

A project entitled

Practicability and challenges of Applying STEAM (Science, Technology, Engineering, Arts and Mathematics) Approaches and concepts in the Music Education of Hong Kong Primary and Secondary Schools.

Submitted by

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Declaration

I, *CAI Yiting* Declare that this research report represents my own work under the supervision of Principal Supervisor Dr. Ng Kwok Wai, and that it has not been submitted previously for examination to any tertiary institution.

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Abstract

Foreign literature shows that education needs to be reformed as time goes by. Research has emphasized the significance of STEAM, which cultivates and equips students to be more creative and be aimed with general skills, for instance, problem-solving skills, collaborative skills, etc. Other benefits like enhancing their learning motivation and greater engagement in music education cannot be underestimated. In foreign countries, some schools have implemented STEAM. This study aims to explore the practicability and challenges of applying STEAM approaches and concepts in the music education of Hong Kong primary and secondary schools.

Based on a review of the literature review on STEAM education in music, my interviews of four local people engaged in STEAM music education have been recorded: questioning their viewpoints to STEAM education, how they conduct STEAM in music lessons, what they gained, the obstacles they encountered and some possible solutions.

Analysis of the response demonstrated that those teachers make consensus on STEAM is a trend in the future and it could cultivate students in creativity so as to enrich in general skills. Apart from the benefits mentioned above, STEAM education makes a positive impact on shrinking the learning difference in a class. Nevertheless, teachers are always confronted with some unexpected challenges: inadequate training for music educators and vague conceptualization. It is suggested that adequate, quality training courses for teachers and STEAM conferences could solve the problems. Further research needs comprehensive data to support and study in a deeper way.

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Introduction

STEAM

Under the technologies advanced and intense globalization era, there is a need to educate the new generation of students to become technology literates. However, it is insufficient if people just stress on science technology, engineering and mathematics. The Educators figured out that to have a bright future, creativity, innovation and entrepreneurship are also the pivotal components of the twenty-first-century talents. (Khine, Areepattamannil, 2019) STEAM (Science, Technology, Engineering, Arts, and Mathematics) education emerged as a new pedagogy, in response to the need to increase student interest and skills in Science, Technology, Engineering, and Mathematics (STEM) fields (Quigley, Herro, & Jamil, 2017). STEAM education merges the arts with STEM subjects for the purpose of improving student engagement, creativity, innovation, problem-solving skills, and other cognitive benefits (Liao, 2016), and to improve employability skills (e.g. teamwork, communication, adaptability) necessary for career and economic advancement. (Khine, Areepattamannil, 2019)

Music Curriculum in Hong Kong

When it comes to music education in Hong Kong, there are some connections between the missions of the curriculum and the ultimate results of STEAM education. According to The Education and Manpower Bureau (2003), the rationale of music curriculum is to process information flexibly and handle problems creatively. Schools are responsible for cultivating in students' broader perspectives, creative thinking, rich knowledge, flexibility and a strong sense of commitment. To achieve the mission, the Education Bureau had designed four learning targets for schools to follow, including developing creativity and imagination, developing music skills and processes, cultivating critical responses in music and understanding music in context, through integrated activities of creating, performing and listening. STEAM education provides innovative ideas and more comprehensive development to students. It is believed that transdisciplinary learning benefits students.

Research Aim and Research Questions

Leung Chi-Hin (2018) mentioned the Hong Kong government, local schools and institutions substantially need to promote STEAM. There are more innovative and effective approaches provided to music educators. With the significance and efficiency of the STEAM education, STEAM education could enhance music learning so that Hong Kong students can benefit, which is worth further investigation. After taking reference of literature review, some resemblances could be seen in curriculum designs as well as education approaches. Inspired by the innovative concepts and references, I would like to have further exploration and focus on these research questions:

- How do Hong Kong teachers view STEAM?
- How STEAM applied in music education in Hong Kong?
- How can we benefit from STEAM?
- What are the challenges of applying STEAM education in Hong Kong music education?
- How to balloon the practicability of STEAM implement?

Literature Review

Importance of STEAM Education

Nowadays, it seems that we need kinds of talents that can collaborate with others well, strong problem-solving skills and also creative thinking. Therefore, Jamie Martinez (2017) suggested that there might be an education reform which creates new kinds of developmental interdisciplinary learning atmosphere named STEAM education and leads an educational fad. STEAM education is kind of transdisciplinary, integrating Science, Technology, Engineering, Arts, Math, transforming from the traditional clear division in subjects and shifting the focus of education from knowledge to abilities. In the previous time, STEM (Science, Technology, Engineering, Mathematics) education was so popular and lots of places lead the concepts in classrooms and the organizations created courses for playgroups, which is popular in Hong Kong. However, it is different from STEAM. It is also important to have innovative thinking and also design abilities. According to Catherine Conradty, Sofoklis Sotiriou and Franz Bogner (2020), STEM subjects often do not enjoy a good reputation as they are regarded as stressful or even anxiety. However, STEAM could improve STEM's reputation, reducing pressure and anxiety. Some schools in different countries are trying to apply STEAM education and experiencing new style pedagogy.

STEAM is a creation based on subjects-integration. It has its value and is believed that it will lead a new education reform. Julia Marshall (2010) suggested that integrating art and key ideas in other subjects and view it as a transdisciplinary space by using contemporary strategies that support STEAM education. Lynn Silverstein and Sean Layne's (2010) have ever raised art integration that recognizes its value. In the 21st century, there are new talents needed in the society. There are different needs from different perspectives. Yilip Kim and Namje Park (2012) mentioned lately, education on convergence and invention from the perspective of cultivating ingenious talents is becoming increasingly critical. Guy Boy (2013) raised the importance of design. With a design thinking, it would fit the future need. However, According to Crisciuc Viorica and Cosumov Marina (2017), to cope with the contemporary world,

students need some generic skills like the ability to learn, competence, and also problem-solving skills. Based on these requirements, scholars come out with the result that STEAM education can deal with the problems. However, in Hong Kong there are few schools that apply STEAM. Leung (2018) raised that the Hong Kong Education Bureau, local schools and institutions substantially need to promote STEAM education to nurture students' creativity, collaboration and problem-solving skills.

