INTEGRATING ART WITH STEM EDUCATION-STEAM EDUCATION IN VIETNAM HIGH SCHOOLS

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ABSTRACT: STEAM stands for Science (S), Technology (T), Engineering (E), Art (A), and Mathematics (M). STEAM is essentially intended to equip learners with the necessary knowledge and skills related to the fields of science, technology, engineering, art and mathematics. These knowledge and skills must be integrated and complementary to help students not only understand the principles but also be able to practice and create products in daily life. In the context of the ongoing 4.0 industrial revolution, jobs in the social sector related to the field of STEAM education tend to increase. In this study, the author investigated 120 students from five regional high schools in Viet Nam, 45 high school teachers in order to understand the current status of STEAM education in Vietnam high schools, then give some recommendations for the development of STEAM education in high schools in Vietnam. The results are as follows: students recognized the meaning and necessity of STEAM education as a problem-solving procedure that resulted in increased STEAM literacy and a development of concepts through sharing opinions. Most students indicated that they would frequently make use of the knowledge they learned in the STEAM program in their science class because it allowed them to have a better understanding of the problem-solving process. Therefore, STEAM programs as develop creative problem-solving abilities by introducing new ideas

KEYWORDS: STEAM, Science, Technology, Engineering, Mathematics, Arts integration; education; creativity; 21st century skills.

1. INTRODUCTION

STEAM stands for Science (S), Technology (T), Engineering (E), Art (A), and Mathematics (M). STEAM education expands the relevance of STEM education by adding the arts (Maes, 2010). STEAM is essentially intended to equip learners with the necessary knowledge and skills related to the fields of science, technology, engineering, art and mathematics. These knowledge and skills must be integrated and complementary to help students not only understand the principles but also be able to practice and create products in daily life.

According to ([KC16]), The recent high-paced development of science technology has led to increases in globalization, convergence, diversification, and unpredictability. As a result, future scientists will not only need to have a solid foundation in STEM education, but they will also need to develop the creative problem solving and global expertise that is fostered through an education in the arts.

In the current trend of globalization, the interaction between different cultures and educations is very significant. Being a fast developing country, Vietnam is inevitably acquiring modern educational achievements in the world in order to promote the education of Vietnam and serve the socio-economic development of Vietnam.

In the context of the ongoing 4.0 industrial revolution, the jobs and professions in society related to the fields of STEAM education tend increase, for example: computer science, digital green technology, automation technology, artificial intelligence, space science and aviation, etc. The STEAM curriculum is designed to train young generations academically, then encourage their inside creation. We need new ideas, new solutions to current and future problems. STEAM education awakens "artists" within the generations of students so that they can become real global citizens. Innovation from STEM to STEAM is essential to improve our education. Whether you are an artist, designer, technology engineer, scientist, the transition to STEAM is urgent; Creativity is a prerequisite for our educational development. No one can deny the importance of art education, which brings innovation to our lives and our future.

At present and in the future the number of employees involved in the fields of STEAM education will also increase. Therefore, high schools need to equip their students with the knowledge, skills and career guidance. To do this, the first factor must be the teacher who is capable of teaching from the perspective of STEAM education.

At the high school level, STEAM requires and equips students with skills in assessing their career, interests, opportunities and development in the historical, present and future context, from the local scope to the globe. They learn and apply knowledge

from the background up to the specific skills and discipline through the implementation of real-world projects and the latest updates on relevant areas. Students also have the opportunity to self-assess their passions, interests, experiences and talents in order to improve the development of each individual day by day. This is extremely useful for students to pursue their future aspirations after graduation. With these advances, we believe that STEAM will help educate students - at every level and ability to become global citizens in their own communities.
This study is indeed practical in the development of high school teachers to capture the achievements of theoretical research, STEAM education in the world, help develop the education of Vietnam towards the development of comprehensive human.

2. METHOD

2.1. Research Questions

This study aims to answer the following questions:
1. What is the necessity of Arts in educational innovation towards STEAM education?
2. What is the current status of STEAM teaching in Vietnam high schools?

2.2. Research Design

This study was designed to explore the STEM education perspective and the need for Arts in the evolution of 21st century educational approaches towards the STEAM education model; research on the state of teaching in STEAM education at high schools in Vietnam; learn the difficulties of teachers and students in the teaching and learning process following STEAM education.

