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Assessing the Competence of Early Childhood Education Students at Teacher Education Universities in Vietnam in Terms of Implementing STEAM Education

Huynh Lam Anh Chuong [a], Nguyen Hoang Thien [a, *], Truong Thi Tuyet Hanh [b], Do Chieu Hanh [a]

[a] Ho Chi Minh City University of Education, Vietnam
[b] Khu Che Xuat Tan Thuan Nursery School, Vietnam

Abstract

The article explores the competence of students majoring in early childhood education at teacher education universities in Vietnam in terms of implementing STEAM education based on self-assessment. The results of a survey of early childhood education students in their third and fourth (final) years at three universities in different provinces/cities of Vietnam show that students rated themselves as meeting all or most of the requirements of STEAM education for children. The students did not rate themselves as unsatisfactory or slightly satisfactory in any aspect. In terms of the specific aspects of competence, the students rated themselves as meeting all of the requirements for content related to the "professional qualities and ethics expressed in the organization of STEAM education" and rated themselves as meeting the majority of the requirements for items related to "knowledge and skills for organizing STEAM education for children," which had the lowest mean scores. Therefore, universities and other stakeholders need to promote the effectiveness of the training they provide to enable such students to further develop their competence in STEAM education for preschool children, especially in terms of knowledge and skills in organizing STEAM educational activities for children. Differences in the competence levels of students from different universities also require further attention.

Keywords: STEAM education, early childhood education students, Vietnamese teacher education, competences, training programs.

1. Introduction

STEAM originated as an innovative idea at the Rhode Island School of Design in the United States. It was then employed by many educators, gradually spreading to other educational organizations in the United States and other countries. It is a new approach to education, in which

* Corresponding author
E-mail addresses: thiennho@hcmue.edu.vn (N. Hoang Thien), chuonghla@hcmue.edu.vn (H. Lam Anh Chuong), hanhtruongthituyet@gmail.com (T. Thi Tuyet Hanh), hanhdc@hcmue.edu.vn (D. Chieu Hanh)

science, technology, engineering, mathematics and the arts are used to teach and guide students (Nguyen, 2020). According to Kim and Chae (2016), in this era of globalization, future scientists need to possess both a firm foundation in STEM education and possess creative problem-solving and professional skills, which are advanced through an education in the arts. A report from the US Bureau of Labor Statistics in 2021 predicted that STEM- and STEAM-related occupations would grow 8.8 % between then and 2028. It also stated that the median annual salary for STEM/STEAM jobs was $ 84,880, compared with $ 37,020 for other occupations (The New Tenth Foundation, 2021).

In general, STEAM can be described as "a developing educational model of how the traditional academic subjects (silos) of Science, Technology, Engineering, Arts, and Mathematics can be structured into a framework by which to plan integrative curricula. STEAM: Science and Technology, interpreted through Engineering and the Arts, all based in a language of Mathematics" (Yakman, 2008). Nguyen and Ta (2021) add, "Over time, the original term Arts was gradually expanded into the term Arts Liberal. The liberal arts element emphasizes creative activities and freedom of thought expressed through art forms, language, music, philosophy, physical movement, etc. in the process students apply a combination of knowledge, skills and techniques to solve practical and meaningful problems for themselves and the community" (p. 312). According to Land (2013) and Madden et al. (2013), STEAM is not simply about "adding" an artistic element to an equation or using an artistic element (design) in a lesson. It is about finding connections between the arts and STEM content and then teaching and evaluating this content in schools.

The STEM/STEAM debate is profoundly significant in shaping education and fraught with difficulties. According to advocates of STEAM, STEM students should appreciate and understand the aesthetics associated with a good product. They have to admit that what they design must be friendly and attractive because what begins as a rudimentary technical product must eventually be experienced and felt by the user. Many technology designers have been plagued by this problem – they design a product but it is not adopted by users, so it dies. From this perspective, art is an important element of the dialogue between STEM and STEAM. Without the creativity and freedom of the arts, STEM would not exist. The arts help students become well-rounded citizens of the twenty-first century who are open to learning; they provide an opportunity for students to broaden their horizons and express themselves in a particular field. In other words, the arts have an undeniably important role in STEM education (Tran, Le, 2019).