STEAM education has lots of characteristics and benefits in cultivating talents that the society needs. Firstly, art elements in STEAM offer an important way to cultivate creativity. John Maeda, an experienced expert in STEAM, argued that art and design education fosters creativity and innovation. (Liao, 2016) The second one is that STEAM education improves students' problem-solving skills. Crisciuc and Cosumov (2017) raised that STEAM helps students to get ready in the future career, the teaching methods enhance students' problem-solving skills. Christine Liao (2016) mentioned that creative problem solving through artmaking should be the center of art-integration practice and with problem-based learning. Students would have adequate space to do what they want and gain autonomy. They need to deal with the problem by themselves. Teachers prefer to assign group projects and the activities are project-based as well. Students are not only required to think out the solutions but also choose a better way to deal with it. From the practice in their daily tasks, students might have a better ability solving problem due to the mature ability. The third one is that STEAM education boosts students' collaboration, which people think is as important as communication skills and it is also a skill that needs to be mastered in the 21st century. The transdisciplinary space helps students develop their collaborative and critical thinking ability. (Liao, 2016) When there is a group project, students need to communicate and cooperate with others. When deciding what to do, how to do and what kinds of ways to do and also the allocations, all of them need communication and collaboration. Regarding La Porte (2016), each student in a group, they all have responsibility to help each other and be a caring leader to take care of the emotions of groupmates. It is not only about the project, but also involves mental care that enhances the relationships. The fourth one is that students would obtain confidence. STEAM education included lots of experiments for them so that they have

opportunities to do hands-on work and being student-centered to explore the unknown world. La Porte (2016) raised that art increased their self-confidence. Sometimes students are interested in arts, they will try and probably approach. The art activities help students believe in themselves. Besides, teaching is a role that encourages them to try. There is no exactly correct answer but just help them to be creative. The encouragement from teachers would also make students being confident. According to Veblen and Elliott (2000), the integration of music with other subjects is a very important topic among music teachers worldwide. Burton (2001) suggests a number of benefits of integration, including applying basic skills to real-life situations, raising standards, enhancing teacher creativity, developing less teacher isolation and providing a more positive classroom climate. Schools can develop art-centered curriculum models and provide in-service training to positively change attitudes of teachers due to the fact that arts integration enhances academic attitude outcomes and provides a deeper understanding of academic areas.

STEAM in Theory and Practice

When applying STEAM theory to music education, Capraro, Robert M, Capraro, Mary Margaret and Morganthe James R. (2013) raised that activities may include project-based learning, problem-based learning. (as cited in Liao,2016) Project-based learning provides opportunities for students to collaborate. La Porte (2016) mentioned students need to be respectful and helpful when having group work. Students would also encounter challenges while reaching collaborative agreements, they realized its real-world application, solving problems through collaboration, not in isolation. When it comes to the transdisciplinary perspectives, Liao (2016) suggested that students are not learning the categorized subjects. Instead, students view their work as created through engaging with all these subjects and beyond these subjects such that they can apply their work to and even solve problems in other settings, which match the goal of music curriculum.

In regard to the **theory** about STEAM, Cassie F. Quigley, Dani Herro, and Abigail Baker (2019) raised social practice theory. Guyotte et (2014) mention: engaging with or collaborating with a public, working across a variety of disciplines, and instigating

works that have relevance to both an art and a variety of non-art audience. In such theory, the key components are collaboration outside of school setting, discipline integration and relevance across fields. By integrating arts elements, students will be equipped by global views and creativity, which attain creative problem-solving. For instance, artmaking and problem or project-based learning open a new ability and how to use these connections among their knowledge, skills and abilities and how to use these connections in advancing their own knowledge. In this manner, students can explore and erect their own knowledge framework. Hope the teaching approaches will provide ample opportunity in self-directed, organic teaching and learning. Crisciuc and Cosumov (2017) suggested transdisciplinary is a horizontally learning, with interdisciplinarity, pluridisciplinarity. The transdisciplinary content organization requires flexibility and leads to suppression of the traditional content organization. It is referred to as problem solving, attitudes and skills formation, situational learning approach, sequences of learning. All these are the basics of cultivating students in the future. The problem must contain a contradiction, a choice, an argument, a challenge, and a doubt.

Regarding the **practical** part, one of the examples is that Leung (2018) raised creative music making with the use of electrical conductors. It aids students in understanding music figure and composition devices. Students can nurture their creativity by designing an instrument with electrical conductors for creative performance and creation. It is a transdisciplinary activity containing science and music to develop creativity and music learning skills. With the tool called Makey Makey, which is a new platform for improving tangible user interfaces. It enables people to make nature-based interfaces, it is compatible with all software and it does not require the user to program or assemble electronics. People may create different interfaces incorporating a wide variety of found objects, both physical and digital. (Collective and Shaw, 2012) It is a good tool for students to explore when they are learning as Makey Makey is flexible in connecting to software, applying the knowledge for students to learn. The teaching approaches inspire me to have further investigation in application or software and they can be facilitative to achieve the goals of music curriculum.

An example from Judith Bell and Tim Bell (2018) was the integration of

computational thinking with a music education. It is the way of exploring computational thinking ideas such as decomposition, patterns, abstraction and algorithms in a meaningful way while also exploring key concepts a music educator would expect to work with. Algorithmic thinking, abstraction, decomposition, generalization and evaluation are considered in the scope of computer thinking. This paper addresses these issues in music education by integrating aspects of music education with computational thinking. Integration means that both subjects are being taught at the same time, which not only provides efficiency in the use of class time, but also helps students to avoid seeing subjects in isolation, and can potentially engage students who are more attracted to one of the integrated elements than the other. There are common elements between music and CT. In practical situations, both rely on notations in formal languages (for music that could include Common Music Notation on 5-line staves, tablature, solfège notation or other notations; for computing it includes programming languages as well as markup languages and protocols); and both use concepts around sequence (the order in which notes appear in time; and the order of statements in a computer program) and repetition (in music this includes repeats, as well as forms such as rondo or the structure of popular songs; in computing loops and recursion provide this).

In 2019, a project-based case study: Child-Robot Musical Theater launched. It was a STEAM project for 25 children grades K-5 and the project based on the fairy tale "Beauty and the Beast", which last two-week. The innovative learning ideas combined robots and musical theater. It was believed that this kind of modular learning offers an unusually rich and engaging means of introducing STEAM education to children and easily leads to discussion of programming, math, physics, human-robot interaction and animation. Different from STEM, it integrates with arts elements, which could be seen from the case that it contains music, singing, acting, drawing, painting, costume design, and etc. The case approach using techniques based on situated learning and cognitive apprenticeship. In the context of the "Beauty and the Beast" story, children learned different aspects of musicals and how to interact with robots according to the needs of their personal activities. In such activities, music and sound was integrated in the project. Students are taught with the role of sound in art and how to produce their own sounds. Students need to record the sounds to sound

cards and program the codes for the robot in order to control it to play the snippet of the song.

Regards as Zdzinski, Ogawa and etc. (2007), Teachers in Japan and America were likely to integrate music instruction with mathematics and other contents, which means it's prevalent for STEAM educators to integrate music and maths. Johnson and Edeson (2003) presented the similar view as well. Patterns are essential to both mathematics and music. Work with patterns enhances the thinking and reasoning skills of children because students must analyze a pattern to figure out its rules, communicate the rule in words and predict what will come next. Lovemore, Robertson and Graven (2020) provided an example between music and mathematics for the purpose of teaching the concept of equivalent fractions in parallel with teaching about equivalent note values. For instance, 1 whole = $\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}$ (a whole is made up of eight eighths) and one whole note in music is made up of eight eighth notes. The same principles apply for adding like fractions or like notes values to create a whole. The research was conducted in an independent school in the Eastern Cape.

