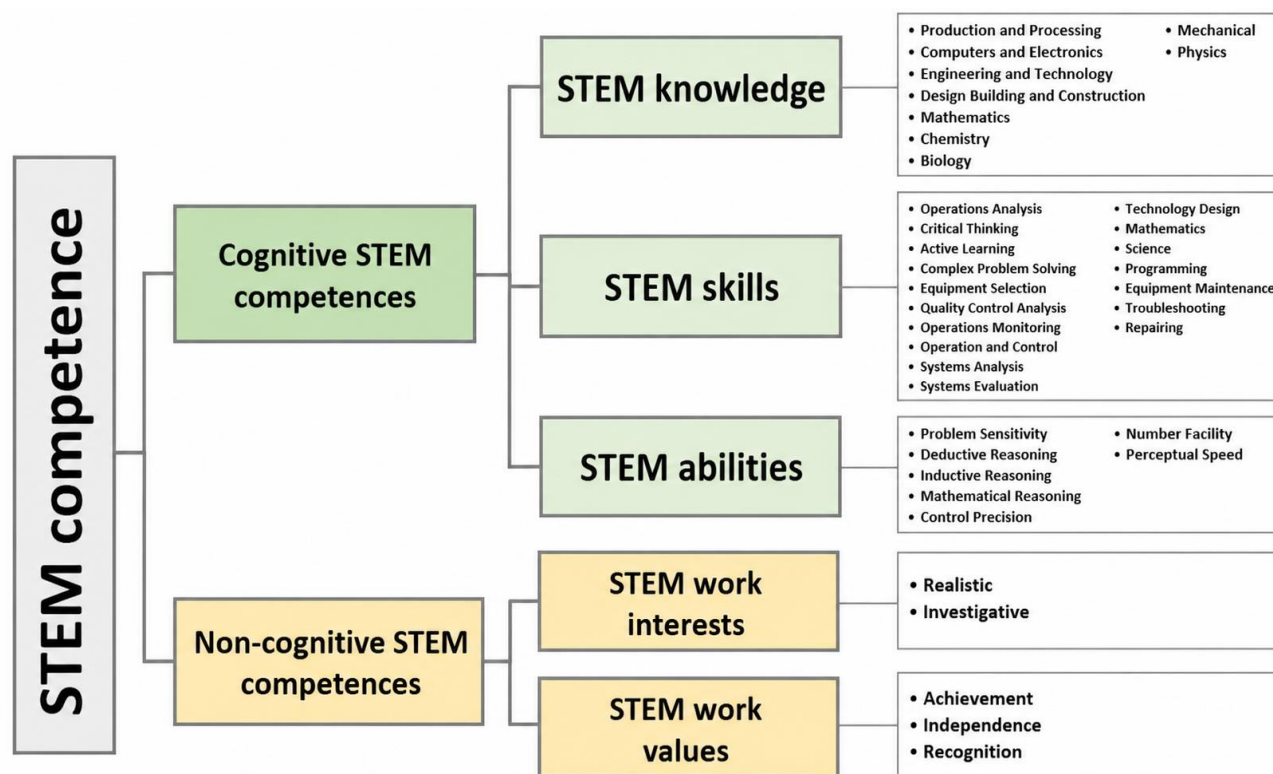


Figure 1. STEM competency structure: Science, Technology, Engineering, and Mathematics (Source based on AP Carnevale, M. Melton, N. Smith (USA, 2011))

(3) Based on the Professional Standards for Preschool Teachers

According to Circular 20/2018/TT-BGDĐT, the professional standards for teachers in general education institutions include standards related to professional competence, which are ((Ministry of Education and Training, 2018a):

Standard “Professional Development”

Standard “Building an Educational Environment”

Standard “Developing Relationships between School, Family and Society”

Standard “Using Foreign Languages or Ethnic Languages, Applying

Information Technology, Exploiting and Using Technological Equipment in Teaching and Education”. The purpose of issuing professional standards for teachers is to serve as a basis for evaluating and classifying teachers at the end of the school year, and also as a basis for building teacher training programs in each stage, and at the same time as important bases for teacher training schools to build a professional competence framework in training students in teacher training faculties.

