

## STEM Teaching Skills of Primary School Teachers: The Current Situation in Ho Chi Minh City, Vietnam

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### Abstract

STEM education is an educational solution that prepares pupils for the future by connecting scientific knowledge with practical applications. This modern method of education is being widely applied in developing countries in order to maintain their scientific and technical standing and strengthen their competition in the global economy. In Vietnam, special attention has been paid to STEM education, as is demonstrated by the policies and guidelines of the Party and State. However, are the skills of the universal teaching staff, particularly in primary schools, sufficient to satisfy the demand for STEM education? A survey was carried out to analyze the current situation with regards the STEM teaching skills of primary school teachers in the district of Thu Duc, Ho Chi Minh City. By analyzing the survey results using SPSS, this article presents the current status of the STEM teaching skills of the primary school teachers in Thu Duc, Ho Chi Minh City, and suggests some solutions to improve and develop teachers' STEM education skills, suitable for the teaching conditions in Ho Chi Minh City, Vietnam.

**Keywords:** STEM education, STEM teaching competences, STEM learning topics, Thu Duc, Ho Chi Minh City, Teachers of primary school.

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### Contribution of this paper to the literature

This article provides the current status of primary school teachers' STEM teaching skills, and suggests solutions for improving the teachers' STEM teaching competencies to meet teaching requirements based on developing students' ability to apply their knowledge and develop creative problem-solving skills.

## 1. Introduction

Education in the subjects of Science, Technology, Engineering and Mathematics (STEM) focuses on teaching integrated and interdisciplinary topics and helping students to apply interdisciplinary knowledge of the subjects to solve practical problems, with the ultimate goal of comprehensively developing the pupils' abilities and competence. The increased importance of STEM subjects has created a demand for teachers to reform the content and teaching methods of their classes. However, STEM education is still relatively new to teachers in Vietnam, especially primary school teachers. Therefore, when attempting to implement STEM education in schools, the majority of primary school teachers are faced with difficulties. Many of these teachers have heretofore focused on teaching theory and have limited experience in teaching the practical applications of their subjects. Successful STEM education, however, requires a combination of theory and practice, of research and experience, in order to maximize pupils' creativity and help pupils to develop critical thinking skills and independent learning skills that allow them to apply their learning to good result. Therefore, in the context of the current curriculum, it is necessary to develop STEM teaching competency, for primary school teachers in Vietnam in general and Ho Chi Minh City in particular.

This article assesses the current state of STEM teaching competency of the teachers in the primary schools in the Thu Duc district, Ho Chi Minh City, and suggest solutions for improving this competency.

## 2. Literature Review

### 2.1. STEM and STEM Education

STEM Education is a program for increasing and improving the teaching of Science, Technology, Engineering and Math from primary school through to university level (U.S. Department of Education, 2007). The STEM approach aims to study and develop the four fields in an integrated way. Using this approach, students develop a variety of skills including: understanding of the subject matter, creation, analysis, group work, independent thinking, initiative, communication, and digital skills (What is Stem, 2020). STEM Education is an interdisciplinary approach to teaching, in which the learning of theory is combined with practical lessons. The students apply their knowledge of science, technology, engineering, and math in context, so that they make the connection between the class and the surrounding world. The importance of STEM Education is emphasized by the Next Generation Science Standards, as an improvement in the way that students are taught to understand and apply science. STEM Education is centered on the teaching format of carrying out a project in the class. The projects combine theoretical and practical knowledge and technology and emphasize the applications of science in order to prepare students for the future (STEM Education: Definition & Importance, 2019). STEM Education, thus, is a teaching program for science, technology, engineering and math, which is both interdisciplinary and practical. Instead of teaching the four subjects separately, STEM integrates them into a single model based on real world applications (Elaine, 2014).