2.3. Participants

The survey was conducted on a sample of 120 students at three levels of education in 5 high schools (Nguyen Hoang High School, Thanh Hoa Province; Xuan Giang High School, Hanoi; Le Hong Phong high school, Dong Nai Province; Nong Cong 2 High school, Thanh Hoa Province; Ha Long High School, Quang Ninh Province) and 45 teachers teaching at high schools in Vietnam. Each school set up two groups and team members were randomly assigned in each school;
The main investigation method is asking the groups to solve the task in the context, then answer the questionnaire. Here, I use the cross-sectional survey with the data collected at the time of the 2017-2018 school year. Besides, I also designed two questionnaires to survey 45 teachers for the research process.

2.4. Data Collection Tools

The experimental process consists of two phases:
+ Phase 1 (from September 2017 to November 2017): Design learning projects and questionnaires.
+ Phase 2 (from November 2017 to February 2018): Conducting survey.
I have conducted the investigation for 2 consecutive days. For each surveyed group, I discussed some of the basics of this research with teachers and students, including the purpose, meaning of the study to help students understand the importance of study, their role in research and how to participate. The requirement for students is that they work comfortably in teams (collaborating, co-ordinating STEAM skills) and demonstrate their competence. Students were very interested in this research topic and the way of participating. Then, students were organized in groups (8 students/group) to participate in the learning project (performing the task according to the context) with a duration of 2 days. After completing the task, I gave students the questionnaire and asked for the answer, then took it back. I also emphasized the meaning of the data collected from the questionnaire and asked the students to answer honestly, frankly just as their thoughts.
In addition, I gave 2 questionnaires of relevant content about STEAM education to the teachers.

2.5. Data Analysis

In this study, to interpret the data, I used the following methods:

- Theoretical approach: to point out the need to conduct this study. I have studied and researched many STEM/STEAM-related materials and the paradigm shift from STEM to STEAM to gain an overview of research issues and theorical frameworks for this study.
- Survey-observation methodology was used to collect data on teaching activity from the STEAM perspective of teachers and students in high schools. I use this method to conduct a survey of 120 students and 45 teachers on the difficulties of teaching and learning STEAM through specific tasks, as well as the attitude of students and teachers about the STEAM education perspective
- The experimental method of education was conducted to collect data related to teaching from the viewpoint of STEAM education, from which to test the practical implications of the study as well as to point out the difficulties that teachers and students encounter in approaching STEAM education, then suggest ways to limit difficulties and improve the progress of high school students in Vietnam.

Data sources for this study include: previous studies on STEM/STEAM education; observation; and answers from students and teachers' questionnaires.

I did not record student paper grades, as it does not make much sense for this study.

For each of the small questions in each assignment, I scored, statistically counted the percentage (%) of students achieving each grade point, calculated the average score of the respondent and the number of students gained over average score. By analyzing what students do on the task and on an assessment scale, I evaluated student progress in the context of solving tasks and difficulties that students and teachers may encounter... In addition to the evaluation based on the score, the study focused on the analysis of the product, the results of addressing the task of students, emphasizing STEM skills and artistic creativity in every product.

With the questionnaire, I statistically state the percent of students who agree with the assertions at given levels. The conclusions drawn from the analysis of questionnaires and questionnaires will help answer the research questions.

Example: Making lanterns for the Mid-Autumn Festival in Vietnam (by T.V. Cuong and L.H. Quang, [TL18])

i. Objectives

- To reinforce the concept of area of circle, triangle, hexagon, cubic ...
- To develop imagination of space, aesthetics.
- To recognize the efficient conversion of electrical energy into light.
- To design and build models using different materials and to test the functionality of the construction model with the selected materials.

ii. Knowledge link

The project is related to:

- *Mathematic:* Learn about units, scales, area formulas, some figures
- *Physical:* Relationship between the tension of bamboo sticks, steel rods, plastic rods to the curvature of rods, ...
- *Technique:* Assemble the details of the lantern
- *Technology*: Using safe, simple materials easy to use, environmentally friendly ...
- *Art:* Students need to be creative in every detail to design products that are user-friendly, user- and attract students and users; Experimental design of some sample lanterns

Prerequisites: Understanding the relationship between cubes in space, the tolerance of materials.

iii. Resources required

- Spreadsheet, bamboo stick, wooden stick, plastic rod, ... computer, scissors, pliers, small steel wire, rubber wire, glue, small wires with two intestines, led or Incandescent type 6V to 12V.

iv. Activity description

- **Activity 1**

To reinforce the lantern model, students and teachers raise questions, discuss ideas.

