

# DETERMINANTS OF PRIMARY SCHOOL TEACHERS' INTENTION OF STEAM EDUCATION IN THAI NGUYEN PROVINCE, VIETNAM

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**Abstracts:** STEAM education is an educational approach that integrates science, technology, engineering, arts, and mathematics into a cohesive and interdisciplinary curriculum. The aim of the study is to explore the determinants of primary school teachers' intention of STEAM education in Thai Nguyen province of Vietnam. The results revealed that the influence of attitude towards STEAM Education includes four factors (interests, willingness, confidence and motivation) and profile of respondents in terms of gender, education levels and teaching experience. The results of a multiple regression analysis indicated that the effect of these factors on STEAM Education was statistically significant. Additionally, among these factors, the factors of Willingness and Confidence were the biggest influence on the STEAM education variable whereas the factor of Interests being the lowest influence. This study's findings contribute to the understanding of the current state of STEAM education implementation in Thai Nguyen province and provide insights into the challenges and opportunities faced by primary school teachers in adopting this approach. The proposed measures for organizing training programs can enhance teachers' capacity to effectively teach science using STEAM education, aligning with the curriculum objectives and the demands of the 2018 Program and Textbooks Innovation in Vietnam.

**Keywords:** STEAM Education, Intention, Primary School Teachers, Thai Nguyen Province, Vietnam.

## 1. INTRODUCTION

In recent years, Science, Technology, Engineering, Arts, and Mathematics (STEAM) education has gained significant attention in the field of primary education. The integration of these disciplines through STEAM education has emerged as a promising approach to foster creativity, critical thinking, problem-solving skills, and innovation among students [3,5,6]. Recognizing the importance of STEAM education, many countries, including Vietnam, have embraced this pedagogical approach to enhance teaching and learning experiences in primary schools[7].

This study focuses on the determinants of primary school teachers' intention of STEAM education in Thai Nguyen province of Vietnam in order to investigate the perceptions of primary school teachers regarding the organization of science teaching with the integration of STEAM education and identify the factors that influence their teaching practices. By exploring these determinants, this research aims to contribute to the advancement of educational innovation in primary schools, with a specific focus on science teaching in Vietnam.

The findings of this study are expected to provide valuable insights into the current state of STEAM education implementation in Thai Nguyen province and shed light on the challenges and opportunities faced by primary school teachers in adopting this approach. Moreover, this research aims to propose effective measures for organizing training programs that can enhance the teaching competency of primary school teachers in science using STEAM education. These measures will align with the requirements of the 2018 Program and Textbooks Innovation in Vietnam, ensuring a strong connection between curriculum objectives and teaching practices.

To achieve the research objectives, a survey was conducted among 278 science teachers from grades 4 and 5 in 21 primary schools located in Thai Nguyen province. The selection of these schools was based on their diverse teaching conditions, allowing for a comprehensive understanding of the factors influencing teaching competency in STEAM education. The survey collected data on teachers' perceptions of STEAM education, their approaches to

integrating it into their science teaching, and the various channels through which they acquire information about STEAM education.

The key findings of this study will provide valuable insights into the attitudes and practices of primary school teachers in Thai Nguyen province regarding the use of STEAM education in science teaching. The results will showcase the significance attributed by teachers to the role of STEAM education and highlight the specific factors that influence their teaching competency. These findings will inform policymakers, curriculum developers, and teacher training institutions in Vietnam, facilitating the development of effective strategies to promote the integration of STEAM education in primary schools.

## **2. LITERATURE REVIEW**

STEM education is gaining widespread popularity and global acceptance, being adopted in numerous countries thanks to its innovative approach in addressing both social and economic requirements [8, 10,12]. In this day and age, innovation is greatly valued across a multitude of fields, as it offers solutions to intricate real-world challenges and fosters sustainable progress. Numerous research studies have postulated that breakthrough innovations result from the synergy of diverse teams, ideas, and resources originating from various disciplines [12, 14, 15]. The literature review provides an overview of relevant studies conducted previously on the determinants of primary school teachers' intention of STEAM education. This section discusses the findings of selected studies and compares them with the current research conducted in Thai Nguyen province, Vietnam.

