International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 05, 2020
ISSN: 1475-7192

Steam Education Route in Vietnam: Framework and Students' Perspective

Nguyen Huu Hau, Tran Trung Tinh and Nguyen Thuy Van

Abstract--- *In terms of the technological development that has significantly proposed and influenced on STEAM education. We elaborate to self-develop a STEAM framework and explore the perspective student's effectiveness for learning and developing consequences. Herewith art education project that precisely considered on the learning of Vietnamese traditional instrument (as called T'rung) in the high school curriculum of the 11th grade. A self-process of 7 steps with 4 experts, 7 teachers, and 1 principal was contributed to generate a framework that probably confirm the procedure of STEAM excellency. On top, a qualitative method with a semi-structure evaluation of 16 students was carried out to explore their perspective usages of the STEAM education implemented. Collected data was measured and analyzed by NVIVO 12 software in themes development. The results reveal a STEAM framework with three stages of "problem-solving activity via STEAM skills and integrated learning capabilities", "teaching process to create knowledge", and "self-seeking solutions in STEAM". These obtained frame works together with assess criteria of students 'outcomes such as creativity, innovation, prototype, explanation, research, information, fluency, presentation and visual appeal were acquired. This may be perspective impact to improve the quality of STEAM education in the Vietnamese circumstance.*

Keywords--- *High School, STEAM Education, Arts Education, Vietnamese Traditional Instrument.*

I. INTRODUCTION

Currently, the context of the ongoing 4.0 industrial revolution with the speed up technological development has significantly influent on Education. STEAM education has emerged as a new pedagogy, stared in US in 2007with the initial purpose for increasing student interest and skills in Science, Technology, Engineering, and Mathematics fields (Allina, 2013; Daugherty, 2013; Quigley, Herro, & Jamil, 2017). And now STEAM has been implemented in several countries to equip students the necessary skills to adapt with the 21st-century skills, like creativity, critical thinking, collaboration, and communication (Daugherty, 2013; Quigley, Herro, & Jamil, 2017). Notably, when STEAM education merges the content of STEM subjects with the "A: arts" and this leads to a controversial related to definition of STEAM education (Perignat, 2019). For example, A (art-arts) refers to none- STEM discipline (Clapp & Jimenez, 2016; Quigley & Herro, 2016; Peppler& Wohlwend, 2018). In this case, A (art – arts) declarations creative thinking, creative skills, creative process, innovation when using STEM or imagination in STEAM education outcomes (Allina, 2017; Costantino, 2018; Gettings, 2016; Glass & Wilson, 2016; Quigley& Herro, 2017; Liao, 2016; Quigley et al., 2017; Weatherly, Oleson, & Kistner, 2017). In another hand, A (art-arts) discusses about "arts education", denote to the visual or performing arts in teaching and learning (Costantino, 2018;

Nguyen Huu Hau, Hong Duc University, Thanh Hoa province, Viet Nam. E-mail: nguyenhuuhau@hdu.edu.vn
Tran Trung Tinh, National Academy of Education Management -Ministry of Education and Training, Vietnam. E-mail: tinh.naem@gmail.com
Nguyen Thuy Van, Faculty of Social Science & Humanities, Universiti Teknologi Malaysia (UTM), Johor Malaysia. E-mail:thuyvanpy2000@yahoo.com

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

Gettings, 2016; Glass & Wilson, 2016; Kim & Bolger, 2017; Knochel, 2018; Liao, 2016); By this way, the design "(art-arts) revealed as part of the learning process and teachers support students making products in art classroom and teachers focused on the final product as result of the STEAM instruction (Bush, Cook, Ronau, Rakes, Mohr-Schroeder, & Saderholm, 2016; Grinnell &Angal, 2016; Clary, 2016; Hughes &Kenne 2017; Kant, Burckhard, & Meyers, 2018; Karabey et al., 2018; Moyer & Miller, 2017). And the process of STEAM education objectives to reach arts education outcomes, instance of exploration, creative thinking, designing, technique, creative-expression, critique, evaluation, and redesign (Choi & Behm-Morawitz, 2017; Costantino, 2018; Gettings, 2016; Gess, 2017; Peppler & Wohlwend, 2018; Rolling, 2016; Weatherly, Oleson, & Kistner, 2017).

Recently, there are several studies indicate that STEAM-based curricula effectively increase student interest, motivation, and engagement in STEAM disciplines (Bybee, 2010). However, diversity conception of STEAM has inherently influence teachers' perception, behaviours, teaching techniques, and the development of a supportive learning environment in STEAM classrooms (Paek & Sumners, 2017; Runco, 2014; Van Driel, Bulte, & Verloop, 2007).In the Vietnamese context, STEAM education has been applied in some piloting programs, however, lack of studies interrelated to the STEAM project procedure and the effectiveness of STEAM education into arts' teaching and learning. This paper tries to fill this gap with two following research objectives: 1) self-develop STEAM education process and applying this process in a STEAM project-based learning on traditional Vietnamese music; for example of the ***ethnic traditional instrument T'rung'***. 2) Explore the effectiveness of STEAM education in the context of teaching and learning about a traditional Vietnamese instrumental product – The T'rung.

II. LITERATURE REVIEW

2.1 Art Education and STEAM Education's Outcomes

Currently, empirical research has shown growing numbers of advocates for developing STEAM education in arts teaching and learning (Paek & Sumners, 2017; Perignat, 2019). STEAM education is an enlightening methodology to learning how uses Science, Technology, Engineering, the Arts, and Mathematics as access points for guiding student inquiry, dialogue, innovative and critical thinking (Riley, 2014, p. 22-23); STEAM education aims to foster the true innovation that comes with combining the mind of a scientist or technologist with that of an artist or designer" (Riley, 2014, p. 23).