Research by educational scientists in the United States, Australia, India, and other countries show that the ideal age to start applying STEAM education is in preschool (Chesloff, 2013; Colker, Simon, 2014). STEAM education is appropriate for the learning features and characteristics of preschoolers, who love to ask questions and explore (DeJarnette, 2018; Nguyen, Dao, 2022; Sharapan, 2012). In Vietnam, according to the Ministry of Education and Training's Circular No. 32/2018/TT-BGDDT, dated December 26, 2018, STEAM is now included in the main curriculum of general education. The 2018 New General Education Curriculum also indicated a switch from a content-based to a competency-based approach, which is suitable for STEAM education. The process of integrating knowledge from separate subjects builds students' competence, which can also help them to work in the modern technology-driven world (Dang, 2020; Nguyen et al., 2022).

In order to implement this circular and related policies from the state, the Department of Education and Training has implemented guidelines on STEAM education in many provinces and cities in Vietnam. The Early Childhood Education Curriculum promulgated by the Ministry of Education and Training is a framework that allows preschools to develop and adjust their curricula in accordance with actual conditions. Curriculum development and implementation can be achieved through a variety of approaches. Integrating STEAM in the Early Childhood Education Curriculum not only ensures that a school's curriculum can meet the requirements of the Early Childhood Education Curriculum promulgated by the Ministry of Education and Training but also allows children to develop skills, qualities, and competencies suitable for the 2018 New General Education Curriculum. This creates a solid educational foundation for them and builds their confidence and readiness in the transition period from preschool to primary school (Pham, Vu, 2020).

In general, STEAM in early childhood education is being implemented by educators as well as preschools as a new educational approach to help preschool children practice, explore, and experience different things and develop into well-rounded individuals. This approach also matches the psychological characteristics of children. STEAM education provides a firm foundation for children transitioning to another level of education.

Although many debates about STEAM education have emerged in academia, research on STEAM education in preschools is limited. According to Brophy, Klein, Portsmore, and Rogers (2008), who believe that early childhood STEAM receives little attention, this lack of focus is unfortunate because young children are born with attributes that help them develop as scientists and engineers but require suitable education to become apparent. Similarly, DeJarnette (2018) reveals that there has been an increase in the positive and self-empowering tendencies of preschool teachers in terms of implementing STEAM education for their learners; however, the rate of implementation is still limited.

In Vietnam, the situation is no different. STEM/STEAM education is widely mentioned in research on general education, from the primary school to the high school level, yet studies concerning STEAM education in early childhood education are still lacking (Ho et al., 2020; Bui et al., 2022). Besides, most current research on STEAM education for preschools in Vietnam is about the organization of STEAM education activities instead of investigating STEAM teaching-related activities for prospective teachers.

Given these circumstances, this research investigates STEAM education for preschoolers in Vietnam. Specifically, the study explores the competence of students majoring in early childhood education at teacher education universities in Vietnam in terms of implementing STEAM education based on self-assessment. The focus of this research is not only related to the lack of research on STEAM education but also stems from the fact that teachers have the greatest influence on student performance (Sanders, 2009; Sanders, Rivers, 1996). Many recent studies have shown that teachers play a particularly important role in organizing STEAM education activities at all levels, from preschool to high school (Nguyen et al., 2017). They need to have a full, comprehensive, and unified understanding of STEAM education and connect its activities with others to ensure that it is implemented with synchronization and efficiency (Nguyen, Wall, 2020). Moreover, the training of students at teacher education universities is crucial to creating teachers with the qualities and competence needed for the effective organization of STEAM education activities for preschoolers.