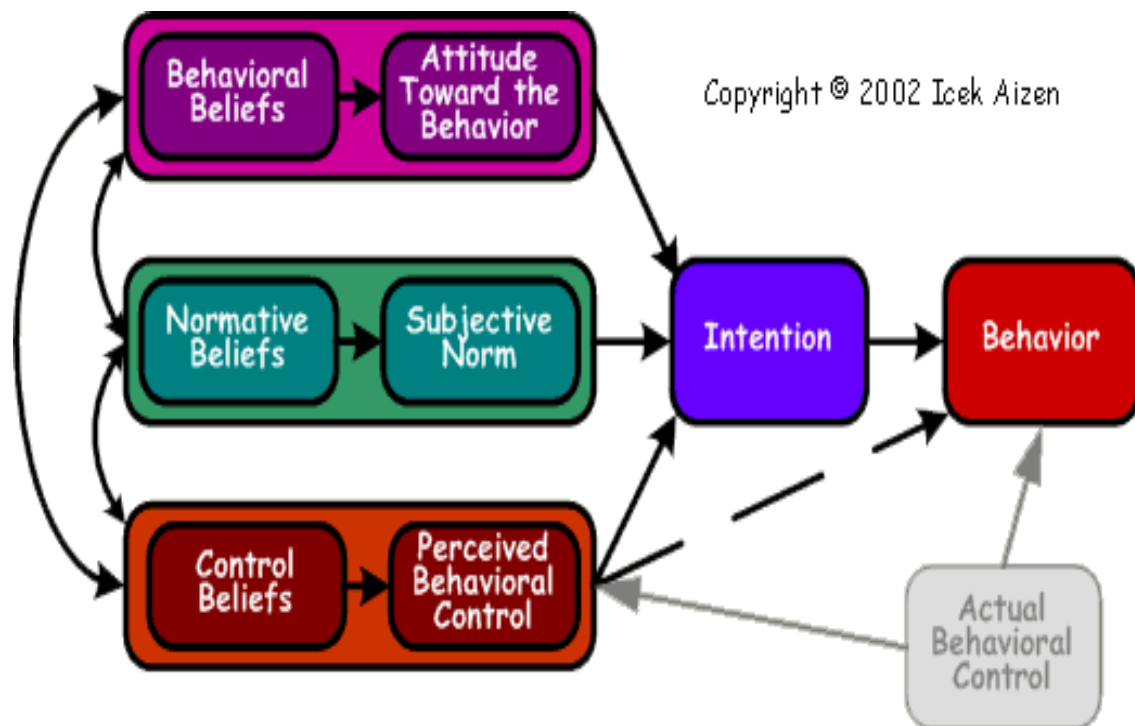
### **2.1. Importance of STEAM Education in Primary Schools**

STEAM education has gained significant attention worldwide due to its potential in enhancing students' critical thinking, problem-solving, and creativity skills. Research studies have emphasized the importance of integrating STEM disciplines with arts and design to provide a holistic approach to education. By incorporating real-world applications, hands-on activities, and interdisciplinary projects, STEAM education promotes active engagement and deeper understanding of scientific concepts among primary school students. Several studies have highlighted the positive impact of STEAM education on students' academic performance, motivation, and career readiness [16, 17, 19, 20].

### **2.2. Perceptions and Attitudes of Teachers Towards STEAM Education**

#### **2.2.1. Theoretical Analysis Model**

To examine the determinants affecting teachers' intentions to implement STEM education, we expanded upon the foundational Theory of Planned Behavior (TPB) [1]. The TPB is a widely employed model in predicting behavioral intentions (BI) within the educational sphere. It has been extensively scrutinized in numerous research endeavors investigating the linkage between teachers' BI and their beliefs, assessing its efficacy in explaining their responses to new learning, habits, and their anticipation of embracing novel educational approaches. In this study, we introduce several potential influential factors, substantiated by robust literature reviews, for a comprehensive analysis of behavioral intentions and attitudes towards STEAM education.



**Figure 1:** The Theory of Planned Behavior: Organizational Behavior and Human Decision Processes

Teachers play a crucial role in implementing STEAM education effectively. Understanding their perceptions and attitudes towards this pedagogical approach is essential for successful integration into primary school classrooms [4]. Research indicates that many teachers view STEAM education as a valuable tool for promoting student engagement, creativity, and critical thinking. However, challenges related to curriculum alignment, lack of resources, and limited professional development opportunities have been reported [2]. Studies have emphasized the need for supportive environments, adequate training, and collaboration among teachers to enhance their confidence and competency in implementing STEAM education [21].

Nguyen et al. (2019) investigated the perceptions and practices of primary school teachers regarding STEAM education in a different region of Vietnam. Their study revealed that teachers recognized the importance of integrating arts and design into STEM subjects, but they faced challenges in terms of limited resources and lack of professional development opportunities. The findings align with the current study, highlighting the importance of addressing resource availability and professional development in enhancing teaching competency [11].

### 2.3. Factors Influencing Teachers' Intentions to Implement STEM Education

Individual perceptions play a crucial role in shaping one's attitudes and intentions. This underscores the importance of a teacher's understanding of STEM education in influencing their perceptions regarding the value of this educational approach. Moreover, value is inherently subjective, influenced by personal feelings, observations, and experiences. As pointed out by Williams et.al., the attitudes of esteemed educators towards STEM education are often shaped by their educational experiences at relevant institutions [19]. It was also asserted that value is intertwined with perceived usefulness and behavioral control. Consequently, we have incorporated this variable into our analytical processes, specifically in examining the relationship between the perceived value of the approach and teachers' intentions for its implementation [9, 13].

Attitudes can be described as people's anticipations and forecasts regarding an action [18]. This demonstrates that a positive attitude is associated with a propensity towards behavioral intentions, a connection that has been substantiated by numerous studies [17]. In this study, attitudes towards STEM education were evaluated in terms of Willingness, Interests, Confidence, Motivation, which had a positive impact on teachers' intentions to implement it.