Reasons of mainstay for implementing of STEAM in arts education, such as visual arts, media arts, design, and performance arts like theatre, music, and dance, etc., are to provide opportunities for students to inherently enhance creativity and other 21st Century skills like creative problem solving, critical thinking, innovation, collaboration, and interpersonal communication (Burton, Horowitz, & Abeles, 2000; Liao, 2016; NAEA, 2016a; Lee& Chang, 2017; Rolling, 2016; Sousa & Pilecki, 2013). In detail, reviews show that arts learners have multi-ability 1) to draw curiosity; 2) observe and express accurately; 3) perceive an object differently; 4) express emotions and construct meaning personally; and 5) work with others or alone effectively (Sousa &Pilecki, 2013).

Reviews found that students enrolled in arts classes not only tend to academic performance but perform better in several fields for student development (Hunter-Doniger & Sydow, 2016), Bequette, & Bequette, 2012; Moore & Smith, 2014);Students are more focus on lectures and improved retention (NAEA, 2016), less prejudice and violent

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

behaviours (Moore & Smith, 201); and improve upon their self-esteem and creative self-efficacy (Burton, Horowitz, & Abeles, 2000). Several empirical researches of arts-based learning demonstrated that the arts encourage and improve certain thinking skills like abstract thinking, spatial reasoning, divergent thinking, creative self-efficacy, openness to experience, and curiosity (Angelone, Hass, & Cohen, 2016; Goldsmith, Hetland, Hoyle, & Winner, 2016; Liao, 2016). The relationship between visual arts and music also enhancing the cognitive benefits resulting for students, like observation skills, pattern recognition, geometrical thinking, and memory retention (Root-Bernstein, 2015, Robelen, 2011; Land, 2013).Root-Bernstein (2015) further declared promoting the benefits of arts education and sparking inquiry regarding the transfer of arts learning to non-arts domains (Angelone, Hass, & Cohen, 2016; Winner & Hetland, 2000; Land, 2013).Arts education has potential value for student development not only for those students who want to be artist (Sousa & Pilecki, 2013)but for creative development: 1) develop cognitive growth; 2) improve long-term retention of content; 3) introduce novelty – something different and unusual activities; 4) reduce stress; etc. (Sousa & Pilecki, 2013; Land, 2013). Notably, the benefits of arts education are not inherent in the final art product, but in the *process* of learning with and through the arts students can self-make achievements outcomes, therefore they can develop creative skills (Edwards, 2010; Hetland, Winner, Veenema, & Sheridan, 2013; La Jevic, 2013). For example, artists usually desire of exploring the new ones (Eisner, 2002), prefer to taking risk and overcome (Hetland et al., 2013) think divergently and flexibly, and inevitably make mistakes (Eisner, 2002; Sawyer, 2012; 2018). These activities during art playing process usually lead artists to face problems as well as they need to solve problems and based on these problem-solving skills improving faster than others. Besides that, they also usually persevere through failure, and otherwise experience the range of attributes associated with the creative process (Guyotte, Sochacka, Costantino, Kellam & Walther, 2015; Glaveanu, 2018; Hetland et al., 2013; Sawyer, 2012).

To emphasized of the enormous benefits when applying STEAM in art education's, Rolling (2016) stated that when we investigate STEAM in "art education", we got the product of STEAM education, not just an art education. These findings have led to a growing interest in using the arts to teach creativity to students in non-arts disciplines (Liao, 2016).Correlated to the strategies apply STEAM in arts' education, Riely (2014) claims that STEAM should not be misunderstood as a curriculum or subjects, but it should be aware as an approach or way to teach the content for student development. Therefore, implementing STEAM education in the classroom should be an integrated approach and requires an interdisciplinary connection among standards, lesson objectives, and assessments should be combined. All the above characteristics of arts education that become the best place to apply STEAM education for student development as the 21-century skills established (Booyun, 2018; Rolling, 2016).

2.2 STEAM Education's Policies in Vietnam

STEM education is a converging education that advanced OECD countries have developed to nurture future talent (Georgette, Yakman, Hyonyong Lee, 2012). STEM education emphasizes the importance of education fostering creative problem-solving skills to become competitive in the global age and prepare for all future challenges (Baeket al., 2011; Georgette Yakman, Hyonyong Lee, 2012). STEAM education extends the relevance of STEM education by adding art (Land, 2013; Maes, 2010).

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Similar to many countries in ASIA, the Vietnamese government has notably driven STEAM (Science, Technology, Engineering, Art and Mathematics) education policy in the era of the fourth industrial revolution through directional documents. For example: In 2013, Vietnamese government promulgated the document called "Resolution No. 29-NQ / TW" about renovation of education and training, in which, they state that " In schools, education needs to focus on intellectual and physical development, well as preparation of career-orientation for students to be good citizens with necessary qualities and capabilities. Beside of improving the quality of nationally traditional education, lifestyle, Vietnamese students need to be improved of foreign languages, informational technology; enhancing of competence and practical skills, able to applying knowledge into practice in real life; pay attention of development creativity, self-study, and encourage students plan in lifelong learning (NQTW29, 2013).

In 2014, the Congress of Vietnamese Government continually promulgated the document namely of "Resolution No. 88/2014/ QH13 about renovating of curricula and textbooks in general education"; In 2015, the Prime Minister's Decision No. 404/QD-TTG approved the project on renovation of textbooks for general education practice. In 2017, the Prime Minister office promulgated of the directive document, namely of No. 16 / CT-TTg, in which, the Vietnamese government planned to foster and support for enhancing and strengthening of national education for human resources development adapting with the 4th industrial revolution's requirements. In which, the Vietnamese Government targets to drastically change policies, content, methods of vocational education and training, enhancing the quality of human resources to adapt to the present labour markets. To reach the targets, the Vietnamese government have strategically plan to strongly invest in training students with new technology productions, and promoting scientific training, encouraging students studying in science, technology, engineering, and math (STEM); besides that Vietnamese government continually promote universities and vocational education enhancing quality of students follow the trends of connecting with real context for sustainable community development (STEAM in Bac Ninh province, 2017)

Base on the above government policies, the Vietnamese Ministry of Education deployment many strategic plans in several provinces for students learning and development outcomes reach the national targets. For example, the new curriculum and textbooks have been complication and editing follow the innovational trends as mentioned above (STEAM in Bac Ninh province, 2017)

In 2011, STEAM education has implemented in piloting for three big cities in Vietnam, including Hanoi, Hochiminh and Danang. STEM-Robotics Program has emerged as a new model to promote students enhancing skills in making robot tools, software to simulate intelligent control systems. From basic steps, students require to develop innovative thinking and confidence to advance to higher creative steps with industrial robot models. With self-study and cross-platform learning, students have the opportunity to fully exploit the creative capacity and flexibility of the open platform so that the future can develop useful products for everyday life.