There are many organizations that promote STEM teaching, and, although each organization defines their own goal, the overarching goal of STEM organizations is to promote the teaching of STEM subjects from an early age. This will benefit students when entering the job market, and in turn it will benefit the wider economy, which is the end target (Bdavis, 2012). Tsupros, Kohler, & Hallinen (2009) state that STEM Education is a method of interdisciplinary study where academic knowledge is closely combined with practical lessons through the application of theories of Science (S), Technology (T), Engineering (E) and Mathematics (M), introducing specific contexts which create a connection between school, community and business, to allow students to develop STEM skills and increase their competitive edge in the new economy. According to Rodger Bybee, the main purposes of STEM Education are: (1) To ensure that future generations of citizens have scientific and mathematical awareness and qualifications; (2) To create a skilled workforce for the 21<sup>st</sup> century (Bybee, 2010). The STEM model of teaching has been developed through the studies of Jean-Marie De Ketele and Xavier Roegiers since 1980. The theoretical and practical basis for implementing integrated interdisciplinary teaching in schools was agreed by the scientific community and ratified during the 1986 UNESCO conference in France. As argued by Roegiers (2004), there exists no natural state that corresponds to and can be described by a single field of the natural sciences in isolation. Rather, any natural state can be shown to be connected to two or more fields of study, and the division into separate fields or subjects is a tool we use to deeply research a particular phenomenon. Hence, firstly, there is no direct correspondence an object of research and any single field of natural science. Secondly, to focus on a single field is to decrease our understanding of the research object, whereas a deeper understanding becomes possible if methods from a variety of fields are applied – in short, an interdisciplinary approach. The interdisciplinary approach, hence, stands in opposition to the division into individual subjects for the purposes of analyzing and understanding natural phenomena (Roegiers, 2004). Thus, following Roegiers (2004), if a school splits the natural sciences in separate subjects to be taught, the danger is that students – despite comprehending the theory behind each subject – will be unable to apply their knowledge to real situations and daily life. Drake and Burns (2008) suggest the following trends in STEM Education:

- Multi-disciplinary integration: The multi-disciplinary integrated approach focuses on teaching separate subjects. The subjects have similar teaching methods and approaches to the content, but each subject has its own program. Each is characterized by practical applications of knowledge.
- Interdisciplinary integration: teachers come together to organize learning programs around common themes characterized by practical application.
- Cross-subject integration: teachers organize learning programs around themes that learners are interested in. Students develop life skills when applying subject and interdisciplinary skills to real life contexts.

It is clear that the studies by [Roegiers \(2004\)](#) and [Drake and Burns \(2008\)](#) advise creating a STEM Education program centered on the integration of subjects and connection with reality. These are the studies that developing countries are using to reform their teaching of Mathematics and Science to follow the STEM approach.

In Vietnam, a number of studies have been carried out into the teaching of Math and Science according to the ideals of the integration of subjects and connection with reality. In these studies, the authors compare traditional teaching methods with the STEM Education approach and identify the advantages of STEM Education. [Quang Bao Dinh and Ha \(2014\)](#) argue that the integration of the teaching of the natural sciences can best be achieved by uniting the educational contents in a single subject, that at the same time ensures the consistency of the subject's relevant contents and offers situations that require students to apply their skills and knowledge of the subject ([Quang Bao Dinh & Ha, 2014](#)). [Tran \(2006\)](#) considers that the integration of the natural sciences can best be achieved through an organic association, in which a single research object is studied through the lens of the different subjects, creating a unified content based on the theoretical and practical foundations of each subject, in order for students to develop the necessary skills ([Tran, 2006](#)). The integrated subject combines the content of two or more fields of the natural sciences and must related to local current affairs, or a real situation in local life, to allow the knowledge of these fields to be applied in practice ([The Ministry of Education and Training, 2014](#)). [Nguyen \(2019\)](#) reports the results of a 2007 study of over 10,000 people from 48 nations, which showed that the majority consider happiness to be more important in life than success, intelligence, knowledge, relationships, or wealth. One key to happiness is to cherish and exercise our innate curiosity for learning about the world around us ([Nguyen, 2019](#)). So, in the current education era 4.0, which educational model is capable of satisfying students' curiosity and helping them to discover the surrounding natural world in order to increase their happiness? [Nguyen \(2019\)](#) answers this question as follows: for many careers, especially in the fields of Mathematics and the natural sciences, curiosity, combined with knowledge and skills, helps to achieve many innovations, inventions and breakthroughs. It is a positive and happy psychological state ([Nguyen, 2019](#)). [Huynh \(2018\)](#) argues that the abovementioned knowledge and skills should be integrated, combined and molded to each other in order to help students to not only understand the principles, but enable them to apply them in practice and create products connected with reality ([Huynh, 2018](#)). [Bui and Le \(2019\)](#) posit that, in order for skills to be developed through STEM education, the STEM approach should be based on the integration of technology and study by means of the project. In this way, students develop the important skills for the 21<sup>st</sup> century: analytical skills; scientific skills; the technology skills; engineering skills; mathematical skills; communication and cooperation skills; the skill for invention by means of problem-solving and developing new ideas; leadership skills; organizational skills. Besides these, STEM education allows students to develop critical thinking and argumentative skills ([Bui & Le, 2019](#)). [Nguyen et al. \(2019\)](#) examined the research of [Becker and Park \(2011\)](#) on the effects of STEM Education and concluded that the impact of STEM on students' study skills is greatest in primary education and at least in university education ([Nguyen et al., 2019](#)). In general education, and particularly in primary education, the STEM approach currently plays an important role in determining teaching methods and developing learners' qualifications. [Bui and Nguyen \(2020\)](#) conclude that STEM Education equips students for the key skills of the 21<sup>st</sup> century, aside from the skills of Science, Technology, Engineering and Math. Through STEM Education, students have the opportunity for self-study, self-searching, discovery, invention and solving actual issues. Teaching that follows the STEM Education approach helps primary pupils to develop the necessary qualifications for research, invention and acquiring new knowledge, through practical application of the skills they are developing. For this reason, it is necessary that within the current Vietnamese educational context primary pupils are taught using the STEM Education approach ([Bui & Nguyen, 2020](#)).