Obstacles and Possible Solutions

It is not uncommon to see that proceeding from traditional teaching mode to a novel education: STEAM will confront adversities. First and foremost, devising genuine transdisciplinary learning material would be a challenge as it needs genuine thinking with disparate subjects instead of containing the relative elements. (Bell and Bell, 2018) Bequette and Bequette (2012) raised even though we perceived STEAM education is conducive, regarding implementation, educators are easily deterred due to the vague conceptualization. The educators did not conduct in-depth research and did not understand the practice of STEAM education. For them, entering STEAM education is a bit difficult and troublesome. Moreover, Henriksen, Mehta and Mehta (2019) reckoned When considering how multiple disciplines intersect in the field of human-centered design, we must also realize that most human-centered problems represent a mixture of disciplines (Buchanan, 2001). In these issues, the stereotype of discipline is not always correct.

To make the situation better, Criscius and Cosummov (2017) recommended evaluation perspectives for teachers so that they have a clear picture of how to evaluate students after STEAM lessons. Four aspects were regarded, containing general methodological skills, metacognitive skills, positive motivating attitude and pragmatic skills.

Reviewing the reference paper named Integrating Music and Mathematics in the elementary classroom, the importance of integrating subjects has been clearly illustrated and the author listed out a large number of samples for teachers to follow. However, the paper makes no attempt to analyse the effectiveness of integrating disciplines. On the condition that it is a case study, with a background information of the schools and students, plus detailed dates and results, it would be a better reference for educators.

Methodology

Qualitative Research Method

The project will conduct in qualitative research. By listing out the key concepts of STEAM education and music curriculum and organized the key words to design the interview questions. (Lune and Berg, 2017) In this research, the interviewees (N=4) were all invited to answering the question and the selected criteria based on their current work experience, which related to STEAM education. Dr. Bradley-Levine (2015) suggested that qualitative research is participant-driven research. It asks broad general questions focusing on the participant's experience. It brings voice to those who may not usually be heard in education or other areas of interest. There are particular methods that are used to collect data. By collecting their background information like working region, seniority, teaching school categories, role in STEAM teaching and etc. The interviews are mainly divided into five parts according to the research questions. Each interview took approximately 30 minutes and they are conducted through online interview. The aims of the interviews are to investigate the current situation of STEAM practice in Hong Kong and have deeper understanding on the practicability and challenges of implementing STEAM in Hong Kong primary and secondary schools.

Procedures

I designed some interview questions for teachers and make appointments with teachers through messages. I conducted the interview via ZOOM in February. After that, I did transcription on the basis of audios and the analysis.

Declaration

Only qualitative research was included in this paper due to the COVID-19 epidemic this year. There were some limitations in collecting first-hand data like interviews and surveys with students, collecting information from stakeholders and observations of STEAM classes since students haven't resumed the face-to-face schooling yet.

Background Information of Interviewees.

	Teacher A	Teacher B	Teacher C	Teacher D
School	University	Primary School	Primary School	Secondary School
Category	UGC	Aided	Aided	Direct Subsidy
Area	Tai Po	Whampoa	Tseung Kwan O	Cheung Sha Wan
Teaching Age	/	7	1	16
Role in STEAM	Training potential music teachers	Teaching STEAM	Teaching STEAM	Teaching STEAM
Tools using in STEAM	GarageBand The Grid LittleBits MakeyMakey	LittleBits GarageBand	GarageBand Chrome Music Lab	GarageBand Spectrum

Results

In this session, the results of some key discussion about applying STEAM education in Hong Kong will be demonstrated. The results will be illustrated according to research questions mentioned in the literature review, including how current teachers view STEAM education; how they launch STEAM activities in Hong Kong and the benefits of applying STEAM in Hong Kong; what the obstacles might be encountered and the possible solutions.

Viewpoints on STEAM from current teachers

“STEAM is in line with the current 21st century development. the future master needs such a wide, multi-angle analysis, and cultivate creativity. STEAM focuses on horizontal development. with a certain foundation, learning and understanding new things will be easier, and acquiring knowledge will not be too difficult for them.”

--Teacher A

“This kind of learning is a trend, and with the development of ever-ongoing technology, learning efficiency will also be increased.”

--Teacher B

“The Hong Kong Music Curriculum Guide for Primary and Secondary Schools also mentions that students are expected to develop their ever-changing problem-solving skills through music courses, have a broad vision, innovative thinking, and the courage to undertake. STEAM is a new trend of society. STEAM helps to cultivate what we need in the future.”

“This is also in line with 21st century education. Students not only need knowledge, but also need the ability to solve problems, communicate, and create. So in the music class, I will focus on cultivating the interest and abilities of classmates, to become more skill-based learners, rather than just about piece-meal knowledge.”

--Teacher D

According to the feedback from a handful local music teachers, they feel happy that STEAM has grown up to become a trend. The interviewees said with no uncertain tone about the problem-solving skills, creativity, collaboration skills of STEAM will get better and wider developed in the 21st century. With the cutting-edge development in technology, knowledge can be freely obtained from the Internet, thus, the ability to solve problems, creativity, cooperation, and communication skills will open up a new horizon to a brave new world.

How teachers apply STEAM?

“We pick out some topics, and then conduct topic-based learning. For example, for sixth grade students, we will reserve some topics and use the STEAM mode to learn. We use LittleBits, GarageBand and combine the topics of the four major families, electronic music, and film music for thematic learning. We will give students a movie bridge without background music, and students need to add background music to the movie. Students need to test the sounds of the four major families of musical instruments on GarageBand, and then choose the instruments and performances according to the effects they want to express. Then LittleBits will be used to make the special effects that appear in the movie. Another example would be learning chords through technology so that students can hear and explore the notes in a chord even though they cannot play the instruments.”

--Teacher B

“I teach music as well as mathematics. The time value in music and the fraction in mathematics can be studied together. The concept of time value is combined with the fraction to enhance students' understanding. In addition, derivation and logical thinking are more important in mathematics. They all have certain patterns, such as the pattern of repeated melody.

For making robots, students will be divided into groups and they need to accomplish their designated tasks. However, before they are assigned to different groups, they have experienced all the steps, like composing, coding.”

--Teacher C

“We have an annual activity of composing by utilizing Garageband and they can perform their own work. Besides, we involved music arrangement, composing music for film, scoring as well.”

“A new module launched recently, which coordinates visual arts and science. The students used the software to arrange the music. This ring can scan the color, it converts the color into an agreed aesthetic experience and converts it into sounds. The tool named Specdrum comes with a cushion, you can pair the ring with the app on your phone, and then play music. You can also use the sounds in the software to create a list of different settings or record your own sound samples and assign them to different colors. Specdrum is not limited by the color of the keyboard, it is suitable for any color. Therefore, students may paint the original pictures by themselves.”

--Teacher D

To sum up, the majority activities are conducted by groups and the learning topics are integrated among different levels in traditional planning. With the combination of the tools like GarageBand, LittleBits, Specdrum and the redesigned topics, comparatively long-lasting projects roll out. Composing, creating is commonly seen in the process. Different subjects are associated in group works which makes it be multidimensional, considering the knowledge horizontally instead of vertically.