## **2.4. Contextual Factors in Vietnamese Primary Schools**

Understanding the specific contextual factors within the Vietnamese education system is essential for examining teaching competency in STEAM education. Studies have identified challenges such as large class sizes, limited resources, and traditional teaching approaches that may affect the implementation of innovative teaching methods like STEAM education [11]. The 2018 Program and Textbooks Innovation in Vietnam aim to address these challenges by promoting student-centered and inquiry-based learning approaches. However, the extent to which these reforms have been adopted and implemented in primary schools, particularly in Thai Nguyen province, requires further investigation. In summary, the literature highlights the significance of STEAM education in primary schools and emphasizes the role of teachers in effectively implementing this approach. The perceptions and attitudes of teachers, along with professional development opportunities, availability of resources, and collaborative environments, influence teaching competency in STEAM education [7]. Considering the specific contextual factors within the Vietnamese education system, this study aims to contribute to the existing literature by examining the determinants of teaching competency among primary school teachers using STEAM education in Thai Nguyen province, Vietnam.

Comparing the current study with previous research, several common themes emerge. Professional development, pedagogical knowledge and skills, access to resources and materials, collaboration, and a supportive school environment are consistently identified as key determinants of teaching competency in STEAM education. These findings suggest that these factors play a significant role in influencing the effectiveness of STEAM education implementation among primary teachers across different contexts. However, it is important to note that the current study conducted in Thai Nguyen province, Vietnam, adds to the existing literature by specifically examining the determinants of teaching competency in the local context. The study contributes to filling the research gap in understanding the factors that influence teaching competency using STEAM education in Vietnamese primary schools, thereby providing valuable insights for educational policymakers, curriculum developers, and teacher training institutions in the region.

In conclusion, the literature review demonstrates the importance of addressing professional development, pedagogical knowledge and skills, resource availability, collaboration, and supportive school environments to enhance teaching competency in STEAM education. The current study conducted in Thai Nguyen province, Vietnam, contributes to the existing literature by providing insights into these determinants in the local context, which can inform strategies to improve the implementation of STEAM education and enhance teaching competency among primary teachers in Vietnam.

## **3. METHODOLOGY**

### **3.1. Research Design**

The study used descriptive research design with survey questionnaires as the method for collecting data in 21 primary schools located in Thai Nguyen province, Vietnam in order to realize the research objectives.

This study adopts a quantitative research design to examine the determinants of teaching competency among primary school teachers using STEAM education in Thai Nguyen province, Vietnam. A survey questionnaire was utilized to collect data from a sample of primary school science teachers. Figure 2 shows the Conceptual Framework of the study as well as operational definitions of variables participating in the proposed model.

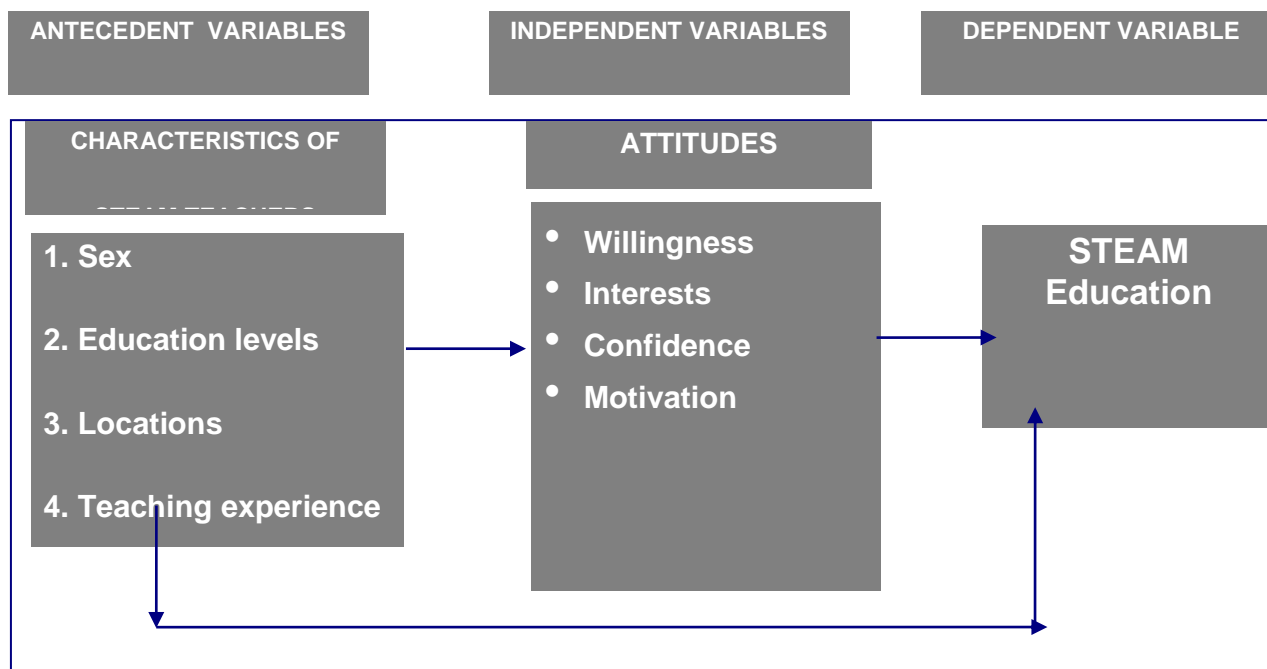


Figure 2. Conceptual Framework

**Sex** refers to the gender of the surveyed teachers whether male or female.

**Education levels** refer to the degrees or certificates the surveyed teachers hold whether master’s degree, Bachelor’s Degree or Junior Bachelor’s Degree.

**Locations** refer to the place the surveyed teachers are working at including remote and mountainous area, rural area, small town, and city center

**Teaching experience.** As used in this study, it means that whether the surveyed teachers have experienced STEAM teaching orientation.