Discussion questions:

1. Identify the basic structure of some lanterns?
2. Recommend material to make some parts of lanterns? materials should be easy to find, inexpensive and safe.
3. Outline the design of each model on the drawing.

Notes for teachers:

Students are divided into groups and provide relevant links. They can prepare and make frames for lanterns.

Figure 1. A frame for lantern

- **Activity 2**

1. Groups outline models and details on paper, on the floor, ...
2. Each group is given a work table. Students complete Worksheet 1 and present the results.
3. Students collect data and complete part 2 of the worksheet.

Discussion questions:

1. For models using plastic rods, plastic tubes, we need to note the problems in the design
2. For models using bamboo sticks, what issues do we need to address in designing, assembling?

- **Activity 3**

Discuss with students to convert one-way electrical energy to light for lanterns; using colored paper, glossy paper to glue the sides of the lantern and create a beautiful light.

Discussion questions:

1. Design the pattern on the sides of lanterns by combining colored paper or art paper, painting art

Estimate the amount of art paper, art color paper (can be many different color papers), avoid wasting paper. What is the relationship between the design, animation, color paper, art paper color?

Notes for teachers

1. In order to save time, teachers can allow students to complete part 2 of the worksheet by using a computer.
2. Teachers can remind students how to use rulers for measurement.

Integration and Application:

- Science: Convert electrical energy to light.
- Technology: Sample design and appropriate material selection.
- Technique: Making technical products, assemble them into lantern models following the design.
- Mathematics: Calculate the area of the models in two-dimensional and three-dimensional space; estimate the cost of materials ...
- Art: Remain innovative design, minimal components, aesthetics materials, friendly with the environment, creating the inspiration for the user.

This project product relates mainly to the following general skills:

1. Collaborative skills
- Collaboration in groups
- Sharing responsibility and understanding the role of each member in building the lantern model.

2. Creation
- Improve and refine the design of the lantern
- Problem-solving skills
- Propose different solutions to increase the aesthetics and ease of making lanterns.
- Put into trial the different designs of the lantern in order to improve usability, environmentally friendly to user…
- Try and improve the solution through various experiments.

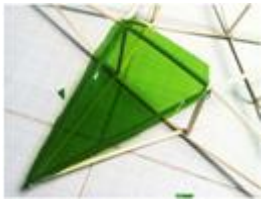
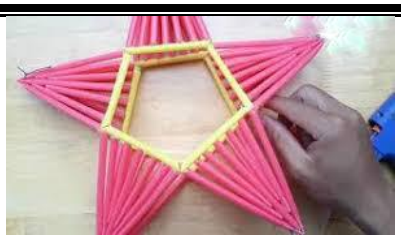
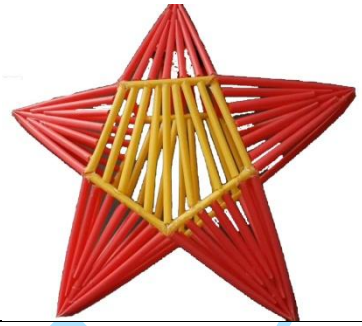
Worksheet

- **Student activity records of Group A and Group B are as follows:**

	Ideas for the model	Drawing
Group A	Model of star-shaped lantern made of bamboo sticks	---
Group B	Model of lantern made of plastic straws	---

One student represents each of the groups describing the drawings, explaining the source of materials and how they are produced

- **Student activity records of groups A, B, and C are as follows:**

	Model drawing	Products
Group A	The stars are made of bamboo sticks, pasted with glossy blue paper	 
Group B	Lanterns are made of pink and gold yellow plastic straw	 

3. FINDINGS

3.1. Answer the first question: What is the necessity of Arts in educational innovation towards STEAM education?

There has been a long time at schools from elementary to colleges in many countries, where students study separate subjects in Science, Technology, Engineering and Mathematics. Each subject is taught separately. Students receive content in individual subjects, and these teaching methods rarely have a common although concepts and theories are interrelated in each content at each time of learning. There are a number of teachers who are beyond the scope of their teaching positions to share with the other subjects. However, it is only few teachers experimenting with integrated teaching methods.

The Correlation of Science conference in Cambridge in 1967 argued that education was losing its roundness, although integration of educational content had been debated for decades. Recent years have witnessed a dramatic change in STEM education throughout the United States and the World. In the United States, STEM education is a solution. However, the results are not really high. It can be said that STEM education lacks a very important part. It's Arts (A), a necessary competitive and creative future in STEAM.