2. Theoretical background and research methodology

In fact, courses at Vietnamese teacher education institutions are aimed at providing students with various skills, such as those necessary to provide STEAM education for preschool children. Different universities achieve this aim to varying degrees. Students are aware of this educational approach, as well as the skills required to implement it. This research, in analyzing how early childhood education students self-assess their capacity to deliver STEAM education, focuses on the forms of competence required at different steps/stages related to early childhood education, in general, and those that are specific to STEAM education. This is because STEAM education is one of the educational activities for preschool children, but it does have some peculiarities.

In addition, the ways in which early childhood teachers are expected to be competent in STEAM teaching are related to institutional matters. Therefore, in this study, the items designed to find out the competence in STEAM education of early childhood education students were built with reference to related theories and the Professional Standards of Preschool Teachers outlined in Circular 26/2018/TT-BGDDT, dated October 8, 2018, issued by the Ministry of Education and Training of Vietnam. This is a framework of the basic requirements for preschool teachers, which specifies the qualities and competencies they need to achieve to perform the task of nurturing, caring for, and educating children (The Ministry of Education..., 2018).

Based on the overview, the research team identified five aspects of competence for early childhood education students: professional qualities and ethics embodied in STEAM educational activities; knowledge and skills in organizing STEAM educational activities; developing a STEAM education plan for learners of different grades; assessing children's progress through participating in STEAM education activities; building a safe and friendly STEAM education environment.

These five aspects were measured using a four-point scale to assess the specific level of the early childhood education students' competence in STEAM education for preschool learners. The specific levels were as follows. 1: does not meet the requirements of STEAM education for preschool learners; 2: meets a few requirements of STEAM education for preschool learners; 3: meets the majority of the requirements of STEAM education for preschool learners; 4: meets all of the requirements of STEAM education for preschool learners. Based on the formula (Maximum-Minimum)/n = (4-1)/4 = 0.75, the levels were transformed into the following four ranks: 1 – 1.75: does not meet the requirements of STEAM education for preschool learners; 1.76 – 2.50: meets a

few requirements of STEAM education preschool learners; 2.51 – 3.25: meets the majority of the requirements of STEAM education for preschool learners; 3.26 – 4: meets all of the requirements of STEAM education for preschool learners (Malhotra, Birks, 2007).

The study surveyed 600 female student–teachers majoring in early childhood education, including 189 students from University A, 200 students from University B, and 211 students from University C. All of these students were in the third (334 students) or fourth (final) year (266 students) of their studies. This sample helped provide information that accurately reflects the competence in STEAM education that students obtain through university training programs, as these students had completed most of the courses. (Fourth-year students mainly take a few extra courses in addition to an internship.) The survey was conducted from September to November 2022.

These institutions were selected because they are all universities with a long history of teacher education in Vietnam, including early childhood education. In addition, these three institutions are governed according to three different modes of governance. Specifically, University A is a key teacher education university in Vietnam under the governance of the Ministry of Education and Training, established in 1957. University B is a member institution of a regional university located in Central Vietnam, established in 1957. University C developed from a college (providing three-year programs) and has been under the governance of the People's Committee of C Province since 2009. The diverse selection of universities offering preschool teacher education programs is helpful to make comparisons and provide information that can serve to improve the programs at each institution and similar institutions in terms of governance characteristics. It can also help institutions learn from each other in developing their training activities.

3. Results

3.1. Professional qualities and ethics embodied in STEAM educational activities

The Professional Standards of Preschool Teachers, as outlined in Circular 26/2018/TT-BGDDT, dated October 8, 2018 and issued by the Ministry of Education and Training, consider the standard on teacher qualities and ethics to be the most important, listing it first. Accordingly, preschool teachers must possess professional qualities and ethics, which means "complying with the regulations on teacher ethics training; sharing experiences, supporting colleagues in moral training and creating teachers' styles" (The Ministry of Education..., 2018: 3). In addition, in the socio-cultural context of Vietnam, the teacher is seen as an example of ethics – an expectation that has deep roots in Vietnamese educational philosophy and is influenced by Confucianism and Buddhism (Vu, Nguyen, 2022). Therefore, the competence of teachers cannot be separated from their qualities and ethics in the Vietnamese context. To explore this content, the study included five items: "being fair in evaluating children," "being exemplary," "having a sense of responsibility," "being scientific," and "being professional" in the organization of STEAM educational activities. The survey results showed that all items had mean values from 3.19 to 3.53; the highest mean belonged to "having a sense of responsibility."