**Willingness.** It refers to the readiness of the surveyed teachers to get involved in STEAM education

**Interests.** It refers to a state of curiosity or concern about or attention to STEAM education

**Confidence.** It refers to the confidence in teachers ' own abilities to conduct STEAM education.

**Motivation.** It refers to driving force or incentive that prompts the surveyed teachers to engage in STEAM education.

**STEAM Education.** It refers to the surveyed teachers' intention to engage in an interdisciplinary approach that incorporates Science, Technology, Engineering, Arts, and Mathematics into their teaching activities.

A survey was conducted among 278 science teachers from grades 4 and 5 in 21 primary schools located in Thai Nguyen province, Vietnam, with varying teaching conditions. The survey gathered data on teachers' perceptions of STEAM education, their approaches to incorporate it into their teaching practices, and the sources of information they accessed for STEAM education.

### 3.2. Population and Sampling Procedures

The study population consisted of 1,000 primary teachers in Thai Nguyen Province of Vietnam including 350 primary teachers working in remote and mountainous areas and rural areas, 250 primary teachers teaching in

towns and 400 primary teachers working in city centre. The desired sample size is calculated by the following formula:

$$n = \frac{NZ^2 (p(1-p))}{Nd^2 + Z^2 (p(1-p))} = 278$$

where:

N = Population

n = the desired sample size

Z = the standard normal deviate, set at 1.96, corresponding to 95% level of confidence

p = the proportion in the target population estimated to have a particular characteristic, 50 percent (.50)

d = degree of accuracy desired, usually set at 0.05

The needed sample size (n) was allocated as follows: 97 respondents from remote, mountainous and rural areas, 70 respondents from towns and 111 respondents from city center.

**Table 1. Sampling distribution of Thai Nguyen’s primary teachers**

Locations	Population	Sampling Fraction	Sample Size
Remote and mountainous areas and rural areas	350	350/1000 * 278	97
Towns	250	250/1000*278	70
City Center	400	250/1000*278	111
Total (primary teachers)	1000		278

Source: Summary from SPSS results

### 3.3. Data Collection

Based on the objectives of the study and the variables identified in the study as well as their operational definition, the following steps have been done for the instrumentation: Step 1: determining what information to collect; Step 2: grouping the information items; Step 3: formulating the questions; Step 4: formatting the questionnaire; Step 5: modifying and pre-testing the instrument; and Step 6: improving and finalizing the questionnaire

In this study, we have random distributed 300 questionnaires to primary teachers in Thai Nguyen Province from August 2022 to May 2023. 288 responses were collected, of which 10 were removed from our database since they missed many items in the questionnaires. 278 were good for the further analysis.

### 3.4. Research Instrument

In order to collect data for the study, a survey was conducted. Prepared questionnaires were delivered to target respondents.

**Content of survey questionnaires:** since our study was to identify the determinants of teaching competency of primary teachers using steam education in Thai Nguyen province, Vietnam , the questionnaires included the following parts:

- Part A was Respondents' Identification or personal contact.
- Part B was the profile of the respondents in terms of **sex, education levels, locations, teaching experience**. These variables were predicted to be antecedent factors which had impact on the respondents' orientation of STEAM education.
- Part C was repondents' attitude towards orientation of STEAM education including the following items:
  - 1 . Interest
  2. Willingness
  3. Confidence
  4. Motivation

5-likert scale questionnaires were used to assess the influences of the surveyed teachers' attitudes on their STEAM education. Respondents were requested to rank the levels of their influence on their STEAM education from weakest point to strongest one, i.e. the respondents had to choose 1 for 'very weak', 2 for 'weak', 3 for 'neutral', 4 for 'strong' and 5 for 'very strong'.

- **Test of reliability**

Cronbach's alpha was used to test reliability of variables, if the group of factors that Cronbach alpha coefficient is greater than 0.6, the sample would meet the requirements of scale. In addition, variable correlation coefficient of variations (Item-Total Correlation) is greater than 0.3 might be retained.

The belows table showed the values of Cronbach's alpha:

**Table 2: Values of Cronbach's Alpha**

Conbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.6 \leq \alpha < 0.8$	Acceptable
$0.5 \leq \alpha < 0.6$	Questionable
$\alpha < 0.5$	Unacceptable

- **Test of Validity**

Correlation matrix is used to measure correlation coefficient of variables, if the significant level of the variable is higher than 0.5, the correlation is strong and vice versa. **Ethical consideration**

The information collected from individuals was treated confidently. The collected information was used appropriately and correctly.

### 3.5. Data Processing and Data Analysis

Since the study dealt with quantitative and qualitative data, a combination of descriptive – normative approaches in its behavioral and managerial context in the analysis of data was used. The gathered data were

encoded, processed and analyzed using Statistical Package for the Social Sciences (SPSS) software. Frequency tables were generated together with descriptive statistics to describe characteristics of primary teachers in Thai Nguyen Province and their attitudes towards STEAM education. KMO and Bartlett's Test was used to test the reliability for factor analysis. Details are followed:

SPSS software was used to code data and to analyze the data. Standard editing and coding procedure were utilized. The statistical methods utilized in this study for analyzing the collected data which were reliability analysis, descriptive statistics, and standard multiple regression analysis. Descriptive analysis was used to analyze mean, frequency, maximum point, minimum point, range (max-min)... of variables. Factor analysis was used to reduce and combine data. Regression is used to define effect of each independent variable with dependent variable.