Benefits of applying STEAM

Entice motivation

“This learning mode (project and technology elements), in which students are given chances to experience and explore will allow students to have better

learning efficiency and learning motivation, including after-class learning and discussion”

--Teacher B

“This learning mode will have an impact on students’ learning motivation.”

“We will use STEAM to teach Japanese and Korean songs. We have previewed it with the students before the class is closed, and the students are looking forward to it.”

--Teacher C

“Students will cherish and be more interested in this kind of learning opportunity.”

--Teacher D

Compared to the traditional learning, STEAM runs in student-centered mode that students need to explore further by themselves, which provides profound motivation. Moreover, combining technology in their learning will draw their attention and they will be more willing to learn.

Shrink the disparity of learning

“The gains are not based on individual students. From the overall effect, the improvement of bridging their learning differences also has conspicuous effects, which could be seen at the evaluation. Like concerning electronic music, they may find it difficult to understand at first, but in learning in small groups, students with different learning abilities can also learn from each other with greater ease.”

--Teacher B

“In the small group, the stronger ones are more willing to help the weaker ones, and the weaker ones also have the opportunity to see how the stronger ones put their knowledge into practice, so as to improve their own situation, and shorten their disparity in learning”

--Teacher C

“Usually we use Garageband, which not only includes the sound of the instrument, but also can record the required music by ourselves. In the software, some settings allow students who are not so knowledgeable in music theory to follow everyone's footsteps in creating and scoring together.”

--Teacher D

It is not uncommon to see that it is conducive to learn STEAM in projects. It creates chances for students with higher capability to teach the groupmates whilst the students with lower capability can learn the better one.

Enlarge engagement in music education

“The interesting part of e-band is lowering the threshold, and so is the STEAM. A new thing for beginners and veterans alike. Everyone started from scratch. There is also no harsh requirement to say how many levels the musical instrument should reach, and it is encouraging to find that the scale of participation has been greatly increased.”

--Teacher A

“Students are very interested in electronic equipment. Compared with traditional musical instruments, it is easier less costly to learn than using conventional musical instruments.”

--Teacher B

With regard to the music engagement, a soaring number of students could be benefitted via STEAM since the threshold of participating in music is more available to those who are not equipped with a solid foundation in music education.

Enhance creativity

“I think the most influential thing is creativity, LittleBits is musical enough to have space for music creation, performance, and expression. Compared with the previous musical instrument sound only piano, now everyone can create new musical instrument sounds in more personal and diversified way. From the point of view of creation, there is more room for personal creativity.”

--Teacher A

“They don’t need to learn much music theory knowledge, but their creativity can be quickly presented through e-music technology.”

“Sounds are created by themselves, and there is a lot of room for creativity.”

“Allow students to have wild ideas and greater freedom to try new things, which can stimulate students' creativity and curiosity in the world of music.”

--Teacher D

It could be seen that modern technology stimulates creativity, and it is easier for students to express their fabulous ideas and creativity. More rooms are available for students to imagine.

Cultivate whole person development: multidimensional thinking and develop general skills

Think in different perspectives:

“I rarely look at things horizontally, instead, I try understanding music in other subjects. An analysis from a physical point of view will help students learn music. STEAM is a kind of enhancement, allowing knowledge to cover a wider range and linking different disciplines, so that you can learn music knowledge in other subjects and find possibilities to break new grounds in traditional music courses.”

--Teacher A

“Before STEAM, I didn’t link up different disciplines. But now I try my best to link them up. Surprisingly, you may find out some common logic in various

subjects. This kind of ability is essential and I need to cultivate students in this way as well.”

--Teacher C

There is a resemblance between teacher A and teacher C that STEAM entices people to view things in a multifaceted way, from different perspectives in a subject via manifold angles in different disciplines, which help students to have a clearer mind and stay cool when analyzing things.

Develop general skills:

“Let students work together to overcome various problems in a group project. They need to communicate and collaborate to get the job done.”

--Teacher C

“Students must communicate and cooperate to complete the group assignment at hand. When they have conflicts of ideas, they also need to communicate and cut a deal. Therefore, both problem-solving skills and communication skills are acquired.”

--Teacher D

Due to the fact that students need collaboration and there is an opportunity to learn from each other. What is worth appreciating is that students not only can present their learning skills but also practice various, problem solving skills as well.

Get a strong sense of belonging and ownership

“An evaluation would be held, which is about how students feel and how they learn from their reflections. We all find that students in general have acquired a sense of satisfaction, which is quite crucial.”

--Teacher D

Build up greater self-confidence

“Teachers need to believe in their students that they can achieve something valuable by themselves if they try hard. Every student has unlimited creativity. When a student succeeds, they will gain greater confidence and self-esteem and are more willing to strive for excellence next time.”

--Teacher D

Obstacles

Dearth of training for teachers

“STEAM is a product of cross-subject learning, which means current subject teachers might not be equipped with various perspectives of knowledge.”

--Teacher A

“The most difficult thing is how to help conventional subject-based teachers to learn electronic tools, use electronic tools to teach, and how the school provide adequate and appropriate training to their teachers.”

--Teacher B

“It is also important for the teacher to be familiar with STEAM. The early and traditional training courses for teachers did not involve STEAM. Sad to say, they knew little or inadequate knowledge about STEAM.

--Teacher C

Vague Conceptualization

“Hong Kong's class time is pressing and limited, and the subject content is huge, let alone to build a bridge to integrate other subjects. If STEAM is used for teaching in every subject, then the original class time for some most basic school subjects will be disrupted.”

“Whether these five elements can be divided equally in lessons is difficult to measure. I think that every element is like a STEAM activity. Some co-workers think that two or three of them are considered STEAM. Given the harsh shortage of resources, I don't completely deny it either. Because it inherently integrates different disciplines, I hope that each lesson can be integrated into different subjects at this tentative stage.”

“What are our expectations? What are the desired outcomes? Because we usually have goals in class, but in STEAM, it may be difficult to explain what the goal is. To what extent is it good for the teacher to complete it? This is difficult to define. These answers are still hard to grasp.”

--Teacher A

“Of course, there will be some teachers who do not know how to operate STEAM, they are used to practising their own teaching mode.”

--Teacher C

Insufficient supports from policy/ policy makers/ schools

“Whether the policy maker and the department can provide support to the teachers is definitely an important factor But now STEAM is not the mainstream of development, the state is like now. This is the difficulty I think the school faces.”

“Next is the source of funds for hardware and supporting facilities.”

--Teacher A

“The development orientation of the school plays an important role. The reason is that it determines how much teachers will be supported by school. If there is not enough space given by the school, teachers have difficulty in trying new teaching approaches.”

--Teacher C

Inadequate experience sharing

“Many schools are trying to do it, but we are not sure how effective it is, and it is not clear whether it can help students. I don’t know if other schools have teaching designs that can be shared with everyone, so as to improve or absorb experience. Whether there are more benefits that can be brought to students is what we want to explore.”