Table 1. Students' self-assessment of their professional qualities and ethics embodied in STEAM educational activities

	Professional qualities and ethics embodied in STEAM educational activities	Number	Mean	Std. Dev.	Rank
1	Being fair in evaluating children	600	3.41	0.66	3
2	Being exemplary	600	3.47	0.61	2
3	Having a sense of responsibility	597	3.53	0.59	1
4	Being scientific	598	3.19	0.72	5
5	Being professional	599	3.31	0.71	4

3.2. Knowledge and skills in organizing STEAM educational activities

Some of the key components of competence are the knowledge and skills to organize STEAM education for children. In STEAM education, students learn primarily through the process of solving problems. Educational and psychological studies show that playing is a natural method of learning that promotes healthy development among children. Children are excited to play; when engaging in an educational game, they can explore, create, improvise, and expand their

understanding of a subject (Nguyen, 2000). Games that require skills such as social communication and problem-solving help children learn STEAM subjects more effectively (Cutter-Mackenzie, Edwards, 2013). Therefore, when exploring the competence of student teachers in organizing STEAM educational activities, the study provided items in which learners self-evaluated their organization of various activities for children.

For preschool students, educational activities can take the popular form of STEAM lessons and experiential activities. STEAM lessons have thematic content associated with solving a problem. Students participate in learning actively and proactively. They also must apply the knowledge they have just learned to solve the problem, thereby contributing to the formation of competence. Depending on the specific subject and facilities, schools can apply different STEAM content in various ways. For STEAM experiential activities, the experiential activities and content selected must be associated with the implementation of the objectives of the early childhood education program, creating excitement and motivation for learners to develop their qualities and competence (Nguyen et al., 2022). Therefore, the organization of STEAM education through lessons and experiential activities was surveyed in this research.

Specifically, this aspect was evaluated through 12 items, all of which had means greater than 2.51. The item with the highest mean (3.18) was "understanding the meaning and importance of STEAM education for children's psychophysiological development" and the one with the lowest mean (2.69) was "being able to research STEAM education materials written in foreign languages (books, scientific articles, educational programs, educational models)."

Table 2. Students' self-assessment of their knowledge and skills in organizing STEAM educational activities for children

	Knowledge and skills in organizing STEAM educational activities for children	**Third-and fourth-year students**		**Third-year students**		**Fourth-year students**	
		Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
1	Understanding the essence of STEAM education	2.99	0.76	2.88	0.75	3.14	0.74
2	Understanding the meaning and importance of STEAM education for children's psychophysiological development	3.18	0.70	3.06	0.70	3.34	0.66
3	Being able to research STEAM education materials written in foreign languages (books, scientific articles, educational programs, educational models)	2.69	0.88	2.61	0.91	2.80	0.83
4	Being skilled in organizing activities for child development in which STEAM educational content is integrated	2.98	0.86	2.85	0.91	3.15	0.76
5	Being able to organize STEAM educational activities according to various themes.	2.94	0.86	2.81	0.88	3.13	0.78
6	Being able to apply information technology in STEAM education (knowing how to use software in STEAM education, interactive boards, kidmart games, electronic lectures, simple technology devices,...)	3.03	0.84	2.90	0.82	3.19	0.83
7	Knowing how to manage children in the process of organizing STEAM educational activities during school hours	3.12	0.75	3.00	0.75	3.27	0.73