The science of education cannot keep up with the current changes in science, technique and technology. Students use advanced technology products that are no longer strange, which also creates a gap in creativity in the science of education from elementary to high school and university. Therefore, many experts has argued about the relationship between science and art. In this view, art education is very important in developing high-value creativity in modern education. Therefore, art

should be added to the education of Science, Technology, Engineering, and Mathematics toward the form of teaching STEAM.

On May 6, 2011, the Obama Administration for the Arts and Humanities issued a report at the Arts Education Partnership (AEP) Conference called "Reinvestment in Art Education: Mastering the future of America through innovative schools". The commission stated "When students participate in the arts, their achievement may be fourfold, GPA/ SAT scores are also higher, and they can improve their IQ score in space-time by up to 56%. The maths of the 12th grade students is significantly improved. Students interact more with their teachers and friends, and become more confident in presenting their views better than before". The report demonstrates the importance of linking art, culture, creativity and innovation, and the emergence of a new program to reform the US education ([TNL17]). We seem to forget that innovation does not really come from a mathematical equation, technology, or new chemicals. It comes from places like art, design, or simply it comes from ourself. Innovation in the lives of people in general and in the sciences in particular is always linked to human experiences, in some way, directly or indirectly. Human experiences come through interaction with art-related things such as listening to music or contemplating a work of art. The art itself helps you see in a more natural, receptive way, and in a more open space. Our world is built by analytical thinkers. However, the artist or the designer - the intuitive thinker will be the person who opens us to countless possibilities. The great innovations are born when we know to combine analytical thinking and intuitive thinking together.

Dr. Jerome Kagan, Professor of Honor at Harvard University, one of the 22 most famous and respected psychologists of the 20th century, says art contributes to motivational learning. Because the arts often incorporate the three main tools that the human brain uses to acquire, store, and convey knowledge, namely, motor skills, visualization, and language. Dr. Kagan spoke at the talk about the acquisition, the art and the human brain at John Hopkins University in 2009: "Art and music require people to use both knowledge of charts and processes, which will enable a child to understand more broadly and deeply about something and the world."

According to Michelle H. Land ([Lan13]), Madden ([Mad12]), Nance ([Nan12]), T.T. Tinh et al. ([TNL17]), educated officials, educators and professionals have paid much more attention to enhance the educational foundation to better prepare students for analytical and creative thinking. The traditional STEM (science, technology, engineering, math) focuses on convergence skills while the art focuses on different skills.

The integration of both STEM and Arts content becomes more subtle and serves many purposes for life. STEAM does not simply "add" the arts to the equation or use an artistic element (design) in a lesson. It is looking for natural standards linking Arts and STEM content, and then teaching in and through such standards. Obviously, this is a more robust and meaningful process than a unique project of artistic design. If we really have this debate, we need to be aware not only of the definition, but of the process and the design of the curriculum behind what STEAM really means. As the economic activity of the nation and the world continues to evolve rapidly, the need to invest in education that promotes innovation and creation has become a cause for central themes in public dialogue. ([Imm12]).

Historically, the United States has been seen as a leader in innovation. There has been a sharp decline in innovative ideas of American innovation ([Whi12]). According to Michelle H. Land ([Lan13]); Root-Burnstein ([Roo12]), advances should not be only from technology but also from the combination of technology and creative thinking through art and design. If the United States wants to remain a global competitor, it will be important to foster creative and practical thinking. As long as an individual pushes personal boundaries and developes his own methodologies creatively, he can have a creative practice in some field. In addition, art (A) can help develop STEM skills because of more different approaches.

Immerman ([Imm12]) commented that the current emphasis on STEM education should be extended emphasis on art and design. Harvey White, founder of Qualcomm Inc., initiated a public dialogue advocating STEAM to replace STEM. His views have been followed by innumerable additional voices that increase the importance of the role of Art Education and its importance to the future of the United States. The recent departure of Steve Jobs has reminded us all about the importance of design to the success of technology, meeting the high demands of today's society and the future. Anne Jolly ([JD14]) has spent a lot of time writing curriculum that integrates mathematical and scientific standards in a specific part to solve practical problems. This also has the advantage that math and science teachers work together on technical challenges. Many teachers consider art standards to be equal partners with math and science standards in a STEAM project. That certainly seems reasonable and also relevant to the art teacher (or music) in a meaningful way. However, we need to be aware of the definition of STEAM. Brianna ([JD14]) says that art is not the "tool" to exploit in the STEM change. Art is sometimes the thinking, the thought, the emotion and the existence of it. Are we often lauded that many students do not have the