#### 4. RESULTS

The results of the study are presented based on the analysis of the data collected from the survey questionnaire administered to 278 primary school science teachers in Thai Nguyen province, Vietnam. The findings provide insights into the determinants of teaching competency among primary teachers using STEAM education.

##### 4.1. Profile of Respondents

Primary school teachers in Thai Nguyen Province, Vietnam, play a vital role in the education system, providing the foundation for children's learning and development. Among 278 Primary school teachers in Thai Nguyen Province, those who have used STEAM education integrate science, technology, engineering, arts, and mathematics concepts into their teaching are called STEAM teachers.

Table 3 shows the typical characteristics of the primary school teachers in Thai Nguyen province in terms of **sex, education levels, locations, teaching experience**. 92.1 percent of the total respondents is female, which is nearly 12 times as many as male teachers. The population of teachers holding Degree of Associate is the most crowded which accounts for 50.7 percent, second is Bachelor's degrees with 43.1 percent and the smallest number is Master's holders with 6.2 percent. More or less third of respondents teaches in rural areas and in the city center whereas 14.1 percent of respondents teaches in remote and mountainous areas and 23 per cent of them teaches in urban areas such as district and town centers. The overwhelming majority of teachers with less than 10 years' experience accounting for 63.4 percent, which is nearly twice as high than the teachers with 10 years' experience or more.

**Table 3. Profile of respondents**

Indicators	Frequency	Percentage
<b>Gender</b>		
Male	22	7.9
Female	256	92.1
<b>Total</b>	<b>278</b>	<b>100.0</b>
<b>Education Levels</b>		
Degree of Associate	141	50.7%
Bachelor's Degree	120	43.1%
Master's Degree	17	6.2 %
<b>Total</b>	<b>278</b>	<b>100.0</b>
<b>Locations</b>		
Remote and mountainous areas	39	14.1%



Rural areas	96	34.5%
Urban areas such as district and town centers	64	23 %
City centre	79	28.4%
<b>Total</b>	<b>278</b>	<b>100.0</b>
<b>Teaching experience</b>		
10 years' experience or more	102	36.6
Less than 10 years' experience	176	63.4
<b>Total</b>	<b>278</b>	<b>100.0</b>

Source: Summary from SPSS results

#### 4.2. Attitudes Of Primary School Teachers in Term of Their Willingness, Interest, Confidence and Motivation Towards STEAM Education

Table 4 describes the attitudes of the respondents in terms of their willingness and interests, confidence and motivation to engage in STEAM education. First, in term of teachers' willingness, the mean maximum gets **3.5674** at the point of teachers' willingness towards STEAM education. In other words, primary school teachers in Thai Nguyen province in Vietnam are willing to conduct STEAM education due to the requirement of the 2018 Program and Textbooks Innovation in Vietnam at mean of 4.18705. Secondly, in terms of teachers' interest, no indicators have mean of over than 2.5, except the finding STEAM education interesting to deliver your lesson.

The assessment of the respondents in terms of confidence, and motivation are also seen in Table 4, in which the mean maximum of indicator confidence and motivation reach 3.91007 and 3.16547 respectively. Both indicators have minimum mean of around 2.5. However, the overall mean of indicator Confidence is a little higher than the one of indicator Motivation, which are 2.9478 and 2.8417 respectively.

Therefore, if a comparison is made among these 4 factors including interests, willingness, confidence and motivation, the overall mean gets max with the willingness of 3.5674, i.e. the primary school teachers in Thai Nguyen province are willing to conduct STEAM education although they are not confident enough and they are not really interested in it because it is clearly shown in Table 4 that the overall mean of the Interest is the lowest and after that are motivation and confidence.

**Table 4. Attitudes of Primary school teachers in term of their Willingness, Interest, Confidence and Motivation**

Indicators	Mean	Std.Deviation	Valid
<b>Interests</b>	<b>2.5459</b>		278
You are interested in STEAM education	2.34892	.767467	278
You find STEAM education interesting to deliver your lesson	3.43885	.761104	278
STEAM education meets your desires	2.15108	.725141	278
The interests and preferences will lead to self-development activities	2.24460	.873532	278
<b>Willingness</b>	<b>3.5674</b>		278
You are willing to conduct STEAM education	3.14388	.995014	278
You are going to be a STEAM teacher	3.89209	.821117	278
The 2018 Program and Textbooks Innovation in Vietnam affects your intention of STEAM education	4.18705	.911763	278
The innovation requirements impact on your willingness of STEAM education	3.04676	.760942	278

<b>Confidence</b>	<b>2.9487</b>		
You are confident to deliver STEAM education	2.54676	.812564	278
You are trained to be STEAM teachers	2.44604	.863815	278
You have the competences to plan, design, and implement STEAM education	2.89209	.780545	278
You have all skills and techniques to deliver STEAM education	3.91007	.834179	278
<b>Motivation</b>	<b>2.8417</b>		278
You have got motivation to carry out STEAM education	2.45683	.847553	278
You have a chance to increase income with STEAM education	3.00000	.828203	278
You have chance to have personal growth with STEAM education	3.16547	.883847	278
The image of being a famous STEAM teacher helps you develop a successful teaching career	2.74460	.794537	278

Source: Summary from SPSS results

### 4.3. Primary School Teachers' Orientation Engaging in STEAM Education

It is clear from the Table 5 that the mean of respondents' intention to engage in STEAM education is 3.017 with the standard deviation of 0.948, i.e., the primary school teachers in Thai Nguyen Province of Vietnam have high intention to engage in STEAM education.