Research conducted by [The Ministry of Education and Training \(2014\)](#) on the integrated teaching materials for teaching in general schools shows the shortcomings of the content-oriented program and the method of teaching by subject:

- (1) Too heavy on theoretical analysis, with no practical orientation and action.
- (2) Insufficient in developing interpersonal skills (communication skills).
- (3) Theory and practice are separate, having little relationship.
- (4) Does not foster group work.
- (5) The content is duplicated.
- (6) Not fitting within the trend for lifelong study.

Studies in the country also show the advantages of the qualification-oriented program, which are based around a core integrated curriculum of Math and Science – an early form of the STEM approach:

- (1) Association between study and work.
- (2) Study is in parallel with practice, with a focus on operational qualifications.
- (3) Teaching aims to develop operational abilities, especially in problem-solving.
- (4) Encourages learners to study more comprehensively (not only for professional knowledge but also the application of this knowledge).
- (5) The teaching content has a dynamic nature.
- (6) The learners are more active and independent and take initiative.
- (7) The students comprehensively develop the capacities for communication, cooperation, critical thought, invention, problem-solving.

To sum up, the STEM Education approach can be understood as a teaching approach that is based on an interdisciplinary connection between at least two of the fields of Science, Technology, Engineering and Math, in which theoretical learning is connected with practice in order to comprehensively develop the skills, qualities and qualifications of the students.

## **2.2. STEM Teaching Competencies**

In Vietnam, primary schools are aiming to develop teaching competency in general, and, in particular, integrated teaching competencies of Math and Science, which is the first step towards developing STEM teaching competency. This area has garnered much attention from educational researchers, who have researched the

theoretical basis for developing integrated teaching qualifications for primary school teachers in general, and an integrated Math and Science curriculum, a form of STEM Education, in particular.

Tran (2006) provided some basic concepts concerning the development of integrated teaching competencies (in particular of the natural sciences) in Vietnam general schools: the viewpoints, goals, content and methods of integrated pedagogy, the conditions and prospects for an integrated curriculum in general, and the development of teaching qualifications in integrated natural sciences (Tran, 2006). Huynh (2018) suggested that teachers have come to understand the importance of integrating math with practical applications, from which logically follows the integration of math with natural sciences, which helps teachers to develop their teaching competencies, and enables them to build towards the development of STEM teaching competency (Huynh, 2018).

In the case of teacher training schools, integration of subjects in the teacher training process is also the object of a great deal of research, for instance, Dinh (2003) argued that the integration of basic science training in education should start with the integration of subjects in teacher training schools. Huynh (2018) argued that in order to achieve STEM education, teachers should teach an integrated form of Math and Science that connects to practical real-life applications (Huynh, 2018).

From the initial research on STEM Education and the development of qualifications for teaching STEM Education, Vietnamese researchers have confirmed the development of an integrated curriculum qualification in general, and the development of STEM teaching competencies in particular, as one of the inevitable trends in teaching at present.

### 3. Research Methodology

#### 3.1. The Argumentative Method

This study will utilize the method of argumentation in order to systemize the viewpoints and conclusions of previous research and put across the arguments of the authors as informed by the current study.

Analysis, generalization and synthesis will be employed with regards the source materials, both domestic and international, in order to search for terms relating to the topic, such as: STEM, STEM Education, STEM teaching competencies, and on this basis to create a system describing the dialectical relationships between the theoretical problems, from which to fully and comprehensively understand the terms and concepts, and any other issues related to the research problem.

#### 3.2. The Survey Method

A survey was carried out to assess the current state of STEM teaching competency among primary school teachers in Thu Duc, Ho Chi Minh City, and, on that basis, to propose measures to develop the STEM teaching competency of these teachers in order to contribute to the development of the quality and qualifications of primary school pupils in Thu Duc, Ho Chi Minh City.