--Teacher B

COVID-19 restriction

“To be honest, the biggest problem now is that classes are not still being suspended. It is difficult to practice STEAM without a face-to-face classroom, because the project will definitely do group activities, which requires cooperation and cannot be done by one classmate.”

--Teacher C

Possible Solutions

Equip teachers in diverse ways

Provide some course design:

“The most effective help is whether there are some tools that can explain how to apply to music courses in Hong Kong, or provide some teaching designs for teachers to refer to and follow, so that schools can organize their own set of courses. This is what I think is most needed now.”

--Teacher B

Training courses:

“For interdisciplinary, teachers themselves also need to be trained.”

--Teacher B

Design training courses for teachers:

“Further studies are also a good way. I believe there are also many STEAM workshops or courses that can be taken. Besides, music technology will be a good choice to improve as well, and then relying on the individual's ability to master and apply the principles of the teaching method, you can also come up with more teaching plans, maybe there will be more possibilities.”

--Teacher C

STEAM conference

“There is a similar plan of conducting a STEAM conference by EDB, which is useful and effective. Some experts or experienced teachers are invited to have a meeting with the current teachers and discuss how to solve the unsatisfactory part. It is very good to explore with experts how to make teaching design, how to plan STEAM courses, etc.”

--Teacher B

“We also want to share our successful experience with music educators and learn from each other.”

--Teacher D

STEAM experts lead schools to apply:

“However, if a leader makes a plan that fits the Hong Kong situation and leads Hong Kong teachers to carry out this plan, with clear short-term and long-term goals, it will be easier for schools and teachers to follow. This will be better.”

--Teacher A

Experience sharing session:

“Only when we communicate more, STEAM can be better developed in Hong Kong. For better results, I think class observation is also a way to improve. Many teachers do not know how to implement STEAM even if they have a classroom design. Moreover, there is a change in the teacher role. It is encouraged that teacher playing a role to give improvement guide instead of transmitting knowledge”

--Teacher B

Personal attitude:

“Teachers need to think about the additional responsibilities of art teachers and the value of art subjects when there is little support given by school, in fact, every discipline has its own space and resource constraints.”

“Never stop learning, especially in a world changing rapidly. We need to explore new grounds with students.”

--Teacher D

Findings & Discussions

This session is mainly focused on the findings and discussion from the result. Based on the transcribed script, a comparison of applying STEAM in foreign countries and Hong Kong will be demonstrated, including the viewpoints, conduct mode, benefits, obstacles and possible solution.

To begin with, relevant viewpoints have been collected. As mentioned in the literature review, there are some vital values in STEAM, which showed the importance of general skills like collaboration, strong problem solving, creative thinking, learning. Both the studies and the local response generally showed the similar values. From the interview results, the core value of STEAM cognized by teachers in Hong Kong and studies are essentially identical, a new trend of education and the future need of talents are clearly indicated as teachers mentioned the keywords of some basic skills like problem solving, communication, collaboration and innovative thinking. Most of them agreed that knowledge is not the most important but the acquisition of general skills. At the same time, it could be found that some teachers realized the pivotal values of STEAM and tried to cultivate the next generation to be the “needed” talents in the future.

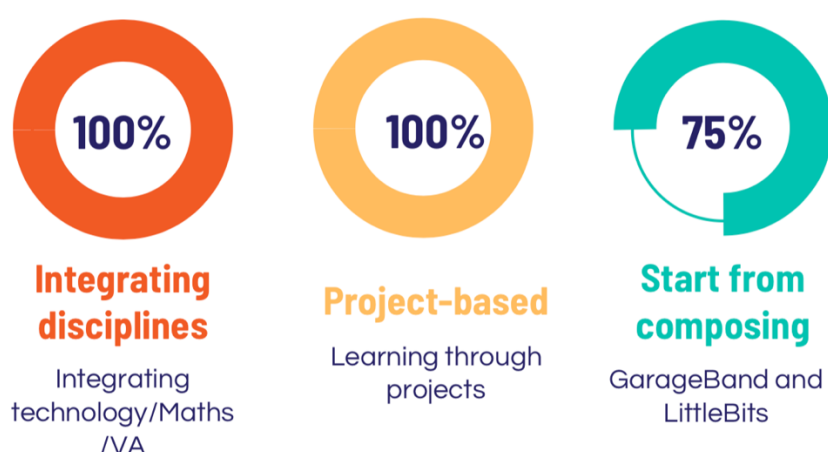


Chart I: How Teachers Apply STEAM

The coming discussion turns to how teachers apply STEAM. Most of the activities

held in Hong Kong schools are similar, the starting point was composing, which attempts to entice students to be creative. By utilizing technology like application by iPad or some tools to help students from learning music. Sometimes, integrating various disciplines could be seen in parts of projects, which contain music, technology, science, visual arts and so on. With regard to comparison, through having reference of the articles or studies abroad, parts of the approaches in other countries similar to that used by interviewees. It was conspicuous that some concepts are identical. For instance, Johnson and Edesion (2003) suggested the importance of pattern and the prediction of the next step. Lovemore, Robertson and Graven (2020) combining time value in music and fraction in mathematics. When it comes to the case in Hong Kong, teacher C managed music and mathematics in the primary school and he is equipped with technology knowledge. Teacher C tried to bridge several disciplines and find out the principles, which can understand different knowledge with one logic. Teacher C mentioned that he taught fraction with music and explaining time value with Math understanding. For the music form and basic chords, teacher C applies a student-centered approach and allows students to predict and observe what will happen next, while sometimes guiding students with math logic. However, some cases are widely varying in different levels. A slight difference could be seen between the case in the UK and Teacher C's school. A project-based case study about robot, music and theatre and students finally can finally guide the robot to play music. Similar ideas are incorporated in Teacher C's class. However, the music part is different. Teacher C suggested the music played by the robots is composed by students rather than recording the theme-related music. The project designed by teacher C's school was based on STEM and added some arts elements like VA and music. The composition would be created by the "app" called GarageBand. A huge contrast of approaches could be applied in Hong Kong, like the integration of computational thinking associated with music education.

In short, there are some popular STEAM approaches like composing through technology by GarageBand, electronic blocks named LittleBits and some transdisciplinary approaches. It is undeniable to say that in Hong Kong, some schools are conducting STEAM, even though in various levels and scope. The studies abroad showed the cases of more developed creative and in-depth teaching approaches in

STEAM.