**Table 5. Primary school teachers' orientation engaging in STEAM education**

Indicators	Mean	Std.Deviation	Valid
You have intention to engage in STEAM education	3.017	0.948	278

Source: Summary from SPSS results

### 4.4. Relationship Between Primary School Teachers' Characteristics and their Attitudes Towards Business

ANOVA and independent test are used to test the significant differences between profile of respondents and their attitudes towards STEAM education. As it can be seen from Table 6, all of the characteristics and attitudes of respondents have significant relationships with STEAM education. However, there is no significant difference between teachers' gender and their attitudes toward STEAM education. There is no significant difference between respondents' teaching experience and their attitudes toward STEAM education except for their willingness with sig. of 0.009. However, there is a significant difference of sig. 0.059 between respondents' willingness toward STEAM education and their levels of education. The significant difference between the respondents' regions and their confidence toward STEAM education is at 0.020.

**Table 6. Relationship between Senior Students' Characteristics and their Attitudes Towards Business**

Attitude of respondents toward STEAM education	Gender		Teaching Experience		Levels of Education		Regions	
	Sig.	Ho	Sig.	Ho	Sig.	Ho	Sig.	Ho
<b>Interests</b>	.759	Accept Null	.687	Accept Null	.878	Accept Null	.429	Accept Null
<b>Willingness</b>	.064	Accept Null	.009	Reject Null	.059	Reject Null	.575	Accept Null
<b>Motivation</b>	.862	Accept Null	.105	Accept Null	.346	Accept Null	.946	Accept Null
<b>Confidence</b>	.245	Accept Null	.190	Accept Null	.138	Accept Null	.020	Reject Null
<b>STEAM Education</b>	.000	Reject Null	.000	Reject Null	.000	Reject Null	.001	Reject Null

Source: Summary from SPSS results

#### 4.5. Relationship between primary school teachers' attitudes towards STEAM education

The following tables 7, 8, 9 reveal the relationship between primary school teachers' attitudes towards STEAM education in Thai Nguyen Province in Vietnam.

**Table 7 Number of items, Mean, Standard Deviation, and Reliability Coefficient on Each factor**

Measurements	Factors	N	Mean	SD	Cronbach's Alpha
Attitudes of primary teachers	Interests	4	2.5459	.53691	.623
	Willingness	4	3.5674	.71768	.836
	Confidence	4	2.9487	.64701	.794
	Motivation	4	2.8417	.55933	.583

Source: Summary from SPSS results

As illustrated by Table 7, there are 4 factors to measure the attitudes of primary school teachers toward STEAM education including interests, willingness, confidence and motivation. There are 4 items for each factor, of which Willingness gets highest mean of 3.5674 while others are below 3.0 but above 2.5. The reliability coefficient on each factor by Cronbach's Alpha is equal or higher than 0.6, which is reliable and meaningful for factor analysis shown in the following Table 8a and Table 8b.

**Table 8a The factor Analysis for five dimensions of service quality  
KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.712
Bartlett's Test of Sphericity	Approx. Chi-Square	1519.321
	Df	91
	Sig.	.000

Source: Summary from SPSS results

This table 8a reconfirms the reliability for factor analysis by KMO and Bartlett's Test. The result of factor analysis was justified. KMO statistics of 0.72 indicates sample adequacy and significance of test of sphericity

**Table 8b Rotated Component Matrix<sup>a</sup>**

	Component			
	1	2	3	4
wil2	.896			
wil3	.844			
wil1	.769			
wil4	.749			
Cof2		.830		
Cof3		.803		
Cof1		.754		
Cof4		.739		
In1			.887	
In2			.887	
In4			.704	
Mot2				.843
Mot1				.827
Mot4				.779

Extraction Method: Principal Component Analysis.  
 Rotation Method: Varimax with Kaiser Normalization.  
 a. Rotation converged in 5 iterations.  
 Source: Summary from SPSS results

Rotated Component Matrix<sup>a</sup> is shown by Table 8b, in which all 4 components with 14 factors are presented in groups. Factor In3 and Eco 3 are dropped from the regression model because they are not significant enough. All results of factor analysis are 0.7 up with the top of 0.896 (factor Wil 2) and the bottom of 0.704 (In4). Hence, there is a significant relationship between primary school teachers' attitudes towards STEAM education including 14 factors presented in the table and their intention to engage in STEAM education.

**Table 9 The influence of the respondents' attitudes towards STEAM education**

Variables		Coefficients <sup>a</sup>	t	Sig
Dependent Variable: STEAM education	(Constant)	-.047	-.119	.905
	Interests	.197	2.510	.013
	Willingness	.359	4.845	.000
	Motivation	.205	2.631	.009
	Confidence	.236	2.900	.004
<b>R square</b>		.186		
<b>F</b>		15.626		.000 <sup>a</sup>

Source: Summary from SPSS results

Firstly, it is clear from the Sig Column -Table 9, all Sig values in are less than 0.05, i.e. all coefficients have their statistic meanings. Therefore, the respondents' attitudes have great influence on their intention to engage in STEAM education.