The survey covered the following themes:

- (1) The current situation of teachers' awareness of the aims of STEM Education.
- (2) The extent to which teachers are currently qualified to select practical problems for use in the construction of STEM learning topics.
- (3) The extent to which teachers are currently qualified to develop interdisciplinary knowledge (science, technology, engineering and maths) in connection with the practical application thereof.
- (4) The extent to which teachers are currently qualified to design STEM learning topics.
- (5) The extent to which teachers are currently qualified to organize and instruct STEM curriculum topics.
- (6) The extent to which teachers are currently qualified to examine and assess students in STEM education.

There are 26 public primary schools within the district of Thu Duc. In order properly evaluate the current situation for developing primary school teachers' STEM teaching competencies in Thu Duc district, Ho Chi Minh City, a survey sample was selected that included teachers from 26 of the 26 primary schools in the district. A total of 600 surveys were issued, and 600 were completed and received back (100%).

By combining theoretical research with the knowledge of the practice of STEM education at the primary schools in question, a questionnaire was developed with clear content that was easy to understand but still ensured scientific accuracy. The questionnaire was designed with many questions and many options for answering each question. The researchers were present while the teachers were completing the survey, so that any questions on the part of the teachers could be answered promptly.

After gathering the data, it was entered into an Excel spreadsheet. SPSS 23 was then used to conduct the analysis and calculate the average frequencies.

The results of the statistical frequency calculation showed that the object of research is suitable for the purposes of research. The Percent column and the Valid Percent column indicate the same value, which means that there is no invalid data. The results of descriptive statistics show a standard deviation of about (0.600; 0.900). Because this is under 1, it indicates that the collected data fluctuates in concentration around the average value. In order to examine the internal consistency of the scale, a Cronbach's Alpha test was conducted for each question. The test result shows that the observed variables have the correlation coefficient of general variables (Corrected Item-Total Correlation) which is suitable ( $> 0.3$ ), and the coefficient Cronbach's Alpha  $> 0.6$  therefore it passes the demand for internal consistency.

### 4. Results and Discussion

#### 4.1. The Survey Results of the Current State of Teachers' Awareness of the Aims of STEM Education

The survey results in Table 1 show that the teachers have a fairly good awareness of the goals of STEM education in primary schools. However, 23.00% of teachers fail to agree with statement (1) The purpose of STEM education is to help students to apply their knowledge, experiences, skills, and attitudes in order to act suitably and effectively in their actual life situations; 23.70% of teachers fail to agree with statement (2) STEM education aims to help students to form and develop reading comprehension skills, computational abilities, problem solving abilities, communication skills, etc., as well as the specific competencies of each subject; 23.20% of teachers fail to

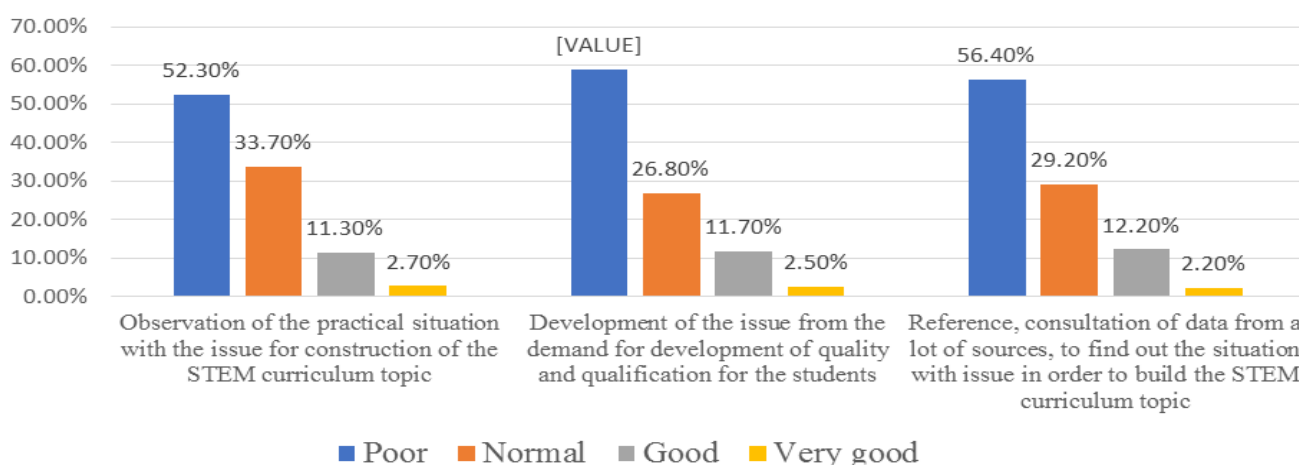
agree with statement (3) STEM education is the organization of teaching activities towards forming and developing students' qualities and competencies in order to prepare students to be able to solve practical problems; 18.80% of teachers fail to agree with statement (4) STEM education increases the potential and discovers and develops the qualities and abilities of the students themselves. Hence, there still remain some teachers who have not clearly understood the aims of STEM education in primary schools.