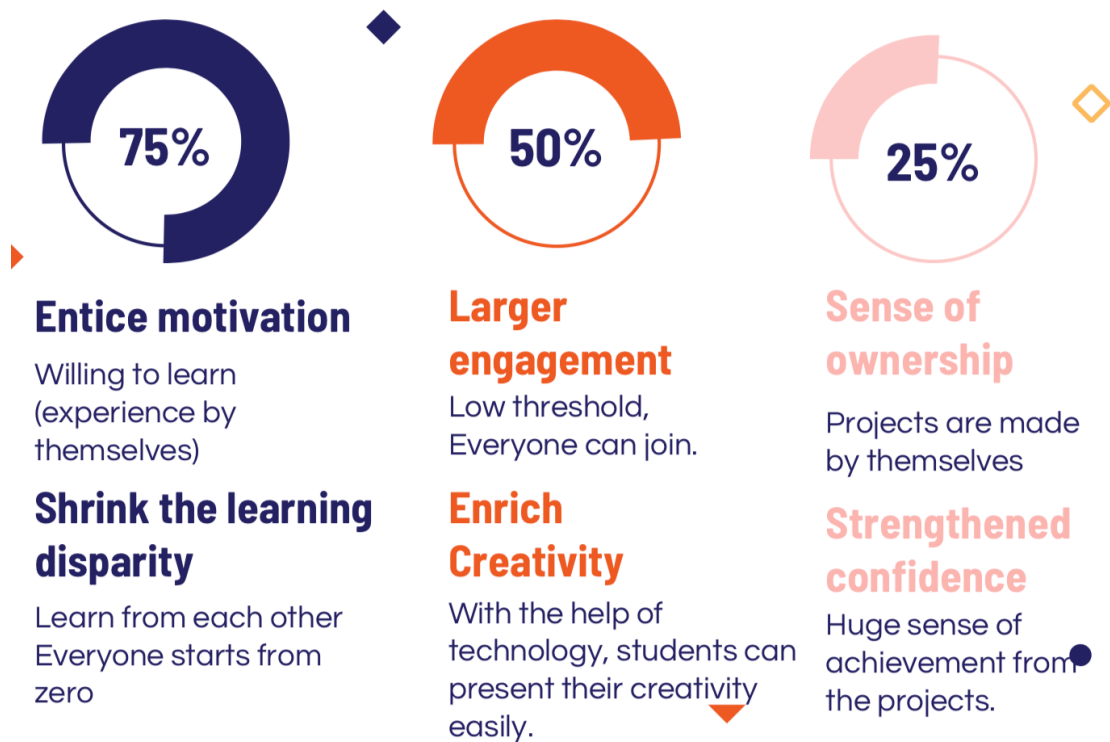


Chart II: Benefits of Applying STEAM

In view of the superiority of implementing STEAM, the result showed how students benefit from STEAM. It is somewhat surprising that students get enhancement in motivation, which wasn't significantly nor adequately mentioned in the literature review. Teacher B shared that different from the traditional teaching, more experiment and exploration attract students to learn. It makes a positive influence in after-class learning as well. 75% of the interviewees presented positively similar ideas. A possible explanation of this result may be the improvement in motivation enjoys the most prevalence among the interviewees and it shows the importance to a certain extent. At the same time, 75% of the participants agreed that STEAM education helps to shrink the learning disparity. The information subsequently followed by larger engagement, enriched creativity, multidimensional thinking and improving general skills that they all identified by 50% of participants. The result may be explained by the fact that they show the identical significance in benefits to Hong Kong context. However, the sense of belonging and ownership and strengthened confidence enjoyed

the least popularity, approximately 25%, which might not show the most crucial enhancement.

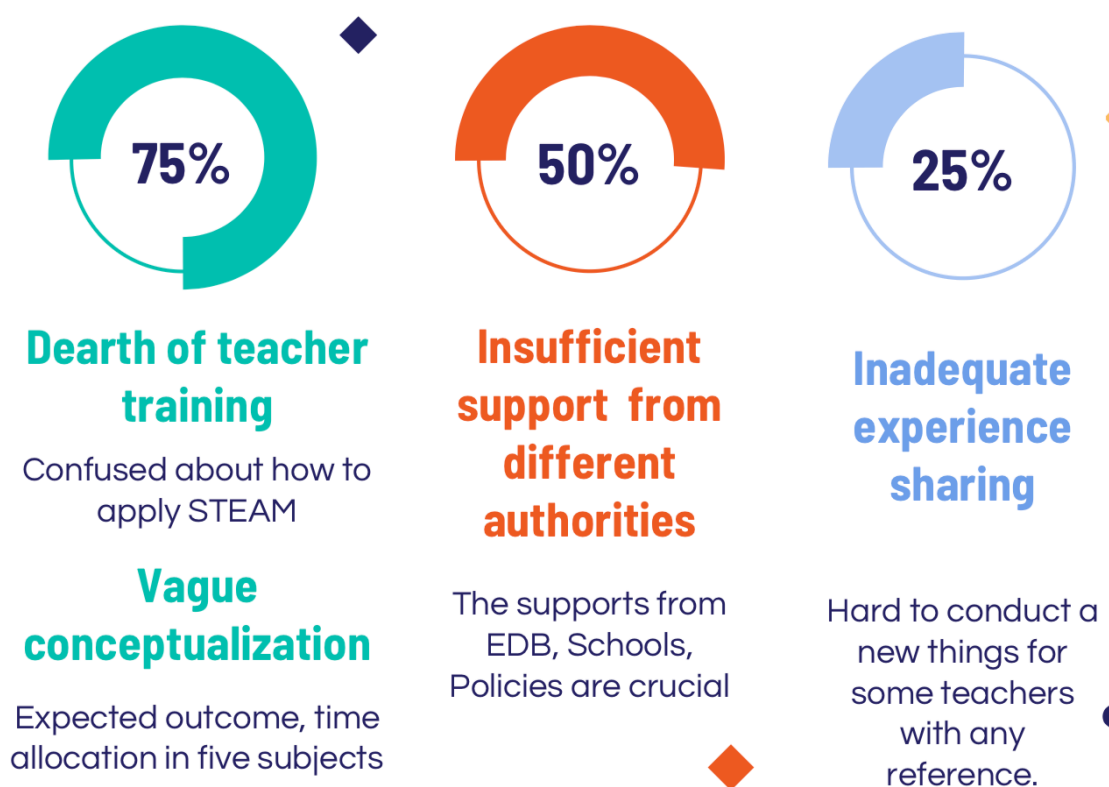
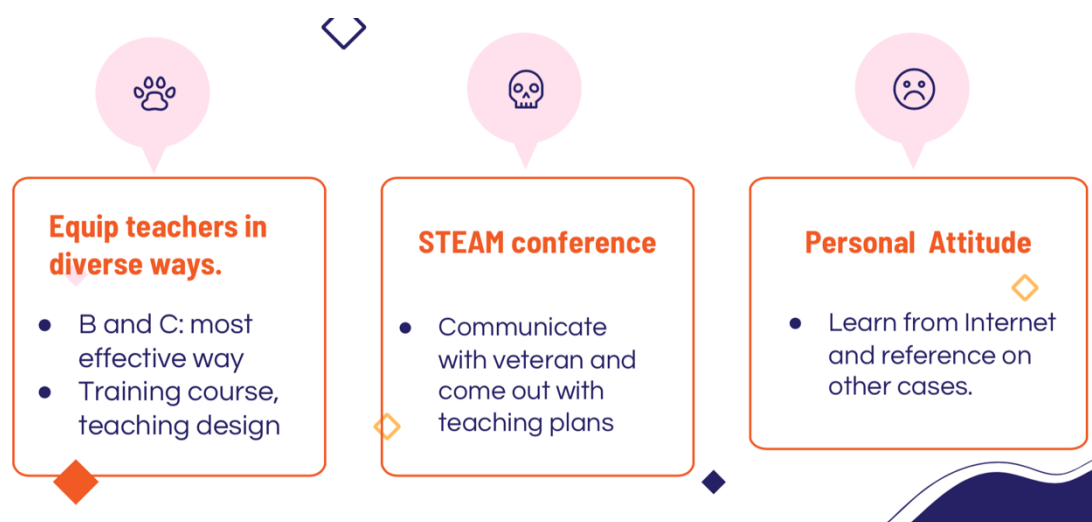