In 2015, the Ministry of Ministry of Science and Technology of Vietnam cognized the first STEM festival in Vietnam to encourage Vietnamese schools to apply STEAM education in teaching and learning. In the academic year 2016-2017, the British Council in collaboration with the Vietnamese Ministry of Education and Training organized the fourth phase of evaluating STEM-oriented educational methods (Science, Technology, Engineering

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and Math) at 15 high schools in Hanoi, Hai Duong, Hai Phong, Nam Dinh and Quang Ninh.

With the success in the initial period, STEAM education has continually emphasized and implemented at some high schools in several provinces in Vietnam since the academic year 2017-2018. STEAM education implemented in teaching and learning of "technology subject" in primary, secondary and high schools, vocational education and universities. Recently, STEAM education has been encouraged to apply in several subjects in higher education institutions to enhance creative thinking and practical skills for students.

In Vietnam, STEAM education utilizes as a teaching and learning method, in which teachers based primarily on hands-on and innovative experiential activities for student learning. Especially, some knowledge or contents is "difficult to understand", "hard to remember" for students that will be illustrated by real-world examples, and look become more easily grasped, students, are conditional on participating in hands-on activities to get a hands-on creative experience, which will help you understand more deeply and remember longer what students have learned. By this way, classroom activities will build not only basic knowledge but also flexibility, making it possible for most learners to apply them in real context. And STEM skills have been understood as flexible integration of four skill groups: scientific, technological, technical and mathematical skills.

In each province, the department of education and training based on the real context todevelop own model to implement effectively of STEAM education.

III. METHODOLOGY

3.1 Self-development of Framework

The research process for the first objective is involved 7 following procedures:

1. Setting up the STEAM project team: 12 people (4 experts and 7 teachers, 1 principle).
2. Studying and understanding contents related to knowledge and practice in the Vietnamese context (Traditional music in Vietnam – Curriculum of grade 11)
3. Selecting topics for STEAM project. (Ethnic Vietnamese instrument – the T'rung)
4. Developing STEAM education process.
5. Getting evaluation from experts
6. Applying STEAM
7. Developing and looking for the STEAM program

The development program has been conducted for 4 weeks, from the beginning of the second week of September to the end of the second week **of October 2019** and students participating in the program are at 11th graders

3.2 Explore the Effectiveness of STEAM Education in Vietnam

This qualitative study employed a semi-structured interview of 16 students participating in the project to solicit data from the respondents. Each interview session lasted between 40 to 45 minutes. The interview was recorded and transcribed verbatim. The students were selected based on purposive sampling. The instruments were self-developed basing on criteria assessment of STEAM education in Vietnam. The qualitative data was analyzed in the form of thematic and basic descriptive.

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

IV. RESEARCH FINDINGS

4.1 STEAM Education Process and Applying in Vietnam

Base on the literature review and Vietnamese education context, the basic elements of STEAM education process can be described in the following figure 1.

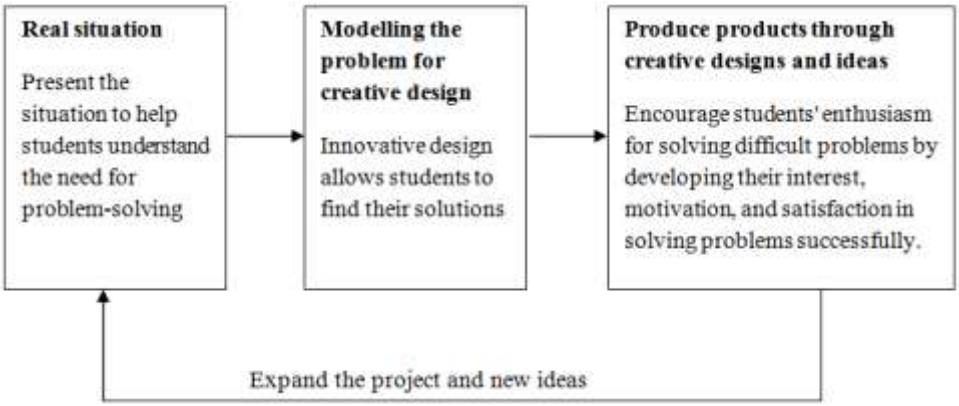

Figure 1: Steam Project Implementation Process

As shown in Figure 3, the STEAM education process is a guideline for implementing STEAM projects.

The first stage is presenting a situation. It is important to let students recognize the problem that is being connected to their lives and link it to the real world (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991).

- The second stage is modelling the problem. This stage is for creative design, encouraging students to act creatively with open designs after identify needs and values. Specifically, the purpose of this step is to develop not only creativity but also communication skills through collaborative learning (Kolodner, J. L., Crismond, D., et al., 2003) with "practical" skills (Baek et al., 2011).
- The third stage: Produce products through design and creative ideas; encourage student in seeking and expanding the emotional domain of educational goals; and emphasize the importance of experiencing and exploring as well as awareness, expression and sharing in learning situations. Also, students make practical skills to have experience, enjoy of self-discovery, interest in learning science.