necessary skills to understand and evaluate a (or non-pop) dance music performance? How does a society get affected by the kind of thinking that always has art in it? Art is not an instrument, but a means of communicating the emotion that STEM cannot achieve. Just like students need to master basic skills such as multiplication, division, and algebra before solving the integral, there are countless cognitive, emotional, and motivational skills that must be learned in the visual arts to achieve maturity. These should be placed in the school's program. Then, if there is an opportunity for interdisciplinary study in science, mathematics or world history, students may participate after knowing that visual arts have a valuable place in the community, nation, school, and contribution from equal status. Visual arts, and all arts, in general, provide ways of thinking, problem-solving, and action that are not found in other topics. When art has achieved equality in the hearts and minds of all educators, parents and community leaders, the STEAM model will have the opportunity to truly bloom. Many argue that it is advisable to combine three different concepts into an 'A' letter that stands for 'Art' and produces a beautiful word STEAM. However, let's make it clear that art and design are different. As educators, we understand the differences and ways in which these concepts and the two principles of art and design can be integrated, enhanced through creative confidence. Design is not just an image, design is not 'style', the design combines form and function, bringing the intention and purpose. On the other hand, art can be the expression or application of an innovative skill, typically as a visual form; however, music, literature, dance and performances are expression forms of art. When we talk about combining art in STEAM, we tacitly understand two creative principles or expressions and understand the human-centered approach to a project and apply the design principles to solve the problem by combining the model and its function. Alison Derbenwick Miller ([JD14]) says that the STEM/STEAM debate actually reflects a profound debate on educational intent. He argues that if the economy is driven by great paintings, novels or witty plays rather than technological innovation, no one can bother about STEM education. The STEM demand is "STEM" in general only if those skills are needed to support economic growth. Our students need a quality education that allows them to make informed decisions that affect their world and way of life. The STEM/STEAM debate is really important and difficult in shaping responsible education. Kris Murphy ([MH15]) argues that STEM students miss out on the value of art. Certainly, we would agree that increasing interest in STEMs (science, technology, engineering, and mathematics) creates a big trend in US universities, due to good promising career after graduation. Do we still have to focus on hard science to prepare students? What is the role of art when changing STEM into STEAM? Kris Murphy said that art is really important to help prepare our young people for careers in STEM. With the exponential growth of data and large data analysis, new career paths have formed that require more than typical STEM skills. We should consider a simple, proven approach based on work by the STEAM fields, demonstrating why we feel students do better when art is incorporated into the STEM program.

Dr. Amy B Hollingsworth ([MH15]) argues that instead of forcing Arts on STEM, let consider A aesthetic. STEM students should appreciate the aesthetics associated with a good product. Just as Apple has found the perfect combination of design and usefulness, STEM students have to admit that what they are designing must be friendly and compelling. What can begin as a rudimentary technical product must ultimately be felt by the user experience process. Many technology designers have been hampered by this problem - if you design it, but the user does not use it, this technology will die.

Recently when talking about the product of labor in the STEM field, CEO Akio Toyoda excitedly talked about the new generation Camry with two options of sexy and really sexy. "I know that calling the Camry is a sexy car right now that sounds overstated to many people, but I really believe the design department has done something unprecedented." The interesting moment is one of many new cuts in Toyota's shift, a car company has been tied to a conservative image, slowly improving. Neutral philosophy in the product, creating a priceless value for durability, keeping prices did help Toyota become a leading car company. Along with that is the boring design, everything is normal at the perfect level from design to performance. The current context with changing customer tastes cause Japan's largest car maker to look back. Toyota Way with 14 principles of governance is the handbook to elevate the car industry to the current position. Akio Toyoda said at a press briefing in May 2017: "I feel something is wrong about whether we should or should not produce cars that consumers expect". Paying much attention to the design makes the car user's emotions secondary. Toyota acknowledged that after years of listening. They changed by giving more power to the design department. Thanks to that, it brings a new wind for the dynamic and alternative design.

According to Deron Cameron, former President of UPES, the first STEAM School in the United States, the current TCSS Coordinator, STEAM represents a paradigm shift from tradition basing on standardized test scores to a modern ideal focusing on evaluating

the learning process as well as the results. In essence, STEAM education dares students to try a variety of ideas, listen to different opinions and create a knowledge base that fits into real life.