Chart III: Challenge of STEAM Implementation

Apropos of the challenges of STEAM implementation, the interviewees pointed out various obstacles. The most striking finding could be seen in the interview result were dearth of teacher training. 75% of the interviewees reported very similar argument. This result agreed with the findings of other studies. Quigley, Herro and Baker (2012) reckoned that Due to STEAM education being so new, teaching resources, professional development opportunities, and even training are difficult for faculty to come by. Therefore, the training for teachers is tough. The percentage of interviewee indicated vague conceptualization showed the resemblance in the percentage. The result of unclear concept to STEAM is in agreement with Bequette and Bequette (2012) findings which showed when it comes down to STEAM implementation, educators are easily deterred due to the vague conceptualization. The subdominant hurdles were insufficient support from different authorities, comprising 50%. The result probably showed that the support from policy and Education Bureau or even

schools are one of the momentous elements. Only 25% of teachers in the interview contend inadequate experience sharing, lack of hardware facilities, and COVID-19, which show the lowest data. Teacher A mentioned that facilities and the hardware equipment would be a big problem, however, teacher B and C showed it is not big deal, particularly some funding could be applied by teachers to develop innovative teaching.



Form I: Possible Solutions

In regard to the possible solutions, the resolution proposed by teachers are mainly categorized into three perspectives. First and foremost, equipping teachers in diverse ways is paramount. It is suggested by teacher B and teacher C that devising training courses for teachers would be one of the effective ways. Teaching design in STEAM is also raised by teachers that could facilitate them as well. In addition, there is a general strong demand for STEAM conferences. The majority of the interviewees have a consensus that improvement could be made through conferences held by veteran teachers and scholars is concerned. Teachers may have opportunities to learn more and communicate with experts so as to solve some of the intense problem in their own schools. Teacher B also mentioned that sharing sessions is also helpful. Teacher D has some successful experience in STEAM and she is willing to share the findings to music educators. Eventually, two of the interviewees reckoned that teachers may search through the internet and find out the relative courses and cases applied in STEAM as there are lots of free resources available. For the vague concept, Crisciuc and Cosumov (2012) mentioned that the scientist emphasizes three degrees of interdisciplinarity. Prior to a degree of application: the methods transfer leads to

concrete practical applications. Then, at an epistemological level: the assimilation of other discipline methods, the new discipline develops its own epistemology and finally, a number of degree generator courses: the methods transfer from one discipline to the other may lead to the appearance of an autonomous domain. When it comes to the hardware resources mentioned by teacher A, teacher B and teacher C respond that some funding are available, like Quality Education Fund.

Limitations and Recommendations

Methodology

Only qualitative research was conducted in the research. However, the feedback and evaluation results are also pivotal data for this research, especially from students, teachers.

Quantitative data and observation of STEAM classes could be conducted if the condition of COVID-19 is improved. The evaluation of STEAM efficiency would be clearly shown by the data, which could make the research more comprehensive.

Lack of data

Four music teachers in local schools are included in this research. Nevertheless, a teacher is one of the key characters in the research, views from other perspectives could not be disregarded, such as the administrator of STEAM education, school principal, publisher, course designer etc..

A further investigation could start from interviewing other dominant stakeholders to have a more accurate position of the STEAM situation in Hong Kong.

Reference

Few benefits and cases from foreign countries are mentioned in literature review. For the solutions of enhancing the practicability of applying STEAM, more improvements from other countries can be collected.

More STEAM cases from different areas and the extent of applying STEAM could be mentioned, particularly the solutions. Other benefits of implementing STEAM can be organized as well.

Conclusion

STEAM is still in its budding development stage in Asia. There are plenty of room for it to get fully mature. To sum up, STEAM is valuable and worth exploring due to the benefits of gaining general skills, creativity, confidence and the ability to think in multidimensional ways. Through the studies and the interviews of local context, it demonstrates the practicability of applying STEAM in Hong Kong. With lots of advantages for students, there is an opportunity to dive in the STEAM world. Some adversities of implementing STEAM cannot be disregarded, for instance, lack of training for teachers, vague concepts. However, the urgent needs from teachers in Hong Kong have been mentioned and the possible solutions like training courses and STEAM conference are suggested as well.

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Appendixes

Appendix A: Interview Questions

1. Could you briefly introduce yourself and your experience of teaching STEAM in music.
2. How do you understand STEAM education, what concepts does it include?
5. What teaching approaches do you apply to music lessons when integrating STEAM elements. Could you state the contents of the activities and results?
6. How do those activities affect students. What will students obtain through STEAM education.
7. The problems encountered when conducting STEAM education and any methods to mitigate?
8. Will you promote STEAM education in Hong Kong? Could you provide reasons to support? How to do it?

Appendix B: Interviewee Transcript

Interviewee A (teacher A)

(Q= Question (interviewer), A= Answer(interviewee))

A: I position myself as a composer and have a background in music education. I am more enthusiastic about creative and creative music education and have some experience. When it comes to STEAM, I am not scared or confused about what this is. My experience is mainly to do STEAM courses and activities in universities, and to train music teachers in primary and middle schools and pre-service music teachers so that they can also run STEAM courses. Mainly from 2017, I applied for teaching material grant money, so that I can try to do a STEAM project, such as littlebits, I also wrote a teaching menu for elementary and middle school teachers, also in the university elective courses. A little STEAM activity. Later, there were many in the market. For example, the Hong Kong Association for Music Educators (HAME) invited me to do workshops and shared with teachers how to do these activities.

Q: To you, what is STEAM?

A: I think STEAM is quite interesting. I discussed it with the Arts Festival earlier because they also want to do STEAM activities. I think there are many entry points. Whether these five elements can be divided equally in each part is more difficult to measure. I think that every element is like a STEAM activity. Some co-workers think that two or three of them are considered STEAM. I don't completely deny it either. Because it inherently integrates different disciplines, I hope that each lesson will be able to integrate different subjects. But the question is, can there be one fifth of everything? I think it is also difficult. As a musician, I certainly hope to start from music, and I also hope that students can learn music better through STEAM. Or conversely, I am not an expert in mathematics or science.

Q: What can STEAM bring to students?