**Table-1.** The current situation of teachers' awareness of the aims of STEM education in primary schools in Thu Duc, Ho Chi Minh City.

Statements	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
(1) The purpose of STEM education is to help students to apply their knowledge, experiences, skills, and attitudes in order to act suitably and effectively in their actual life situations.	5.50%	17.50%	58.30%	18.70%
(2) STEM education aims to help students to form and develop reading comprehension skills, computational abilities, problem solving abilities, communication skills, etc., as well as the specific competencies of each subject.	4.70%	16.00%	58.30%	21.00%
(3) STEM education is the organization of teaching activities towards forming and developing students' qualities and competencies in order to prepare students to be able to solve practical problems.	4.70%	18.50%	55.50%	21.30%
(4) STEM education increases the potential and discovers and develops the qualities and abilities of the students themselves.	4.40%	14.50%	59.30%	21.80%

The above analysis of the current situation shows that the educational service needs to continue training to enhance teachers' awareness of the aims of the STEM curriculum in primary schools.

#### 4.2. The Survey Results of the Current State of Teachers' Competency in Choosing Practical Problems for Developing STEM Learning Topics



**Figure-1.** The current situation of teachers' competency in choosing practical problems for developing STEM learning topics.

The survey results in Figure 1 show that only 14% of teachers do well in choosing real-life problematic situations to develop STEM learning topics; 15.20% of teachers do well in choosing problems with an eye to developing students' qualities and qualifications; 14.40% of teachers have the ability to consult many sources of information to choose practical problems to develop STEM learning topics.

The survey results thus suggest that the teachers' ability to choose practical problems to develop STEM learning topics is not yet at a high level. This might be explained by the fact that the current educational program inclines toward theoretical knowledge and less towards the practical application by students. Teachers thus are less inclined to examine students' actual experiences that a lesson could be applied to, rather than prepare them for tests by having them commit theoretical knowledge to memory. As a consequence, students are less able to connect the studied theory with real life and students lack skills to apply their knowledge.

In summary, this survey result suggests that teachers' skills need to be improved in the area of choosing practical problems for developing STEM learning topics, at least in the case of primary school teachers in Thu Duc, Ho Chi Minh City.

#### 4.3. The Survey Results of the Current Situation of Teachers' Competency in Interdisciplinary Theory (Science, Technology, Engineering and Math) and its Application

The survey results in Table 2 indicate that there are 61.8% teachers with good ability and 2.80% teachers with very good ability in knowing the mathematical theory associated with a practical problem and being able to apply the mathematical theory to solve the problem; and 60.80% teachers with good ability and 2.30% teachers with very good ability in knowing the scientific theory associated with a practical problem and being able to apply the

scientific theory to solve the problem. But there are only 10.70% teachers with good ability and 2.70% teachers with very good ability in knowing the interdisciplinary theories required to solve a practical problem, and there are only 10.80% teachers with good ability and 2.00% teachers with very good ability in applying theories of technology and engineering to solve a practical problem.

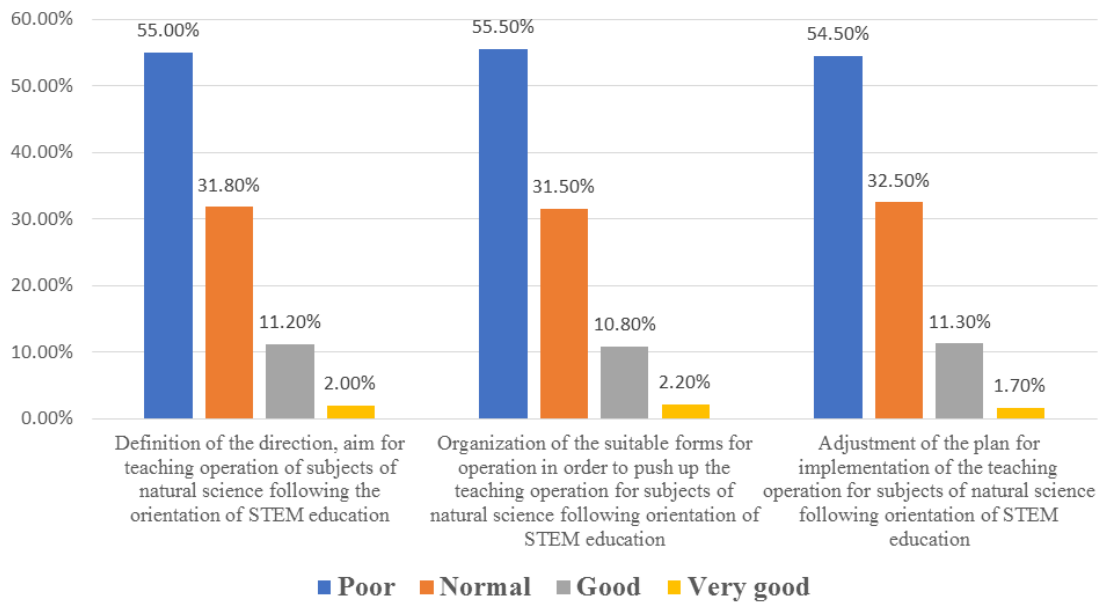
**Table-2.** The current situation of teachers' competency in interdisciplinary knowledge (science, technology, engineering and math) and its application.