Also, the following regression model was made from Table 9 :

$$\text{STEAM} = -0.047 + 0.197 \cdot \text{Interests} + 0.359 \cdot \text{Willingness} + 0.205 \cdot \text{Motivation} + 0.236 \cdot \text{Confidence} + e$$

In which,

**Willingness** refers to the readiness of the surveyed teachers to get involved in STEAM education.

**Interests** refers to a state of curiosity or concern about or attention to STEAM education

**Confidence** refers to the confidence in teachers ' own abilities to conduct STEAM education.

**Motivation** refers to driving force or incentive that prompts the surveyed teachers to engage in STEAM education.

**STEAM** refers to the surveyed teachers' intention to engage in an interdisciplinary approach that incorporates Science, Technology, Engineering, Arts, and Mathematics into their teaching activities.

**e** refers to standard errors

Therefore, the teachers' willingness has the most significant influence on STEAM education and it is followed by their confidence, then by motivation, and finally by interests.

It is also shown by Table 9, R square is 0.186 and T-test gives the reliable results, i.e. the respondents' attitudes are able to explain 18.6 percent of the change of their STEAM education.

#### 4.6. The Relationship Between Primary School Teachers’ Characteristics and their STEAM Education

Model:

$$STEAM = 3.064 + 0.250 \cdot D_{Gender} - 0.665 \cdot D_{regions2} + 0.651 \cdot D_{teachingexp} + e$$

A multiple regression analysis was implemented to determine the influences on STEAM education among the respondents according to their characteristics after rejected the insignificant variables which had the significant value higher than 0.05. The results of the regression analysis illustrated that there was an extremely significance between gender, education levels and teaching experience variables and STEAM education variable due to  $F = 29.963$  and  $Sig (F) = .000^a$  while 24,7% of the total STEAM education change was explained by three variables which include gender, education levels and teaching experience. In addition, the results also indicated that more male teachers intended to engage in STEAM education than women ( $\beta = .250$ ;  $Sig = .026$ ). The teachers working in urban and town and city centers engaging in STEAM education than the other regions ( $\beta = -.665$ ;  $Sig = .000$ ). Teachers who had 10 years of teaching experience had more intentions to engage in STEAM education than the ones with less experience.

**Table 10. The relationship between primary school teachers’ characteristics and their STEAM education**

Variables		Coefficients <sup>a</sup>	t	Sig
Dependent Variable: STEAM Education	(Constant)	3.064	38.065	.000
	D Gender (1=male; 0 =female)	.250	2.232	.026
	D Region2 (1=rural areas; 0=the others)	-.665	-6.392	.000
	D teachingexp (1=10 years of teaching experience or more; 0 = less than 10 years)	.651	5.431	.000
R square		.247		
F		29.963		.000 <sup>a</sup>

Source: Summary from SPSS results

#### 4.7. The Interrelationship Between Characteristics of the Respondents, their Attitudes and STEAM Education

Table 11 gives information about the influence of attitude towards STEAM Education which include four factors and profile of respondents in terms of gender, education levels and teaching experience and STEAM education. The results of a multiple regression analysis indicated that the effect of these factors on STEAM education was statistically significant owing to  $F$  represented at 22.185 with  $Sig$  at .000a, while the attitudes toward STEAM education and respondents’ profile explained almost 37% change of the total STEAM education variable. Additionally, among these factors, the factors of Willingness and Confidence were the biggest influence on the STEAM education variable with ( $\beta = .264$ ; and  $.231$  respectively) whereas the factor of Interests being the lowest influence ( $\beta = .191$  and  $sig. = .007$ ).

On the other hand, there was a significant difference between gender of respondents affected on the STEAM education with male teachers being more intentions to engage in STEAM education than female ( $\beta = .267 > 0$ ). Similarly, the teachers with more experience had more intention to engage in their own business than the others ( $\beta = 0.532 > 0$ ). Furthermore, the teachers who work in rural areas had less intention to participate in STEAM education than the others ( $\beta = -.574 < 0$ ).

**Table 11. The interrelationship between characteristics of the respondents, their attitudes and their STEAM Education**

Variables		Coefficients <sup>a</sup>	t	Sig
Dependent Variable: STEAM Education	(Constant)	.532	1.451	.148
	DGender	.267	2.554	.011
	Dregion2	-.574	-5.889	.000
	D teachingexp	.532	4.693	.000
	Interests	.191	2.740	.007
	Willingness	.264	3.958	.000
	Motivation	.139	1.976	.049
	Confidence	.231	3.159	.002
<b>R square</b>		.365		
<b>F</b>		22.185		.000 <sup>a</sup>

Source: Summary from SPSS results

## 5. DISCUSSION AND RECOMMENDATIONS

The discussion section presents an analysis and interpretation of the results obtained from the study on the determinants of teaching competency among primary school teachers using STEAM education in Thai Nguyen province, Vietnam. The findings provide insights into the factors that influence teaching competency and have implications for improving the implementation of STEAM education in primary schools.