4.2 A Sample of the STEAM Project is based on the Theme of Vietnamese Traditional Musical Instruments

When the theme of traditional Vietnamese culture is chosen and the T'rung as the name of the lesson. This program is based on the high school science curriculum in grade $11^{th.}$

4.2.1 The first stage: Based on the real context, students focus on learning the traditions of using the T'rung in Vietnamese culture;

The first stage, the real context helps students recognize learning content connect with real life. In other words, they study the history and development of The T'rung in the traditional culture of the Vietnamese. Next, students tried to learn how to play an T'rung and discuss the reason why playing a T'rung is difficult. Also, students find out the reason for the change in string tension or the design of the plus box, the material used to influence the change in

DOI: 10.37200/IJPR/V24I5/PR201690
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sound output. As a result, the student becomes immersed in the activity of the group because of the increased relevance between the presented situation and the student's life.

Figure 2: The T'rung, traditional instrument making by bamboo in Vietnam

4.2.2 The second stage: modelling problems for creative design through analysis of the composition of the T'rung;

The second stage, modelling the Problem for Creative Design is an important stage of the STEAM Project. This stage helps students reflect their creative ideas in the context of actual learning. To do so, they experimented with measuring the frequency of The T'rung sound using computer applications, describing the image of the components of The T'rung (negative resonance box, guitar, tuning string, strings) and they learn about the design process through the Internet and exchange with artisans. This stage allows students not only to learn but also to use their knowledge and experience, thereby improving their problem-solving ability. By motivating students to identify and solve problems, students can become more creative problem solvers.

Figure 3: A performance of the T'rung in Traditional Instruments

4.2.3 The third stage: producing through the design and creative ideas and artistic emotions.

This stage focuses on the implementation of making the T'rung instrument and using it. During the making implementation of our project, teachers ask students used a computer to check the sound scales and adjust the components of The T'rung (the computer has installed the software to identify the sound for The T'rung). We divided 16 students into 4 groups (4 students per group). The main content of the STEAM Project is shown in Table

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

1. The STEAM skills are as follows: Scientific (S), Technology (T), Technical Skills (E), Art (A) and mathematics (M).

The third stage, produce The T'rung through design and creative ideas and artistic emotions.

Table 1: The Process of Implementing the T'rung Project

Step	Content	STEAM skills
Looking for context in the real world	Understand the relationship between the learners and applied knowledge in the real-life, such as emotions (painting, music...); others (machinery, equipment, construction...)	S, A
	Students select topics for the STEAM project. Learn about a Vietnamese traditional instrument – the T'rung	A
	Students realized that most Vietnamese traditional instruments are made of bamboo, wood and its sound varies in size, shape, and length of the instrument.	S,T,E,A
	Students learn to know how the sound changes when the sticks click on different positions of the instrument.	S, E
Modelling problems for creative design through analyzing the composition of The T'rung	Students observe a sample of the T'rung for modelling and testing the sound	A, T
	Students measure the frequency of the sound of the T'rung by using computer software (a computer with a microphone).	S,E,M
	Students understand that a certain percentage of bamboo will give different sizes. Outline the T'rung model on the drawing	T, E, M
Produce The T'rung through the design and creative ideas, artistic feelings	Students made by bamboo tube. Students design an T'rung which can be used to play easily.	T, E, M
	Students show a national musical composition by the T'rung by their hands.	A
	Students shared their feedback on the T'rung and the performance of the performers	E, A
	Students shared their ideas and compare the strengths and weaknesses of each application's design.	T, E, A
Developing a broader STEAM project	Students exchanged their ideas for future STEAM projects.	S,T,E,A,M

Figure 4: Making bamboo T'rung in Vietnam

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4.3 The effectiveness of STEAM education in the context of teaching and learning

4.3.1 Students perception of the meaning of STEAM

In analyzing the initial theme on delivery of TEAM education's meaning from the students perspective, three sub-themes emerged: Integrated learning for problem-solving, Exploring new knowledge and skills, and Self-seeking solution.

Table 2: Students' Perceptions of the Meaning of the STEAM Project (N = 23)

Students' perceptions of the meaning of the STEAM Project	%
Integrated learning for problem-solving	26.1
Exploring new knowledge and skills	21.7
Self-seeking solution	52.2

As shown in Table 2, 26.1% of students identified STEAM as "problem-solving activities with STEAM skills along with integrated learning activities". Students understood that they need to use knowledge from multi-subjects to have solutions to solve the problems in STEAM education.

The sound principle of the T'rung" was discussed. Sound is hard to explain scientifically. Several textbook physics reports have been reviewed the transferred sound structure in terms of learning how to measure the wave frequency and being correlated with T'rung instrument standard. Thus, it requires to be practised in Music and Mathematic respectively. Then I asked my friends, asked the teacher about which software to related to this. Finally, I got the answers about the sound principle of The T'rung. I think that I can solve a problem completely through the activities of the STEAM Project. (S1)

This citation demonstrates how to solve the problem using STEAM skills and integrated learning capabilities for STEAM education. This learning activity is designed for students to solve a complicated problem and from this, they can develop creative thinking skills.

The table 2 shows that 21.7% of respondents in this study indicated that STEAM education was as a "breaking and winning knowledge". Respondents thought that STEAM is a guiding method provides opportunities for students creating knowledge through mutual exchange of ideas. Based on this students can build the modelling and design process as well as discuss their feelings about their future product.

According to Wheeler & Jones (2008), the application of ideas through exchange of ideas allows students to gain new knowledge through interacting with others in STEAM activities, thus enabling them to expand on the present or create new knowledge. This reflects the process of reasoning through knowledge recall (Wheeler & Jones, 2008).

My group handled the big challenges as roughcast when to be asked self-making the T'rung. No one has experienced. To solve this problem, we had to discuss many times. We looking for helping from teacher, village players who have experiences linked to traditional instruments productive making, deliberated with them about how to choose the materials; how to test and measure the sound in each item; how to resonance box, etc. During the process, we learn a lot by interacting with friends and experienced people. These were concededly exciting and motivating. It is a precise experience in this study for me.