Objective	Poor	Normal	Good	Very good
(1) Knowing the mathematical theory associated with a practical problem and being able to apply the mathematical theory to solve the problem.	10.60%	24.80%	61.80%	2.80%
(2) Knowing the scientific theory associated with a practical problem and being able to apply the scientific theory to solve the problem.	11.50%	25.30%	60.80%	2.30%
(3) Knowing the interdisciplinary theories required to solve a practical problem.	56.80%	29.80%	10.70%	2.70%
(4) Applying theories of technology, engineering to solve a practical problem.	56.20%	31.00%	10.80%	2.00%

The above results demonstrate that currently teachers' knowledge of which interdisciplinary theories (science, technology, engineering and math) are required for solving a practical problem and the ability to apply technological and technical knowledge to solve practical problems is still at a very low level. Meanwhile, interdisciplinary teaching is one of the requirements for teachers to be able to encourage students to apply the knowledge they have learned to solving problems in real life.

The results suggest that, in order to improve STEM teaching in primary schools, teachers' competencies in developing interdisciplinary knowledge (science, technology, engineering and math) and the practical application of this knowledge need to be improved.

#### 4.4. The Survey Results of the Current Situation of Teachers' Competency in Designing STEM Learning Topics



**Figure-2.** The current situation of teachers' competency in designing STEM learning topics.

The survey results in Figure 2 are as follows. For the objective "Defining the aim of teaching the natural sciences following the STEM education approach", only 11.20% of teachers achieve the level Good and 2.00% of teachers achieve the level Very Good. For the objective "Organizing suitable teaching methods to enhance the teaching of the natural sciences following the STEM education approach", only 10.80% of teachers achieve the level Good and 2.20% of teachers achieve the level Very Good. For the objective "Adjusting the teaching plan of the natural sciences following the STEM education approach", only 11.30% of teachers achieve the level Good and 1.70% of teachers achieve the level Very Good.

These results show that, although teachers are aware of STEM education, the application of the approach in designing STEM learning topics is not yet satisfactory and teachers have a lot of difficulties. Indeed, the primary teachers have been trained in STEM education methods but are not able to apply these methods in the classroom. The practice of STEM education for primary teachers is essentially confined to seminars and some teaching forums, in which they can share experiences with one another.

Thus, the training in the design of STEM learning topics is an important improvement to be made in the development of primary school teachers' STEM teaching competencies, and one that needs to be implemented soon.

#### 4.5. The Survey Results of the Current Situation of Teachers' Competencies in Organizing and Instructing STEM Learning Topics

The survey results show that, generally, performance in the objectives is judged to be at the Good or Very Good level, with most respondents scoring in these categories (about 70%). This is an accurate picture of the

current situation. In recent years, primary teachers have changed their approaches and use of teaching methods to incorporate active teaching into the teaching practice.