8	Promoting the positivity of each child in the process of participating in STEAM educational activities (e.g., children are observed and given opportunities to work in groups, practice, present in front of the class)	3.15	0.75	2.99	0.76	3.36	0.68
9	Demonstrating artistic abilities in the organization of STEAM educational activities (in choosing teaching and learning equipment and educational methods and evaluating children)	3.03	0.78	2.89	0.81	3.21	0.71
10	Being able to review, edit, and perfect STEAM education programs for children	2.89	0.87	2.71	0.88	3.14	0.79
11	Being able to propose new theories of STEAM education for children	2.80	0.89	2.66	0.89	3.00	0.86
12	Being able to propose initiatives to leaders for adjusting the policies and guidelines on the organization of STEAM education activities	2.70	0.95	2.51	0.93	2.97	0.91

3.3. Developing a STEAM education plan for learners of different grades by school year

The study also explored the participants' levels of competence in terms of the application of knowledge and skills to develop STEAM plans for children of different grades. This is a practical requirement since teachers working in preschools must comply with the teaching requirements of their schools when applying STEAM education in the curriculum. The steps of developing an educational plan – from specifying educational goals and content to identifying the necessary educational equipment – were assessed by the students themselves. In addition, the study also considered when and how to assess children, along with improving the planning process after each school year. The survey results showed that most of the items (6 out of 7) had means of 3.0 or higher. The item with the highest mean (3.08) was "being able to identify teaching and learning equipment for STEAM education for children of different grades by school year." The only item with a mean lower than 3.0 was "being able to improve STEAM education planning for children of different grades after each school year" (mean: 2.95).

Table 3. Students' self-assessment of their competence in developing STEAM education plans for learners of different grades

	Developing a STEAM education plan for learners of different grades by school year	**Third-and fourth-year students**		**Third-year students**		**Fourth-year students**	
		Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
1	Being able to identify STEAM education goals for children of different grades by school year	3.03	0.81	2.90	0.82	3.21	0.75
2	Being able to identify STEAM education content for children of different grades by school year	3.08	0.81	2.95	0.83	3.27	0.74
3	Being able to identify the form of STEAM education for children of different grades by school year	3.02	0.83	2.84	0.83	3.26	0.76
4	Being able to identify STEAM education methods for children of different grades by school year	3.01	0.83	2.85	0.83	3.24	0.78

5	Being able to identify teaching and learning equipment for STEAM education for children of different grades by school year	3.10	0.81	2.93	0.82	3.34	0.73
6	Being able to identify the time and forms of testing and assessment of children of different grades by school year	3.00	0.81	2.87	0.83	3.19	0.76
7	Being able to improve STEAM education planning for children of different grades after each school year	2.95	0.88	2.79	0.90	3.17	0.82

3.4. Assessing children's progress through their participation in STEAM education activities

Student assessment is one of the key components of STEAM education that student–teachers must be skilled at. The study explored students' opinions on various items related to this aspect of teaching. In particular, the item with the highest mean (3.04) was "being skilled in assessing children's progress in STEAM in terms of learning attitudes" and the item with the lowest mean (2.90) was "being skilled in assessing children in the form of integration."

Table 4. Students' self-assessment of their competence in assessing children's progress through their participation in STEAM education activities

	Assessing children's progress through their participation in STEAM education activities	**Third-and fourth-year students**		**Third-year students**		**Fourth-year students**	
		Means	**Std. Dev.**	**Means**	**Std. Dev.**	**Means**	**Std. Dev.**
1	Being skilled in assessing children's progress in terms of STEAM knowledge	2.96	0.81	2.78	0.80	3.20	0.75
2	Being skilled in assessing children's progress in STEAM in terms of learning attitudes	3.04	0.82	2.86	0.82	3.28	0.75
3	Being skilled in assessing children in the form of integration	2.90	0.83	2.76	0.84	3.09	0.78
4	Being skilled in assessing children in a thematic form	2.93	0.84	2.80	0.86	3.11	0.79

3.5. Building a safe and friendly STEAM education environment

In order to make STEAM education effective, preschool teachers – in addition to individuals in relevant functional departments – must know how to build a safe and learner-friendly STEAM educational environment. The survey results showed that the majority of students considered themselves to meet this requirement: the means of all of the relevant items on the survey were higher than 3.0. The item with the highest mean (3.66) was "being able to collaborate with children's parents or guardians during STEAM educational activities."