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Finally, 52.2% of students identified STEAM as a problem-solving activity by seeking solutions by themselves. Their search for a solution is reflected in the process of stimulating their creative thinking, ideas, imagination and awareness in the STEAM project. This supports previous research (Maes, 2010), which states that art or liberal arts help increase student creativity and participate actively in learning projects. Art is an important component of the STEAM Project.

In my opinion, the most significant thing during the STEAM project is that students must solve the problem by ourselves not only listening to in the class as others. We self-discuss in teamwork the knowledge correlated to the T'rung as well as self-making the T'rung productive making by ourselves. Through this learning style, we learning a lot in theories and applying the knowledge achievements in implementing practical skills, like playing T'rung or self-making T'rung.

4.3.2 Students' Awareness of the Necessity of STEAM

In the second theme development in data analyzing process of the necessary of TEAM education in teaching and learning from students perspective, three sub-themes emerged: 1) Form the scientific concepts through the exchange of ideas; 2) Develop knowledge through problem-solving in project implementation; 3) Develop thinking skills through problem-solving.

Table 3: Students' Awareness of the Necessity of STEAM (N=23)

Students' awareness of the necessity of STEAM	%
Form the scientific concepts through the exchange of ideas	34.8
Develop knowledge through problem-solving in project implementation	26.1
Develop thinking skills through problem-solving	39.1

As shown in Table 3, there are 34.8% of all students realized the need for STEAM as it promoted "the formation of scientific concepts through exchange of ideas"

I deliberate that STEAM education is necessary for school education because the concepts are complicated and hard to understand, these synopses will be clear in real context explaining and students can practice by STEAM education. For example, in the T'rung project, we can see the T'rung instrument, watching the T'rung performance, learn how to play it and practice in making the T'srung by bamboo. If only explain by words, it was hard to understand deeply. (S4)

In the second theme developed, 26.1% of students thought that STEAM is necessary because it develops their knowledge through problem-solving. Explore something is new by themselves from facing problems and solve them that was attractive students and they advocated for the necessary of STEAM in application.

To be honest, my sensitivity is so stimulating when studying the T'rung..... STEAM should be applied in my school because, during studying of STEAM project, we understand new knowledge through solve many issues during the project through discussing. For example, I was able to easily understand the structure of T'rung, different sound of T'rung when playing,…because the members of the group had asked and taught each other the principles of the sound of The T'rung. Moreover, I think we learned something about trying to solve the problem in the design discussion of the model (S5).

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Finally, 39.1% considered it as an incentive to "develop thinking skills through problem-solving". The question of how to improve creative thinking is one of the enormous challenges in teaching. In STEAM design, students need to learn through different stages with different pedagogies. For example, speech to introduce some new topic; problems based learning to find know knowledge and skills for solving problems; project-based learning for students apply theories in the practice in real context. In STEAM education, the outcomes require new products from self-making from students. With the complicated process, STEAM education training students develop high order thinking skills, like critical, creative, innovative, etc. as well as intelligent emotion so on.

Actually, during the studying process, my group had the chance to discuss, debate and exchange information to understand deeply about the T'rung. Such as analysis and distingue the T'rung among traditional instruments in Vietnam. After watching the T'rung performance, new ideas, new feeling had been coming with full of e nice emotion for Vietnamese folklore instruments. Especially, during self-making the T'rung, we have changed our mind, from anxiety by new tasks to exciting to discover the procedure and self-implemented carefully all stages to get new T'srung instrument. Thoughtful a lot, testing many times, comparing others when analyzing the principles of composition and operation of a T'rung. All make us look to grow up in thinking, solving real problems and contributing our value from studying for real life. (S6)

4.3.3 Satisfaction of STEAM Project

Table 4: Students' Satisfaction of STEAM Project (N=23)

Content questions	Total students	%
Interested and satisfied with learning the STEAM Project	15 Students	65.2
rarely satisfied with learning the STEAM Project	8 Students	34.8

As shown in Table 4, there were 65.2% of respondents who were interested and satisfied with the STEAM Project implemented in the T'rung instrument. The main reasons to explain for these results as following students sharing in their interview:

- Teamwork for achieving interacted knowledge and skills.

Well, I am very keen on and satisfied when joining the STEAM project of "the T'rung". I have a wonderful time when study in a group, discussing and communicating in problem-solving tasks collaboration in playing to perform the T'rung, learning and gaining lot of iterated knowledge for understanding the new concept and able to do practical skills during self-making that special instrument (S7).

- Self – learning in complicated process and productive self- making

For me, I am honey and desire to join the STEAM project that our school designed for us. I have the chance to understand different fields related to our traditional instruments, for example, know about it, enjoy performance. Moreover, I can learn how to play it … not professional but in level basic and feeling very happy. Last but not least, were able to make it and when we look at our self –product we are so satisfied with this learning model that helps us be interested in study Music, sciences, mathematics, technology, and so on. (S8)

- Attractive, motivate, engaging students by various fields

This project is different from other lesson is that we learn various fields in one topic with discussion and self-

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achieve knowledge and skills and connect with real-life. For example, not only reading and listening in the classroom but watching performance, practice playing and making "the T'rung". These were attractive students, motivate our interest in studying. Although we were facing many problems, teachers always engaging us, support and assist when we need helps and succeed with self-making product. Which made us be satisfied and enjoyed. I will be interest and join the STEAM project next time. (S9)

However, 34.8% of students indicated that they were rarely satisfied when joining STEAM Project. The reasons they explained the following opinions:

- Different outcomes from students and families' expectations

My interest subjects are Mathematic, Physic and Chemical. My parents asked me to practice more and more exercise homework and tests to get a high score in the important exams. The STEAM project took a long time and outcomes not suit with my targets in academic achievements. (S10)

- Uninteresting topic and learning activities

This project looks exciting by many study activities, however, my feeling is uncomfortable much and looks boring when only studying one topic "the "T'rung". I plan not to be an artist so I desire to learn another subject. (S11)

- Difficult to change learning habits

For me, my learning styles is reading, doing homework, assignment and practice test. This learning process effectively for me. I'm not confident in communication, discussion. That why when teachers give us a direction on how to teach STEAM, I think it looks very weird and strange. So, I do not know how to solve the problem of producing the T'rung and apply the software for calibration of the instrument, as it is a new approach. I feel it is so difficult for me…very shy to play T'rung not well.