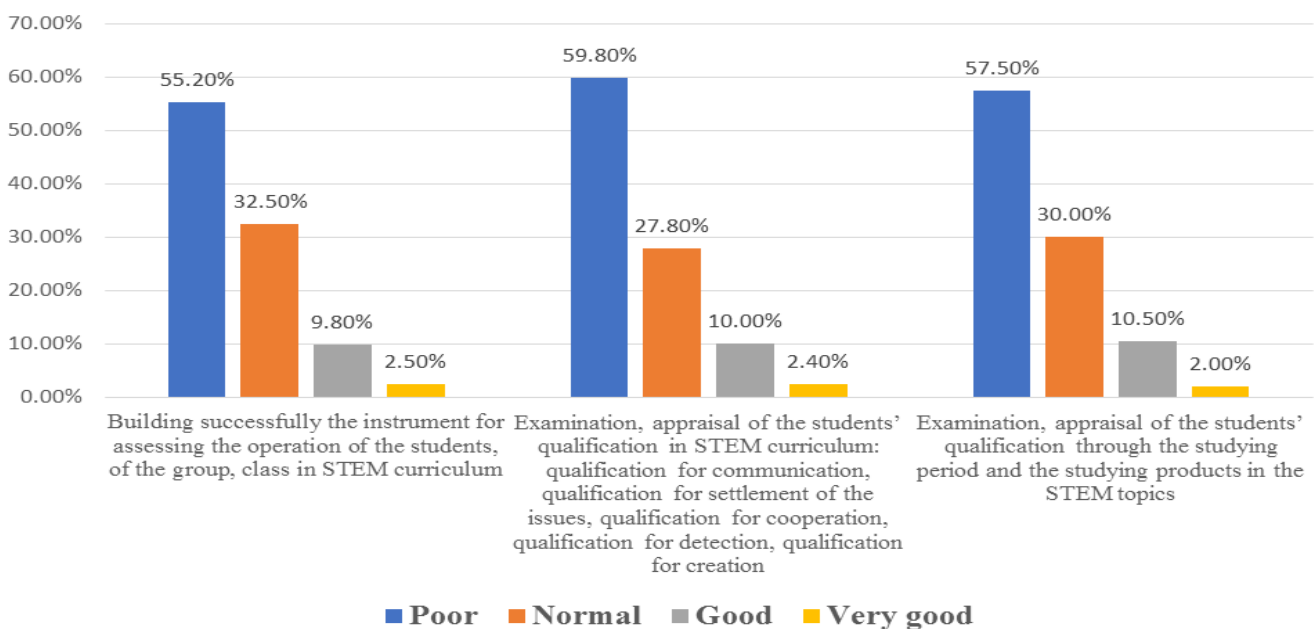
**Table-3.** The current situation of teachers' competencies in organizing and instructing STEM learning topics.

Objective	Poor	Normal	Good	Very good
(1) Combining traditional teaching methods with active teaching	2.30%	24.70%	63.30%	9.70%
(2) Using modern teaching means effectively	1.80%	26.50%	61.30%	10.30%
(3) Applying the methods for teaching math in class with teaching personality	2.80%	20.20%	65.70%	11.30%
(4) Combining teaching in the class and teaching outside the class	2.30%	32.50%	56.80%	8.30%
(5) Dividing the group flexibly, creatively, suitable for each topic	7.00%	24.30%	58.30%	10.30%

However, in the case of objective (1) Combining traditional teaching methods with active teaching, there are still 2.30% of teachers at the level Poor, and 24.70% of teachers at the level Normal; in the case of objective (2) Using modern teaching means effectively, there are still 1.80% of teachers at the level Poor, and 26.50% of teachers at the level Normal; in the case of objective (3) Applying the methods for teaching math in class with teaching personality, there are still 2.80% of teachers at the level Poor and 20.20% of teachers at the level Normal; in the case of objective (4) Combining teaching in the class and teaching outside the class, there are still 2.30% of teachers at the level Poor, and 32.50% of teachers at the level Normal; and particularly in the case of objective (5) Dividing the group flexibly, creatively, suitable for each topic, there are still 7.00% of teachers at the level Poor, and 24.30% of teachers at the level Normal. Thus, there is still a relatively large number of teachers who do not yet believe themselves to be well-qualified in the area of organizing and instructing STEM learning topics. This may be because these primary teachers have not yet been expertly instructed on STEM teaching and learning methods – specifically the characteristic of STEM education as “learning through application”, which helps students apprehend the knowledge through practical experience, not just through theory. In order to effectively achieve “learning through application”, the teacher needs to be able to divide the student group, to create the conditions under which each student in each group can participate directly in the operation, and under which each group can construct a strategy for action and, through their group work, form and develop the necessary qualities and qualifications. If teachers are proficient and confident in the STEM teaching and learning methods, then they can organize for the students to work in groups effectively.

The above analysis shows that, in order to develop the STEM teaching competencies of primary school teachers in Thu Duc district, Ho Chi Minh City, it is necessary to improve teachers' capabilities for organization and instruction of STEM learning topics.

**4.6. The Survey Results of the Current Situation of Teachers' Competency in Evaluating Students' STEM Learning**



**Figure-3.** The current situation of teachers' competency in evaluating students' STEM learning.

The survey results show that 55.20% of teachers still rate themselves as Poor in regards the construction of appraisal instruments for students', groups' and classes' performance in the STEM curriculum; 59.80% of teachers are rated Poor in regards the examination and appraisal of students' skills in the STEM curriculum: communication skills, problem-solving skills, cooperation skills, critical thinking skills, and creative skills; 57.50% of teachers are still rated Poor in regards the examination and appraisal of students' skills by means of the learning products of STEM learning topics.