3.6. Comparison of groups of participants

Third- and fourth-year students

The research also tested whether there was a difference in the opinions of the third- and fourth-year students, as determined by the mean values of the items on the survey. If the p-value value of the t-test were less than 0.05, this would indicate a difference in the opinions of the third- and fourth-year students. The t-test in the "equal variances not assumed" row was used. The results

showed a difference between the third- and fourth-year students in all aspects. Fourth-year students had higher mean scores than third-year students.

Table 5. Students' self-assessment of their competence in building a safe and friendly STEAM education environment

	Building a safe and friendly STEAM education environment	**Third-and fourth-year students**		**Third-year students**		**Fourth-year students**	
		Means	**Std. Dev.**	**Means**	**Std. Dev.**	**Means**	**Std. Dev.**
1	Being able to build a physical environment to ensure safety for children (arranging classrooms, using educational equipment, creating opportunities for children to interact with specific materials, etc.)	3.14	0.75	2.96	0.78	3.38	0.65
2	Being able to build a psychological environment that ensures a friendly relationship between teachers and children	3.18	0.76	2.96	0.77	3.45	0.66
3	Being able to collaborate with children's parents or guardians during STEAM educational activities	3.66	0.77	3.02	0.80	3.37	0.69

Table 6. Independent Samples Test of third-year and fourth-year students' mean scores for aspects of STEAM education

Independent Samples Test									
	Levene's Test for Equality of Variances	t-test for Equality of Means							
								95 % Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Professional qualities and ethics embodied in STEAM educational activities									
Equal variances assumed	16.42	0	-2.51	598	0.01	-0.10	0.04	-0.18	-0.02

Equal variances not assumed			-2.55	593.01	0.01	-0.10	0.04	-0.18	-0.02
Knowledge and skills in organizing STEAM educational activities for children									
Equal variances assumed	12.83	0.00	-3.78	597	0.00	-0.19	0.05	-0.29	-0.09
Equal variances not assumed			-3.87	596.95	0.00	-0.19	0.05	-0.29	-0.09
Developing a STEAM education plan for learners of different grades by school year									
Equal variances assumed	12.99	0.00	-5.48	598	0.00	-0.31	0.06	-0.42	-0.20
Equal variances not assumed			-5.63	597.87	0.00	-0.31	0.06	-0.42	-0.20
Assessing children's progress through participating in STEAM education activities									
Equal variances assumed	8.77	0.00	-3.75	598	0.00	-0.21	0.06	-0.33	-0.10
Equal variances not assumed			-3.79	588.91	0.00	-0.21	0.06	-0.33	-0.10
Building a safe and friendly STEAM education environment									
Equal variances assumed	6.40	0	-5.06	598	0.00	-0.27	0.05	-0.38	-0.17
Equal variances not assumed			-5.17	597.24	0.00	-0.27	0.05	-0.37	-0.17

Among the three institutions

The study also focused on comparing the mean values of students from different universities. For four aspects, the p-value of Levene's test was greater than 0.05, indicating no difference between the universities. Hence, the results of an F-test in ANOVA were used. The p-value of the F-test was 0.00 < 0.05. This shows a difference in the means of the three universities. University A had the highest mean scores, followed by University B and University C.