- Take a long time and spent much money

In my opinion, the STEAM project looks new approach and help students improve many academic performance and skills. I only wonder why take a long time and spent much money on one topic the T'rung.

In sum up, while major respondents advocated in applying STEAM project in Vietnamese high schools, some others gave the negative perspective of this method. Advocators gave the benefits of STEAM education through students' perspective of STEAM education. With STEAM education, students have more chances to active discuss, creative thinking, self-problem solving to achieve integrated learning, exploring new knowledge and skills, and Self-seeking solution. In the other hand, some respondents indicated that reasons they were less interesting and satisfied in STEAM when they found that STEAM education outcomes different from students' expectations, uninteresting topic, take a long time and spent much money is enormous challenges and change learning habits is also barriers in implementing STEAM education in Vietnam.

V. DISCUSSION

One of important study's findings is development of The *STEAM Project Implementation Process,* include of three stages: "Real situation", "Modeling the problem for creative design, "Produce products through creative

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

designs and ideas**".** This is the first model applying Vietnam to guild how STEAM education implementing in the present practice effectively by emphasizing the innovational process. This finding contributed the new model of problem-solving process through collaboration of multi activities incorporate subjects with a hope to make students interested and excited as well as improving communication skills and appreciate skills through collaborative "hands-on" activities and "Practice" (Baek et al., 2011).

This finding has been supported some previous researches, such as Porter, Roessner, Oliver & Johnson (2006) investigated a systems model of innovation processes in university STEM education; An ecological model of STEM education: Operationalizing STEM for all or Basham, Israel, & Maynard (2010); 21st century STEM education: A tactical model for long-range success Ostler (2012). In Vietnam, to apply STEAM education in teaching and learning effectively, selecting interesting topic is the crucial step. Three types of select the lessons for STEAM education are topics, related topics and creative experiential activities can be used in STEAM application (Tinh, Hau, Hieu, 2017). The types of topics involved teach a major topic related to science, technology, engineering, art and math. The allied topic should be a lesson based on a topic associated with many other sub-topics involves various subjects students have learnt. Based on themes, teachers design plans or re-structured the whole curriculum to suit with the real situation.

These results correspond to the STEAM educational goals that the Vietnamese education sector aims to help students develop their STEAM skills; enlarge their knowledge by sharing ideas and problem-solving process.

VI. CONCLUSION

Recently, Vietnamese has continually annoyed to increase the interest and implement of STEAM education to enhancing the quality of students learning performance. However, there are no specific STEAM frameworks focused on nurturing talent and few studies have verified the impact of the STEAM Project. This study aims to self-development of STEAM Project framework in the context of teaching and learning a Vietnamese traditional instrument, namely the T'rung, made by bamboo. This model was applied in a high school to explore the effectiveness of the program through the students' perspective. As illustrated in this study, students identify the STEAM learning project as "problem-solving activity using STEAM skills and integrated learning capabilities", "teaching process to create knowledge", and "self-seeking solutions in STEAM". The awareness in STEAM classroom activities through the development of their emotion stimulates creative science thinking and their ideas through the process of argument. Also, most participants are willing to use the STEAM Project in a regular science project. However, some respondents found some struggling barriers to implement this approach, such as unmatched with students and families' expectations of getting a high score for Entrance Examination to University; took a long time and spent much money.

This study also found a strong link between the STEAM Project and Vietnamese real context. Such as the STEAM Project has been that students can develop a solid understanding of the scientific principles as well as their creativity, embrace their emotions by exploring the beauty of Vietnamese traditional instrument T'rung. This STEAM Project contributed in increases of interest and invest time to learn scientific, creative efficiency while

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

maximizing engagement and motivating in learning science, technology, engineering, arts and mathematics that hope to equip the 21 skills for Vietnamese students.