3.1.1. Questionnaire

- *For students*

The survey was conducted on a sample of 120 students from all three levels in 5 high schools (Nguyen Hoang High School, Thanh Hoa Province; Xuan Giang High School, Hanoi; Le Hong Phong high school, Dong Nai province; Nong Cong 2 high school, Thanh Hoa province; Ha Long High School, Quang Ninh). Each school has 2 groups with 24 students of each group.

Through investigation, I found that:

For the role of art: (45.83% and 36.67%) answer very important and important. Students are aware of the need for creativity in the process of learning to solve tasks, consider the real results. they found that the creative team had the product close to their expectations. As for the average (9.17%) response to the role of art, according to the author, most of these students do not distinguish between artistic elements in learning activities. Sometime they felt ambiguous between Specific art and artistic elements. Only (8.33%) are not interested in the role of art, these students are often poorly trained in STEM, not actively involved in general activities.

Join group activities: (40.83% and 42.50%) of students think that group work in learning is very important and important. It helps students demonstrate skills and apply them to solve tasks. (4.17%) students do not pay attention to group or individual activity. This percentage explains that group work is essential for learning from a STEAM perspective.

Table 1. The necessity of Art and learning activities through the project in high schools in Vietnam

Content	Very important		Important		Normal		Unimportant	
	Number of respondents	%	Number of respondents	%	Number of respondents	%	Number of respondents	%
The role of art in STEM education	55	45.83	44	36.67	11	9.17	10	8.33
Join group activities	49	40.83	51	42.50	15	12.50	5	4.17
Learning through projects	57	47.50	47	39.17	9	7.50	7	5.83
Creativity in the product	43	35.83	42	35.00	26	21.67	9	7.50

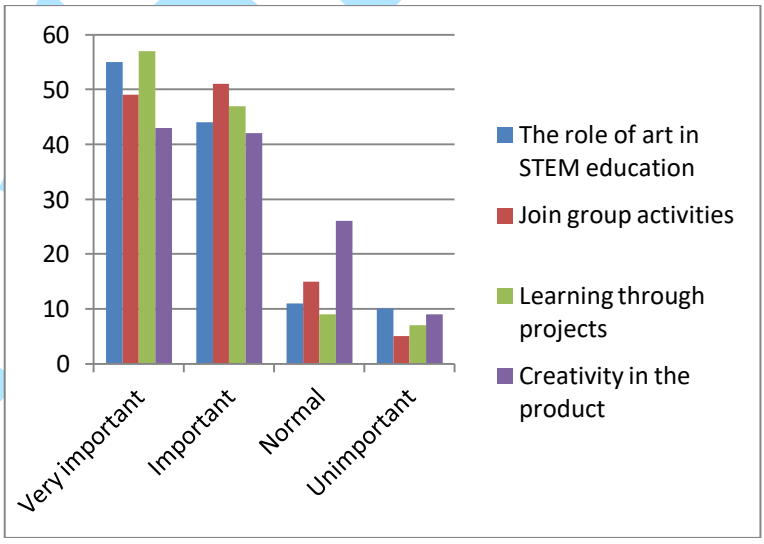


Chart 1. The necessity of Art and learning activities through the project in high schools in Vietnam

Learning through the projects: Through the table, we find that most students who wish to participate in group activities highlight the problem of learning through projects. It helps students to experience, express themselves, and do experiment with their ideas.

Creativity in the Product: The innovation of STEAM education that STEM education previously did not bring is that the product is embellished by art, the product is highly appreciated not because of the difficulty in the real present, but because that product is then used. The table shows the importance of creativity in the implementation process and in the product.

- *For teachers*

The survey was conducted with 45 teachers applying STEAM to teaching in high schools in Vietnam. The teachers answered the questionnaire by circling the answer and answering open questions.

Through investigation, I found that:

For the role of art: (44.44% and 40%) respond in very important and important, the majority of respondents are aware of the need for art in education. They said that the world's inventions also begin with creative thinking and artistic aesthetics, so education also needs to be brought into the teaching and learning process.

The explanation for the proportions (11.11% and 4.44%) of uninterest in art, according to our understanding, most of these teachers are older, they are weak in STEM skills, and they find no motivation for the innovation of teaching methods. They think that completing textbooks is enough. This is a reality in Vietnam, because these teachers are trained at Vietnamese universities in a time of underdeveloped society, where they have no access to learning and awareness of STEM skills for teaching.