Table 7. F-test results in ANOVA of mean scores of students in three universities for aspects of STEAM education

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Professional qualities and ethics embodied in STEAM educational activities					
Between Groups	10.07	2	5.03	21.63	0.00
Within Groups	138.98	597	0.23		
Total	149.05	599			
Knowledge and skills in organizing STEAM educational activities for children					
Between Groups	19.75	2	9.88	27.40	0.00
Within Groups	214.81	596	0.36		
Total	234.56	598			
Assess children's progress through participating in STEAM education activities					
Between Groups	20.19	2	10.10	21.82	0.00
Within Groups	276.29	597	0.46		
Total	296.48	599			
Building a safe and friendly STEAM education environment					
Between Groups	28.04	2	14.02	35.58	0.00
Within Groups	235.24	597	0.39		
Total	263.29	599			

As for the aspect "developing a STEAM education plan for learners of different grades by school year," the p-value of Levene's test was 0.01 < 0.05. This also indicates a difference among universities. Hence, the results of Welch's test in the "robust tests of equality of means table" were used. The p-value of Welch's test was 0.00 < 0.05. This indicates a difference in the mean values for "developing a STEAM education plan for learners of different grades by school year" among universities. Again, University A had the highest mean score, followed by University B and University C.

Table 8. Sig test Welch results in ANOVA of mean scores of students in three universities for an aspect of STEAM education

Robust Tests of Equality of Means				
Developing a STEAM education plan for learners of different grades by school year				
	Statistica	df1	df2	Sig.
Welch	21.67	2	397.39	0.00
a. Asymptotically F distributed.				

4. Discussion

STEAM education plays an increasingly important role in helping learners to become suitable laborers in the context of the ongoing Fourth Industrial Revolution. Education at all levels, from preschool to university, needs to equip students with age-appropriate integrated knowledge and skills that allow them to solve complicated practical problems. Moreover, training and retraining that help teachers implement STEAM education are necessary to develop the professional

competence of those who work at all levels of education, including the preschool level; teacher education institutions share responsibility in this sphere (Tran et al., 2017).

The results of this study, which explored the competence of students majoring in early childhood education at teacher education universities in Vietnam in terms of implementing STEAM education based on self-assessment, show that they rated themselves as meeting most or all of the requirements of STEAM education for children. They did not judge themselves to be unsatisfactory or slightly satisfactory on any items. Of the 31 items surveyed, the participants said they were "meeting all of the requirements of STEAM education for preschool learners" on five. The item with the highest mean (3.66) was "being able to collaborate with children's parents or guardians during STEAM educational activities" (which addressed the aspect of "being able to build a safe and friendly STEAM education environment"). The items with the next highest means were "having a sense of responsibility" (3.53), "being exemplary" (3.47), "being fair in assessing children" (3.41), and "being professional" (3.31). Four of the five items with the highest mean scores were related to the aspect of "professional qualities and ethics embodied in STEAM educational activities."

Of the remaining 26 items, for which students claimed to "meet the majority of the requirements of STEAM education for preschool learners," the items with the lowest means were "being able to research STEAM education materials written in foreign languages (books, scientific articles, educational programs, educational models)" (2.69), "being able to propose initiatives to leaders for adjusting the policies and guidelines on the organization of STEAM education activities" (2.70), "being able to propose new theories of STEAM education to children" (2.80), and "being able to review, edit, and perfect STEAM education programs for children" (2.89). It is worth noting that all of these items were related to the aspect of "knowledge and skills in organizing STEAM educational activities for children."

Generally, the students considered themselves to meet all of the requirements of items related to "professional qualities and ethics embodied in STEAM educational activities," while they rated themselves as "meeting the majority of the requirements of STEAM education for preschool learners" for many items concerning "knowledge and skills in organizing STEAM educational activities for children." Some of these items had the lowest means of all items on the survey. In addition, the items for which students considered themselves to "meet all of the requirements of STEAM education for preschool learners" represented a small proportion (5 out of 31 items) of the total items. Four out of five of these items related to the aspect of "professional qualities and ethics of teachers".