REFERENCES

[1] Allina, B. (2013). The Evolution of a Game-Changing Acronym: Why Government Recognition of STEAM is Critical. *ARCADE*, *31*(2).
[2] Allina, B. (2017). The development of STEAM educational policy to promote student creativity and social empowerment. Arts Education Policy Review, 1–11.
[3] Allina, B. 2018. "The Development of STEAM Educational Policy to Promote Student Creativity and Social Empowerment." *Arts Education Policy Review* 119 (2): 77–87.
[4] Alvarez, C.A., Edwards, D., & Harris, B. (2010). STEM Specialty Programs: A Pathway for Under-Represented Students into STEM Fields. *NCSSSMST journal*, *16*(1), 27-29.
[5] Aschbacher, P. R., Li, E., & Roth, E. J. (2010). Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *47*(5), 564-582. Pamela
[6] Angelone, B.L., Hass, R.W., & Cohen, M. (2016). Skill transfer in visual arts expertise. *Psychology of Aesthetics, Creativity, and the Arts*, *10*(2), 147.
[7] Basham, J.D., Israel, M., & Maynard, K. (2010). An ecological model of STEM education: Operationalizing STEM for all. *Journal of Special Education Technology*, *25*(3), 9-19.
[8] Baek, Y., Park, H.J., Kim, Y., Noh, S., Park, J.Y., Lee, J., & Han, H.S. (2011). STEAM education in Korea. *Journal of Learner-Centered Curriculum and Instruction*, *11*(4), 149-171.
[9] Bequette, J.W., &Bequette, M.B. (2012). A place for art and design education in the STEM conversation. *Art education*, *65*(2), 40-47.
[10] Brown, J.S., Collins, A. S., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18(1),* 32–42.
[11] Burton, J.M., Horowitz, R., & Abeles, H. (2000). Learning in and through the arts: The question of transfer. *Studies in art education*, *41*(3), 228-257.
[12] Bush, S.B., Cook, K.L., Ronau, R.N., Rakes, C.R., Mohr-Schroeder, M.J., & Saderholm, J. (2016). A highly structured collaborative STEAM program: Enacting a professional development framework. *Journal of Research in STEM Education*, *2*(2), 106-125.
[13] Bybee, R.W. (2010). Advancing STEM education: A 2020 vision. *Technology and engineering teacher*, *70*(1), 30.
[14] Cook, K.L., & Bush, S.B. (2018). Design thinking in integrated STEAM learning: Surveying the landscape and exploring exemplars in elementary grades. *School Science and Mathematics*, *118*(3-4), 93-103.
[15] Costantino, T. (2018). STEAM by another name: Transdisciplinary practise in art and design education. *Arts education policy review*, *119*(2), 100-106.
[16] Choi, G.Y., &Behm-Morawitz, E. (2017). Giving a new makeover to STEAM: Establishing YouTube beauty gurus as digital literacy educators through messages and effects on viewers. *Computers in Human Behavior*, *73*, 80-91.
[17] Clary, R. (2016). Science and Art in the national parks: Celebrating the centennial of the US National Park Service. *The Science Teacher*, *83*(7), 33.
[18] Dakers, J. (Ed.). (2006). *Defining technological literacy: Towards an epistemological framework*. Springer.
[19] Daugherty, M.K. (2013). The Prospect of an" A" in STEM Education. *Journal of STEM Education: Innovations and Research*, *14*(2).
[20] Dewey, J. (1934). Art as Experience (New York: Capricorn, 1958). *hereafter ART*, *21*, 75-78.
[21] Fattal, L. R. (2017). Into the Woods-environmental problem solving through STEAM lesson planning. *The STEAM Journal*, *3*(1), 8.
[22] Gershon, W. S., & Ben-Horin, O. (2014). Deepening inquiry: What processes of making music can teach us about creativity and ontology for inquiry-based science education.
[23] Gess, A. H. (2017). SEAM education: separating fact from fiction. *Technology and Engineering Teacher*, *77*(3), 39-41.
[24] Gettings, M. (2016). Putting it all together: STEAM, PBL, scientific method, and the studio habits of mind. *Art Education*, *69*(4), 10-11.

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

[25] Glaviano, 2018; Aguilar Camaño, D., & Pifarré Turmo, M. (2019). Promoting social creativity in science education with digital technology to overcome inequalities: a scoping review. *Frontiers in Psychology, 2019, vol. 10, num. 1474, p. 1-16*.

[26] Glass, D., & Wilson, C. (2016). The art and science of looking: Collaboratively learning our way to improved STEAM integration. *Art Education*, *69*(6), 8-14.

[27] Goldsmith, L. T., Hetland, L., Hoyle, C., & Winner, E. (2016). Visual-spatial thinking in geometry and the visual arts. *Psychology of Aesthetics, Creativity, and the Arts*, *10*(1), 56.

[28] Gross, K., & Gross, S. (2016). Transformation: Constructivism, design thinking, and elementary STEAM. *Art Education*, *69*(6), 36-43.

[29] Grinnell, S., & Angal, S. (2016). Luminous lighting. Science and Children, 53(6), 54.

[30] Guyotte, K.W., Sochacka, N.W., Costantino, T.E., Kellam, N.N., & Walther, J. (2015). Collaborative creativity in STEAM: Narratives of art education students' experiences in transdisciplinary spaces. *International journal of education & the arts*, *16*(15).

[31] Guyotte, K.W., Sochacka, N.W., Costantino, T.E., Walther, J., & Kellam, N.N. (2014). STEAM as social practice: Cultivating creativity in transdisciplinary spaces. *Art Education*, *67*(6), 12-19.

[32] Hughes, M., & Kennedy, M. (2017). *New Futures: changing women's education*. Rutledge.

[33] Kant, J.M., Burckhard, S.R., & Meyers, R.T. (2018). Engaging high school girls in native American culturally responsive STEAM activities. Journal of STEM Education, 18(5), 15–25.

[34] Kim, D., & Bolger, M. (2017). Analysis of Korean elementary pre-service teachers' changing attitudes about integrated STEAM pedagogy through developing lesson plans. *International Journal of Science and Mathematics Education*, *15*(4), 587-605.

[35] Kim, H.S. (2012). A study on the relation and importance of art education and STEAM education. *Journal of Korean Society of Basic Design and Art, 13(5),* 105–113.

[36] Knochel, A. D. (2018). An object-oriented curriculum theory for STEAM: Boundary shifters, materiality and performing 3D thinking. *International Journal of Education Through Art*, *14*(1), 35–48.

[37] Kolodner, J.L., Camp, P.J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., & Ryan, M. (2003). Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting learning by design (TM) into practice. *The journal of the learning sciences*, *12*(4), 495-547.

[38] LaJevic, L. (2013). Arts integration: What is happening in the elementary classroom? *Journal for Learning through the Arts*, 9(1), 1–28.

[39] Land, M.H. (2013). Full STEAM ahead: The benefits of integrating the arts into STEM. *Procedia Computer Science*, *20*, 547-552.

[40] Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. *Cambridge university press.*

[41] Liao, C. (2016). From interdisciplinary to transdisciplinary: An arts-integrated approach to STEAM education. *Art Education*, 69(6), 44–49.

[42] Liao, C., Motter, J.L., & Patton, R.M. (2016). Tech-savvy girls: Learning 21st-century skills through *STEAM digital artmaking. Art Education*, 69(4), 29–35.

[43] Lee, B., & Chang, E. (2017). A Cross-Cultural Study on STEAM Education in Korea and the United States. *한국과학예술융합학회*, *30*, 277-288.