Building a STEAM Education Competency Framework for Early Childhood Education Students at the Faculty of Education, Thu Dau Mot University

Competency structure is the integration of knowledge, skills, and attitudes. Typical of this approach, author Dang Thanh Hung (2012) argues that competencies have a complex structure, but their basic components only include knowledge, skills, and expressive behavior (attitude) (Dang, 2012).

Following the research approach based on component competencies, author Nguyen Thu Ha (2014) argues that competency structure consists of three main parts: components, elements, and behavior. In which, components are competencies in the professional field; elements are the sub-competencies that make up the components; and behavior is the part separated from the elements (Nguyen, 2014).

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Based on GVMN's professional standards and the departmental competency framework structure, we have developed a STEAM competency framework for early childhood education students, comprising three component competencies, from Competency 1 to Competency 3, specifically as follows:

Competency 1: Cognitive Characteristics:

- Clearly understand the nature and goals of STEAM education, especially in relation to the developmental characteristics of preschool children.
- Master the basic knowledge of the fields within STEAM and be able to integrate this content into children's play and learning activities.
- Ability to make connections and integrate interdisciplinary subjects, for example: combining storytelling (art), measurement (mathematics), and simple experiments (science).
- Ability to apply STEAM education design methods and processes such as: the 5E process, Engineering Design Process (EDP)

Competency 2: Instructional Skills

- Skills in planning STEAM educational activities for preschool children: Designing creative, engaging, and age-appropriate STEAM integrated learning activities.
- Skills in creating an environment for STEAM educational activities.
- Skills in implementing STEAM educational activity plans: Organizing flexible classrooms, encouraging children to explore, ask questions, and experiment.
- Skills in using technology in STEAM educational activities: Using appropriate technology (e.g., projectors, simple robots, learning applications) in the classroom.
- Skills in designing assessment tools and conducting assessments in STEAM educational activities: Assessing children's holistic development through STEAM activities instead of just through tests.

Competency 3: Affective Characteristics:

- Passionate about teaching, patient, and confident in the abilities of young children.
- Always open to learning and willing to innovate teaching methods.
- Collaborates effectively with colleagues to develop interdisciplinary STEAM activities.
- Overcomes psychological barriers when teaching non-specialized subjects, such as technology or engineering.

IV. IMPLEMENTATION PROCESS AND ACHIEVED RESULTS

Implementation Process

STEAM has been included in the curriculum for the 2020-2024 academic year and is currently offered as an elective course, such as: Organizing STEAM activities for preschool children. In addition, this competency is integrated into many other specialized courses: Methods of organizing art activities, Methods of forming mathematical symbols, Methods of familiarizing children with the surrounding environment, methods of organizing activities to familiarize children with literature, etc. As a result, both full-time and part-time students in the preschool education program of the Faculty of Education are equipped with knowledge, skills, and attitudes regarding STEAM education for preschool children.

In early 2023, many lecturers participating in a strong research group on STEM education, under the leadership of Dr. Nguyen Kim Chung, participated in training and certification for preschool teachers in private preschools in Tan Uyên... Therefore, full-time students in the program also had the opportunity to gain practical experience.

From 2024 to the present, with the attention of the school's leadership, the program has collaborated with the Center for Training According to Social Needs to provide professional development for administrators and preschool teachers in cities and districts of the province: Phu Giao, Dau Tieng, Di An...

During this process, the program has always focused on improving and enhancing the quality of teaching: organizing professional meetings, arranging for lecturers to conduct demonstration lessons, observe classes, and receive in-depth training with foreign experts. Many lecturers in the program have certificates in STEM education competence.

Achieved Results: Regular and regular students are very satisfied with the quality of training in the major. Students have research projects at the faculty level on STEAM education, and many students choose this field for their graduation thesis.

Advantages and Disadvantages

Advantages: Several favorable conditions support the implementation of STEAM education in the early childhood teacher education program. First, strong institutional commitment provides an essential foundation for curriculum innovation. The university and faculty leadership actively encourage the integration of STEAM into teacher education by supporting curriculum development, research activities, and interdisciplinary collaboration. This institutional support creates an enabling environment for lecturers to experiment with innovative teaching approaches and continuously improve course quality.