Although there have been no similar studies on prospective early childhood teachers for comparison, these findings seem to differ from the results of other relevant studies concerning current early childhood teachers. For example, research by Tran et al. (2019) showed that teachers in Vietnam lack STEAM education skills and are limited in their ability to assess students' learning outcomes. This creates a significant gap between learning and practice. Therefore, learners face many difficulties in applying theory and transforming operating principles into products that are applicable in real life. In addition, based on a survey of preschool teachers in 10 cities and provinces across Vietnam, Bui et al. (2022) indicated that the competence of teachers in implementing STEAM activities or projects for preschoolers is only moderate (with an approximate mean of 3.2 out of 5). Similarly, from the results of a survey on the competence of teachers in the implementation of STEAM education activities for preschool children (5 to 6 years old) in Tuyen Quang Province, Vu (2022) concluded that the teachers' competence was merely average. Nguyen et al. (2022) and Tran (2021) also shared a similar view that STEAM games are rarely applied in teaching preschool children in Vietnam to strengthen instruction during school hours.

Although the paper's findings show that students believed that they meet the requirements of all items addressed in the survey (completely or mostly), further improvements are needed so that students can develop their competence, especially when it comes to the knowledge and skills needed to organize STEAM educational activities for children. This is especially important in light of the knowledge that what students learn may be difficult to apply to real work environments, as shared by Vu (2022). One reason that there are barriers is that the students are new to STEAM education and lack opportunities to experience and practice. Tran et al. (2019) said that it is necessary to pay more attention to the quality of teachers at all levels of education in order to effectively implement STEAM education activities. This opinion and the results of this research should be considered by university

leaders and faculty when determining which aspects of training should be prioritized and improved to help students become more competent in terms of STEAM education.

In addition, comparing the mean scores of several different groups shows that the mean scores of the fourth-year students were higher than those of the third-year students in all aspects. This could be explained by the fact that fourth-year students have had internship time at school while third-year students have not, so they have had more opportunities to practice and apply what they have learned. With the help of lecturers, internship instructors, preschool teachers, and peers, they can gradually develop their competence. As for the participant universities, the results of the ANOVA test show that University A had the highest mean scores, followed by University B and C. To convincingly explain this result, more research is needed in the future, which can also help the universities in this study and institutions with similar circumstances to develop.

5. Conclusion

STEAM education in general and for preschool children in particular – Is receiving increasing attention from training institutions and society due to its role in developing modern learners. In Vietnam, specifically, the legal conditions for conducting STEAM education and the respect it receives in society are adequate. The core issue is that the education and training sector needs to promote the preparation of human resources to implement STEAM education, especially in early childhood education. To ensure that teachers are competent and can meet the practical requirements of schools, the training they receive at teacher education universities is key. The results of this research show that the students at three teacher education universities who participated in the survey rated themselves as meeting most or all of the requirements of STEAM education for preschool learners. Compared to some relevant studies on STEAM education in Vietnam, this result seems to paint a positive picture of STEAM education for preschool children. However, universities and other stakeholders also need to promote the effectiveness of training so that students can further develop their competence to develop STEAM education for preschool children, especially in terms of knowledge and skills in organizing STEAM educational activities for children.

Since the findings are the result of students' self-assessments, more studies are needed to get opinions from other stakeholders, such as lecturers and employers, to provide a more comprehensive view of early childhood education students' competence. Furthermore, the individuals participating in the study were students from three key universities in Vietnam with a long tradition of training preschool teachers, so the research results cannot fully reflect the diverse picture of students' competence in this aspect. Therefore, studies including more participants are needed in the future. Moreover, some findings from this research are in need of more investigation to obtain persuasive explanations.

6. Limitations

Due to the conditions of time, funding and accessibility, the research can only focus on three universities in Vietnam; therefore, the findings cannot fully represent the general picture of the competence of early childhood education students at teacher education universities in Vietnam in terms of implementing STEAM education. In addition, the limitation of the study also comes from the quantitative method used, which is impossible to deeply exploit many aspects related to the topic and explain the information from the survey results. These are also suggestions for further research in the future.

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