For the STEM transformation to STEAM: From the data sheet and the survey, I found that teachers who appreciate the role of art are also teachers who propose innovative teaching methods following STEAM education. (13.33% and 4.44%) is not interested, because of the lack of initial STEM skills and not enough motivation to change their teaching method.

Based on the above, I think art is an important component of STEM and STEAM dialogue. Without the creativity and freedom of art, STEM would not exist. Art helps us create the impossibility, helping students become a full-fledged citizen of the 21st century. Art provides openness to learning - an opportunity to express yourself in a field, extend a person's vision. Thus, art should play an integral role in educating our future citizens.

Table 2. The Need of Art in Educational Innovation, toward STEAM Education in High Schools in Vietnam

Content	Very important		Important		Normal		Unimportant	
	Number of respondents	%	Number of respondents	%	Number of respondents	%	Number of respondents	%
The role of art in STEM education	20	44.44	18	40.00	5	11.11	2	4.44
STEM education should be replaced by STEAM	19	42.22	18	40.00	6	13.33	2	4.44

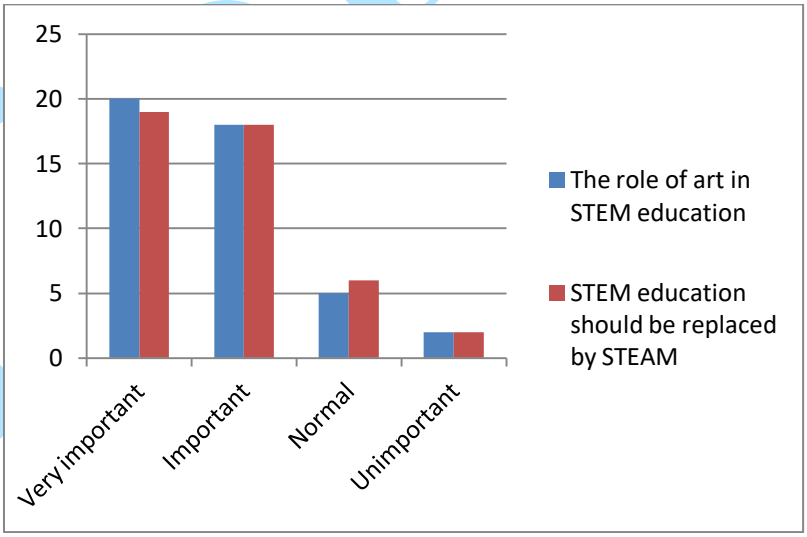


Chart 2. The Need of Art in Educational Innovation, toward STEAM Education in High Schools in Vietnam

3.2. Answer the second question: What is the current status of STEAM teaching in Vietnam high schools?

In the context of the ongoing 4.0 industrial revolution, the jobs and professions in society related to the fields of STEAM education tend to be increasing, for example: computer science, digital green technology, automation technology, artificial intelligence, space and aerospace science, etc.

As ([Ngu13]) poses questions such as: How to achieve success in a modern society filled with information, constantly moving, changing non-stop? According to ([Mar07]), the era in which we live is a

time of intense scientific and technological competition between nations. In that context, a country that does not develop its own scientific and technological capabilities can hardly avoid lagging behind. Thus, an advanced education creates high quality human resources contributing to the development of national science and technology capacity.

According to ([Do17]) in the real situation of the country in terms of qualifications and capacity of management staff and teachers; material facilities at schools; local socio-economic conditions, etc., the application of STEM education is not simple. In addition, integrating and developing problem-solving capabilities associated with practice are difficult issues for teachers today. It has been emphasized many times over the years, but the reality is that the school is not as expected. It can be said that STEM education is only available at some high schools in the form of attracting some students to take part in the competition, typically the Intel ISEP exam held annually. For each form of education, we need to choose the most appropriate form of assessment. However, the mindset "Test what you study" is a big barrier in bringing STEM education into the school. According to Do Duc Thai of the Hanoi University of Education, Nguyen Thanh Hai of the University of Missouri, both have the same opinion: STEM education is not programming and robotics. According to Richard Sherwood, president of the American Education Group ([Van15]). "The STEAM program is so successful in inspiring students. They even do not realize they are absorbing large amounts of knowledge through passion to become a technology engineer, a researcher" Inspiration is always an important factor for children to find passion and develop their potential.

3.2.1. Questionaire

As shown in Table 4, 39.2% of the students recognized STEAM as a "problem solving procedure using convergent thinking," 35% thought of it as an "instructional procedure for knowledge generation," and 25.8% perceived it as "finding a solution on their own in the STEAM activity."