[44] Lee, B.Y., & Hyun, E.R. (2014). The Development of an Art-centered STEAM (Science, Technology, Engineering, Arts and Mathematics) Program Based on Discipline-centered Curriculum. *한국과학예술융합학회*, *18*, 459-471.

[45] Maes, B. (2010). Stop talking about" STEM" education!" TEAMS" is way cooler! Retrieved July 27 (2011). http://bertmaes.wordpress.com.

[46] Moore, T.J., & Smith, K.A. (2014). Advancing the State of the Art of STEM Integration. *Journal of STEM Education: Innovations and Research*, *15*(1), 5-25.

[47] Moyer, L., & Miller, T. (2017). Cultivating community resources: Formal and non-formal educators partner to change the world…one step at a time. Children's Technology and Engineering, 22(2), 16–19.

[48] National Art Education Association [NAEA] (2016). Using art education to build a stronger workforce. Accessed December 10, 2017, at https://arteducators-prod.s3. amazonaws.com/documents/535/ff8bfae5-6b4f-4352-b900-4fc1182ad2b1.pdf?1455134278.

[49] Ostler, E. (2012). 21st century STEM education: A tactical model for long-range success. *International Journal of Applied Science and Technology*, *2*(1), 28-33.

[50] Oreck, B. (2004). The artistic and professional development of teachers: A study of teachers' attitudes toward and use of the arts in teaching. *Journal of Teacher Education*, *55*(1), 55-69.

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020

[51] Karabey, B., Koyunkaya, M.Y., Enginoglu, T., & Yurumezoglu, K. (2018). Discovering complementary colors from the perspective of steam education. *Physics Education*, *53*(3), 035001.
[52] Paek, S.H., & Sumners, S.E. (2019). The indirect effect of teachers' creative mindsets on teaching creativity. *The Journal of Creative Behavior*, *53*(3), 298-311.
[53] Perignat, E., & Katz-Buonincontro, J. (2019). What Does Creativity Look Like in the STEAM Classroom? *Circe Magazine: Steam Edition*, 66-69.
[54] Perignat, E., & Katz-Buonincontro, J. (2019). STEAM in practice and research: An integrative literature review. *Thinking Skills and Creativity*, *31*, 31-43.
[55] Peppler, K., & Wohlwend, K. (2018). Theorizing the nexus of STEAM practice. *Arts Education Policy Review*, 119(2), 88–99.
[56] Porter, A.L., Roessner, J.D., Oliver, S., & Johnson, D. (2006). A systems model of innovation processes in university STEM education. *Journal of Engineering Education*, *95*(1), 13-24.
[57] Quigley, C.F., &Herro, D. (2016). "Finding the joy in the unknown": Implementation of STEAM teaching practices in middle school science and math classrooms. *Journal of Science Education and Technology*, 25(3), 410–426.
[58] Quigley, C.F., Herro, D., & Jamil, F.M. (2017). Developing a conceptual model of STEAM teaching practices. *School Science and Mathematics*, *117*(1-2), 1-12. Herro & Quigley, 2017.
[59] Riley, S. M. (2014). *No permission required: Bringing STEAM to Life in K-12 schools*. Visionist Press.
[60] Rolling, J. H., Jr (2016). Reinventing the STEAM engine for art + design education. Art Education, 69(4), 4–7.
[61] Root-Bernstein, R. (2015). Arts and crafts as adjuncts to STEM education to foster creativity in gifted and talented students. Asia Pacific Education Review, 16(2), 203–212.
[62] Robelen, E.W. (2011). STEAM: Experts make case for adding arts to STEM. *Education week*, *31*(13), 8.
[63] Runco, M.A. (2014). Creativity: Theories and themes: Research, development, and practice (2nd ed.). Elsevier.
[64] Sawyer, R.K. (2012). Explaining creativity: The science of human innovation (2nd ed.). New York, NY: Oxford University Press.
[65] Sinclair, N. (2009). Aesthetics as a liberating force in mathematics education?. *ZDM*, *41*(1-2), 45-60.
[66] Sousa, D.A., & Pilecki, T. (2013). *From STEM to STEAM: Using brain-compatible strategies to integrate the arts*. Corwin Press.
[67] Tran Trung Tinh, Nguyen HuuHau, Le Trung Hieu (2017), STEAM education study and some thoughts about general education settings in Vietnam. *Journal of Education Management*, Vol. 10, No. 10, p. 49-55, Vietnam.
[68] Van Driel, J.H., Bulte, A.M., & Verloop, N. (2007). The relationships between teachers' general beliefs about teaching and learning and their domain-specific curricular beliefs. *Learning and instruction*, *17*(2), 156-171.
[69] Weatherly, L., Oleson, V., & Kistner, L.R. (2017). Over the fence: Engaging preschoolers and families in a yearlong STEAM investigation. *YC Young Children*, 72(5), 44–50.
[70] Walker, C.M., Winner, E., Hetland, L., Simmons, S., & Goldsmith, L. (2011). Visual thinking: Art students have an advantage in geometric reasoning. *Creative Education*, *2*(01), 22. Hetland, Winner, Veenema, & Sheridan, 2013.
[71] Yakman, G., & Lee, H. (2012). Exploring the exemplary STEAM education in the US as a practical educational framework for Korea. *Journal of the Korean Association for Science Education*, *32*(6), 1072-1086.
[72] Yakman, G. (2008). STΣ@ M Education: an overview of creating a model of integrative education. Pupils Attitudes towards Technology. *2008 Annual Proceedings. Netherlands*.
[73] Zimmerman, A.S. (2017). The STEAM Inherent in STEM: A Mathematical Example. *The STEAM Journal*, *3*(1), 13-24.

DOI: 10.37200/IJPR/V24I5/PR201690
Received: 05 Feb 2020 | Revised: 01 Mar 2020 | Accepted: 18 Mar 2020