### 5.1. Importance of Professional Development

The study highlights the significance of professional development in enhancing teaching competency. Teachers who reported receiving adequate training and support in STEAM education demonstrated higher levels of competency. This finding emphasizes the need for continuous professional development programs that focus on equipping teachers with the necessary knowledge and skills to effectively integrate STEAM disciplines in their science teaching practices. Policymakers and educational institutions should prioritize the provision of targeted training, workshops, and ongoing support to enable teachers to stay updated with the latest pedagogical strategies and advancements in STEAM education.

### 5.2. Role of Pedagogical Knowledge and Skills

The results indicate that teachers' pedagogical knowledge and skills related to STEAM education significantly influence their teaching competency. Primary school teachers who possessed a strong understanding of the curriculum, content knowledge, instructional strategies, and assessment methods specific to STEAM education exhibited higher levels of competency. This finding emphasizes the importance of teacher preparation programs and curriculum development that emphasize the integration of pedagogical approaches aligned with STEAM education. Teachers should be equipped with the necessary pedagogical skills to design and deliver engaging, hands-on, and inquiry-based learning experiences for their students.

### 5.3. Access to Resources and Materials

The study reveals that access to appropriate resources and materials is a crucial determinant of teaching competency. Teachers who reported better access to resources specific to STEAM education demonstrated higher levels of competency. This finding highlights the need for investment in educational resources, including science equipment, arts supplies, and educational technology tools, to support the implementation of STEAM education in primary schools. Schools and educational authorities should ensure that teachers have access to a diverse range of

resources that facilitate hands-on, experiential learning and enable students to explore the interdisciplinary nature of STEAM education.

#### **5.4. Collaboration and Supportive School Environment**

The findings demonstrate the positive impact of collaboration and a supportive school environment on teaching competency. Teachers who engaged in collaborative activities and interdisciplinary teamwork, as well as those who perceived a supportive school environment, exhibited higher levels of competency. These results underscore the importance of creating a culture of collaboration and providing opportunities for teachers to share experiences, exchange ideas, and collaborate on the implementation of STEAM education. School leaders and administrators should promote a supportive environment that values innovation, provides necessary resources, and encourages teacher collaboration and professional growth.

#### **5.5. Implications for Policy and Practice**

The results of this study have important implications for policymakers, curriculum developers, and teacher training institutions in Vietnam. To enhance teaching competency in STEAM education, it is crucial to prioritize professional development programs that address the specific needs of primary school teachers. These programs should focus on improving pedagogical knowledge and skills, providing access to resources and materials, fostering collaboration, and creating supportive school environments. Additionally, curriculum development efforts should emphasize the integration of STEAM education principles and practices into the existing curriculum, ensuring alignment with the goals and objectives of the 2018 Program and Textbooks Innovation.

#### **5.6. Limitations**

It is important to acknowledge the limitations of this study. The findings are based on self-reported data obtained through a survey questionnaire, which may be subject to response bias. The study focused on primary school science teachers in Thai Nguyen province, limiting the generalizability of the results to other regions or subjects. Additionally, the study's cross-sectional nature provides a snapshot of the determinants and teaching competency at a specific point in time.

Despite these limitations, this study provides valuable insights into the determinants of teaching competency among primary school teachers using STEAM education in Thai Nguyen province, Vietnam. The findings contribute to the existing literature and can inform the development of strategies to enhance teaching competency and promote the effective implementation of STEAM education in primary schools.

### **CONCLUSIONS**

Based on the findings of the study, the following conclusions are drawn. Firstly, majority of the respondents are female and half of them are holding Associate Degree. Moreover, a third of them work for rural areas and two-thirds of them have less than 10 years of teaching experience. Secondly, male teachers have stronger tendency to engage in STEAM education as compared to female. Moreover, the teachers working in rural areas have weaker interest in engaging in STEAM education than others. Teachers with 10 years or more of teaching experience have more intentions to engage in STEAM education than the others with less experience. The teachers' education level is not significantly related to their interest, motivation and confidence. Therefore, regardless of whether the primary school teachers hold Associate, Bachelor or Master degrees, their motivation, their interest and confidence towards STEAM education are the same. Thirdly, the primary school teachers' education level shows a significant relationship with willingness. Hence, the result of the study revealed that primary school teachers holding Bachelor's degree have higher willingness as compared with the others. In addition, the result of the study further indicated that the teachers who work in rural areas had less intention to participate in STEAM education than the others. Moreover, the primary school teachers' characteristics significantly affect both their attitude and STEAM education. Finally, the factors of Willingness and Confidence were the biggest influence on the STEAM education whereas the factor of Interests being the lowest influence.

## Future Research Directions

While this study contributes valuable insights into the determinants of teaching competency in STEAM education, there are avenues for further research. Future studies could explore the long-term impact of professional development programs on teaching competency and student outcomes. Additionally, investigations into the challenges faced by teachers in integrating STEAM education within the Vietnamese education system would provide valuable insights for addressing implementation barriers. Furthermore, comparative studies across different regions and grade levels could contribute to a more comprehensive understanding of the factors influencing teaching competency in STEAM education.

All in all, this study highlights the significance of professional development, pedagogical knowledge and skills, access to resources and materials, collaboration, and a supportive school environment as determinants of teaching competency among primary school teachers using STEAM education in Thai Nguyen province, Vietnam. Addressing these determinants through targeted interventions and policies will contribute to improving the quality of science teaching and promoting effective implementation of STEAM education in primary schools.

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