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Second, the university's research-oriented policy has significantly strengthened the academic foundation for STEAM implementation. Lecturers and students are encouraged to conduct research on STEAM education, resulting in numerous publications in scientific journals and presentations at national and international conferences. These research activities not only update lecturers' professional knowledge but also ensure that teaching practices are informed by current evidence and international developments in STEAM education.

Third, students demonstrate high levels of interest and engagement in STEAM-related learning. The course consistently attracts a large number of students who actively participate in project-based learning, collaborative activities, and practical teaching experiences. Their positive attitudes toward interdisciplinary learning facilitate the implementation of learner-centered instructional approaches, which are fundamental to STEAM education.

Finally, the program benefits from the experience accumulated by lecturers who have participated in STEAM-related teaching and research projects. Although their expertise varies across disciplines, their experience in curriculum design, classroom implementation, and educational research provides valuable support for mentoring pre-service teachers. Collectively, these institutional, academic, and human-resource advantages create favorable conditions for developing future early childhood teachers who are capable of organizing integrated STEAM learning experiences for young children.

Disadvantages: Despite these favorable conditions, several challenges continue to hinder the effective implementation of STEAM education in early childhood teacher education. One of the most significant barriers is the limited availability of facilities, instructional equipment, and dedicated learning spaces required for hands-on, inquiry-based, and interdisciplinary STEAM activities. Since STEAM learning relies heavily on experimentation, design, and collaborative problem-solving, insufficient physical resources may reduce opportunities for pre-service teachers to experience authentic teaching situations and develop practical competencies.

A second challenge relates to teacher educators' professional competence. Although lecturers possess substantial expertise in early childhood pedagogy, most have not received formal preparation in interdisciplinary STEAM education. Consequently, they may encounter difficulties integrating science, technology, engineering, mathematics, and the arts into coherent learning experiences, particularly when teaching content beyond their disciplinary backgrounds. This limitation affects not only curriculum design but also the selection of appropriate teaching strategies, learning materials, and assessment methods capable of evaluating children's integrated competencies.

Furthermore, implementing STEAM requires considerable instructional planning, interdisciplinary collaboration, and continuous curriculum adaptation. Designing authentic learning tasks, coordinating knowledge across multiple disciplines, and assessing children's learning processes demand substantial time and professional expertise. These requirements may increase lecturers' workload and reduce the consistency of STEAM implementation, particularly in contexts where institutional resources and professional support remain limited.

Recent studies suggest that overcoming these challenges requires a shift from isolated training initiatives toward competency-based professional development supported by comprehensive teacher competency frameworks. International frameworks such as STEAMComp Edu emphasize the systematic development of interdisciplinary pedagogical competence, digital competence, curriculum design, assessment literacy, and collaborative professional learning (Spyropoulou & Kameas, 2023). Similarly, recent studies in early childhood education recommend integrating STEAM competencies into pre-service teacher education, establishing continuous professional development programs, strengthening interdisciplinary collaboration, and improving access to learning resources and practice environments (Anh, 2024; Muniyif, 2025). These emerging trends indicate that sustainable STEAM implementation depends not only on improving infrastructure but also on systematically developing educators' competencies through evidence-based training and competency-oriented teacher education programs.

VI. CONCLUSION

The findings of this study indicate that developing STEAM competencies for pre-service early childhood teachers is essential for improving the quality of STEAM implementation in preschool education. A competency-based training approach enables students to acquire not only theoretical knowledge but also the practical skills, confidence, and professional readiness required to design and facilitate integrated STEAM learning experiences after graduation. The proposed competency framework provides a valuable reference for curriculum development, competency assessment, and teacher preparation in early childhood education. To effectively cultivate these competencies, teacher education institutions should strengthen professional development for university lecturers, promote the integration of STEAM pedagogy across specialized courses, expand opportunities for practical and experiential learning, and invest in appropriate facilities, teaching resources, and STEAM laboratories. In addition, creating STEAM clubs, academic competitions, and collaborative learning communities can further enhance students' creativity, interdisciplinary thinking, and instructional competence. Collectively, these efforts will contribute to narrowing the gap between

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theoretical preparation and classroom practice, thereby preparing a new generation of preschool teachers capable of responding to the demands of educational innovation and twenty-first-century learning.

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