From these results, it is clear that the primary teachers' skills of examination and appraisal of the students in STEM education are still very limited. This result was expected, considering the state of education in Vietnam in general, and the state of primary education in Thu Duc in particular, which is in the process of moving from a theory-oriented approach to teaching and learning to a skills-oriented approach. Teachers are familiar with a

quantitative assessment of students and often neglect to ensure that the necessary competencies are developed through applied learning.

In summary, to achieve a new universal education program based on the STEM approach, it is necessary for primary teachers to be trained in the skills of examination and appraisal of students' skills in STEM education.

## 5. Discussion

Throughout the Vietnamese education system, a shift is currently taking place to integrate STEM teaching practices and, in order to achieve this, it is urgent and necessary to develop teachers' STEM teaching skills, particularly in primary schools. But as the survey results indicate, the STEM teaching competencies of primary school teachers in Thu Duc district, Ho Chi Minh City, are still very limited. Based on the current situation, the following suggestions are made to improve the STEM teaching competencies of the primary school teachers in Thu Duc district, Ho Chi Minh City:

- Teachers must be trained in integrated interdisciplinary teaching skills and trained in using modern teaching methods.
- Teachers must be trained to enhance their awareness of STEM teaching skills.
- All stakeholders in the school system in Thu Duc district, Ho Chi Minh City, must be educated in the short-term and long-term advantages of STEM education.
- Teachers must be trained in the contents and implementation process of STEM teaching activities.
- Domestic and international documents must be consulted to ensure teachers improve in the areas of developing students' skills, creating suitable appraisal methods, active teaching, interdisciplinary integration, practical application of teaching, and selecting STEM learning topics suitable for Vietnamese primary pupils.
- Teachers must participate in training classes relating to the STEM approach and must further their understanding of STEM education by means of textbooks and journals.
- Teachers must be trained to develop STEM curriculum topics.
- Teachers must be assisted in connecting the theory, subjects, contents, methods, and active teaching that are required for the STEM approach to learning topics.
- Teachers must connect the application with the theory of each separate school subject to ensure a STEM approach to the curriculum.

## 6. Conclusion

The result of the survey indicates that the STEM teaching competencies of the primary school teachers in Thu Duc, Ho Chi Minh City, are still at a low level. Meanwhile, STEM education is an integral part of the new universal education program in Vietnam. The particular characteristics of the STEM teaching approach require: teaching connected with practical applications, an integrated interdisciplinary curriculum, and the teacher serving as organizer, instructor and activator of the students' work. A teacher who has good STEM teaching skills will help students to study more independently and actively, enabling students to develop the desired knowledge, skills and attitudes. These skills and qualities respond to the demand for innovation of the education sector, and include: self-control and self-study, communication and cooperation, problem-solving and innovation, language, calculation, inquisitiveness about nature and society, etc. The teacher holds the role of organizer, for good instruction will contribute to students acquiring the basic knowledge and skills. At the same time, the teacher has a great deal of influence on the development of students' attitudes and thought processes. In the new education program, the teacher develops students' creative abilities as well as their thinking. In each teaching period, it is the teacher's responsibility, using his/her pedagogic skills, to organize, instruct, and conduct all operations regarding the students, to ensure that the children become empowered, independent thinkers, who search out knowledge and apply it in practical situations to good results. The result of the STEM approach is the crystallization of the students' qualities and skills, developed through practical activities, with the self-awareness to act independently. Thus, STEM teaching competency is an important factor that contributes to the development of pupils' qualities and skills, both in primary schools generally, and in Thu Duc, Ho Chi Minh City, in particular.

STEM education is important in the school system, in order to prepare students to respond the demands of the new industrial/technological revolution, especially if it begins in primary school. If STEM education can soon be effectively deployed in primary schools, particularly in Thu Duc, Ho Chi Minh City, it will create a generation of citizens with all the qualities and skills required to improve their lives, and those of their families, and contribute to the development of Ho Chi Minh City. However, the results of this study show that the current level of STEM teaching skills among the primary school teachers in Thu Duc district, Ho Chi Minh City, needs to be improved by deploying solutions aimed at improving and developing these skills. This will enable the primary school teachers to implement high-quality STEM teaching activities, which in turn will develop the qualities and skills of the students; the teachers' effective organization and instruction will help the children become active, self-aware, independent learners.

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