Table 3. Analysis of survey data on teaching status following STEAM perspective

Content	Analysis of survey data
Understanding STEAM education philosophy	(11 teachers /45 teachers are 24.44%) of teachers do not understand enough about STEAM education, some teachers think that STEAM education is teaching students to design robots; (33 teachers /45 teachers are 73.33%) of young learners who are dynamic, eager to learn information and knowledge through books and over the Internet understand the nature of STEAM education and eagerly designing STEAM instructional programs. The majority of students (104/120 students are 86.67%) misunderstood.
STEM skills	(32 teachers /45 teachers are 71.11%) of teachers said that they were not trained these skills, most of them self-accumulated over time; The use of STEAM skills in teaching is limited, lack of coordination between teachers, experts in the fields of STEAM and students
The environment for STEAM teaching and learning	In Vietnam, the design for STEAM teaching is very difficult with (32 teachers /45 teachers are 71.11%) of teachers and (102 students /120 students are 85%) of students believe that most teachers and students are taking advantage of the materials in life to serve STEAM study. The schools always lacks the facilities for teaching STEAM. As a result, the teaching of STEAM in high schools is very limited.
Product Reviews	(38 teachers /45 teachers are 84.44%) teachers said that most of the products created after the STEAM study projects were almost unused; Educational administrators do not pay much attention to the products of the learning process. (6 teachers /45 teachers are 13.33%) of teachers do not pay much attention to the product (ie, regardless of creativity, art, aesthetics, etc.) during the implementation process.
Ideology of Educational Managers	(41 teachers /45 teachers are 91.11%) Teachers believe that educational managers have not called for strong innovation in the minds of teachers. There are no policies to support teachers' research and teaching practices following STEAM. In addition, (31 teachers /45 teachers are 68.89%) of teachers say that educational managers themselves have been not yet aware of STEM and STEAM education.
Family and society	Through the students and the learning process, I have found that most parents do not care about STEAM. They just really involve when being asked by the teacher or students. Outside the school, STEAM's educational philosophy is blurry, largely unappreciated and uninterested in learning from any educational point of view! In Vietnam, the evaluation of learning outcomes is still based on the traditional form of assessment.

Table 4. Students' awareness of the meaning of STEAM (N=120)

Students' awareness of meaning of STEAM	*%*
Problem-solving procedure using convergent thinking	39.2
An instructional procedure for knowledge generation	35
Finding a solution on their own in the STEAM activity	25.8

In Vietnam, at high school education level (career orientation) the study and teaching from the viewpoint of STEAM education is almost none. It is sometimes seen in some competitions that describe this form of education but are not sufficient, such as: Robocon Creation or some experiential activities (but these activities are mainly in private schools and in big cities for example the Western Australian School System (Ho Chi Minh City) is adopting the STEAM method for children from preschool to 12 years old.

It can be said that in the high schools teaching and learning following the point of view of STEAM education is still open and is paid not much attention.

4. CONCLUSIONS AND RECOMMENDATIONS

Many recent STEAM educational materials provide a reason to teach STEAM concepts in a context commonly offered in the proposals of learning projects, solving problems. It can be helpful if the teacher teaches from the perspective of STEAM education that engages learning content through context. The fact is that Vietnamese general education has a rigid structure with programs, requirements, content standards and year-end exams of the department. If these barriers remain in education in Vietnam, they may limit the successful implementation of the STEAM education program.

The author believes that the key to preparing teachers for STEAM education is firsly building a conceptual understanding of STEAM education by teaching key learning theories, pedagogy and raising awareness about research results of STEAM education initiatives. Through many studies, I have found that high quality STEAM education programs must include: Integrating technique and technology into scientific and mathematical theory; Promoting scientific research and technical design including mathematics and science instruction; Connecting students and teachers with the STEAM field and professionals; Combining strategies such as project-based learning; providing formal and informal learning experiences; Incorporate appropriate technologies to enhance learning. Finally, more research and discussion about STEAM education are needed so that high school teachers can implement effectively teaching methods.

Thus, STEAM education is very important to help Vietnam gradually integrate into modern education. STEAM education in high school is important to stimulate the pursuit of exploration ideas in students. However, teachers do not carry the entire burden of STEAM education. Parents must also encourage their children to pursue STEAM activities and raise awareness and interest at home and in extracurricular activities on STEAM education.

5. ACKNOWLEDGEMENTS

This work is supported by Ministry of Education and Training, Vietnam (code B2018-HVQ-06).

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