A: STEAM has its own advantages, but in music subjects, there is one class time to teach music, and now only one-fifth of the time is left. STEAM cannot replace the original classroom, and the solid foundation of music cannot be replaced. So, I will understand STEAM as a kind of enhancement. Previous music teaching may have focused on classical music, Chinese music, folk music, and a small amount of electronic music. I rarely look at things horizontally, such as watching music in other subjects. In the past, for example, physics and music were closely related. Waveform, ADSR, and sound propagation are all physical. It's just that STEAM develops more content, such as the combination of chords, why do mi sol are more harmonious when put together? An analysis from a physical point of view will help students learn music. But if there are only these things in the music class, you can't cancel all the things you want to learn in music. STEAM is just a kind of enhancement, allowing knowledge to cover a wider range and linking different disciplines, so that you can learn music knowledge in other subjects and find gaps in traditional music courses.

Q: In practice, how should primary and secondary schools practice STEAM?

A: My idea is that the activity needs to be musical. If the sound produced is not beautiful or there is no possibility of continuing to explore, it is not necessary. And LittleBits needs to be musical enough to have space for music creation, performance, and expression in it. With the addition of other subjects on this basis, students have more space, compared to the previous students composing for violin and piano. With STEAM, you can create the sound of the instrument you want, or even make an instrument. The boundary of this kind of activity is wider and more tailor-made. Compared with the previous musical instrument sound only piano, now everyone can create new musical instrument sounds more personal. From the point of view of creation, there is more room for personal creativity, and it can also cultivate students' creativity.

Q: Is e-orchestra feasible in primary and secondary schools?

A: The interesting part of e-band is lowering the threshold, and STEAM is similar. A new thing, everyone started from scratch. Yemi has a hard requirement to say how many levels the musical instrument should reach, and participation has been greatly improved. If it is used in music teaching, I think it will be of great help. It is very musical and can also connect with the music in our lives.

Q: In addition to personalization and greater scope for their creativity, what impact does E-orch have?

A: I think the most influential is creativity and problem-solving. The second is that the perspective of things is different. For example, when I studied music before, I didn't think about why the chords are more harmonious in this situation, why the octave is more harmonious, and the third degree is not so harmonious. Previously, I would not pay much attention to and study the relationship between these and science, but STEAM can look at and analyze the same thing from different angles. In the past, one thing was looked at from different angles in the music major, but now it is analyzed in different majors. Humanities are all formed under the common influence of different things. Music is not just music.

Q: STEAM can indeed bring us a lot of benefits, but in Hong Kong, we will still face some difficulties. What will those difficulties be? How can they be improved?

A: There are several difficulties: whether the policy maker and the department can give support to the teachers is definitely an important factor. For example, the e-learning in Hong Kong is supported by the Education Bureau, and the progress will be much smoother. STEAM is the same, depending on how much help can be given. If the Education Bureau says that STEAM is very important, then we also need to add a lot of STEAM education courses and training in the university. But now STEAM is not the mainstream of development, the state is like now. This is the difficulty I think the school faces. Next is the source of funds for hardware and supporting facilities. Third, the training of teachers, if

there is no training, there are policies, and hardware cannot be done. Fourth, the problem of class time. Hong Kong's class time is very urgent, and the subject content may not be completed, let alone build a bridge to integrate other subjects. If STEAM is used for teaching in every subject, then the original class time will be disrupted. STEAM is a bridge to open up all subjects, but there must not be only a bridge. Fifth, what are our expectations? What are the desired outcomes? Because we usually have goals in class, but in STEAM, it may be difficult to explain what the goal is. To what extent is it good for the teacher to complete it? This is difficult to define. How much time and to what extent do we have to do STEAM in a semester? These answers are still unknown. In Hong Kong, it can be done, but there are many problems that need to be solved. Arts exhibition also talked about STEAM, but the examples cited are not many samples of lesson plan, and there are limitations. It seems that it is not enough. However, if a leader puts forward a plan that fits the Hong Kong situation and leads Hong Kong teachers to carry out this plan, with clear short-term and long-term goals, it will be easier for schools and teachers to follow. This will be better.

Q: Will you promote STEAM education?

A: I think it is worth promoting, but the positioning in Hong Kong is like extracurricular activities. Some of the issues mentioned just now, plus no exams, the situation in Hong Kong is more like regular classrooms, extracurricular activities. But positioning as a bridge, as the pillar of the future, the future master needs such a wide, multi-angle problem solving, and cultivate creativity. And STEAM can help us to a large extent. This is very similar to our learning art, but STEAM has a broader vision, and it covers more fields, which is also in line with 21st century learning. I think learning should be more and more. The more expansive. In the past, when we trained professionals, we only needed to consider one category, but now we need generalists. A generalist is knowing everything and knowing something. With the development of science and technology networks, as long as students are interested and capable, they can learn what they want to explore by themselves. Because STEAM focuses on horizontal development, with a certain foundation, learning and understanding

new things will be easier, and learning knowledge will not be very difficult for them, so I think STEAM is in line with the development of the 21st century and is worthy of promotion.

Interviewee B (teacher B)

(Q= Question (interviewer), A= Answer(interviewee))

Q: Hello, I am honored to invite you to interview. I am a year five student of EdUHK and I am studying STEAM education. The Hong Kong Music Curriculum Guide for Primary and Secondary Schools mentioned that students are expected to develop their ever-changing problem-solving skills through music courses, to have a broad vision, innovative thinking, and the courage to assume. The concept of STEAM education is gradually being recognized by everyone, such as cultivating students' creativity. I know you have some experience in STEAM education, can you briefly introduce yourself about school, region, seniority, school support for STEAM, etc.

A: I teach in a school in Whampoa, which is a subsidized school. The situation in Whampoa is that some students have good family backgrounds, but some live in the old districts, so some students are easily exposed to music development, and some students have no way to access music education outside the school, so the learning differences are still quite different. There is nothing wrong with doing simple tasks in class, but when it is a little bit more difficult, even if you want them to come out to play, they may not be able to do it. I have been teaching in this school for seven years. In recent years, we have been looking for some solutions to the situation of the school, because simple activities have been unable to cater to highly capable students. Our school has also seen some opportunities in STEAM. It is easy to apply the content of STEAM to the music subject. The difference between students is not that big. In the activities, we can achieve our goals without spending too much time.

Q: What activities will you organize?

A: Originally, we all taught with the content of booksellers, but you will find that there is a lack of STEAM elements. We pick out some topics, and then conduct topic-based learning. For example, for primary six students, we will reserve some topics and use the STEAM mode to learn. We use LittleBits, GarageBand and combine the topics of the four major families, electronic music, and film music for thematic learning. We will give students a movie bridge without background music, and students need to add background music to the movie. Students need to test the sounds of the four major families of musical instruments on GarageBand, and then choose the instruments and performances according to the effects they want to express. Then LittleBits will be used to make the special effects that appear in the movie. This forms a large-scale project, which of course will take a long time. Students use the group model to explore, how to use the skills learned in class to create special effects with instruments, etc.

Q: Will the school give enough resources to support the teaching of STEAM?

A: Of course. Because this is a subject plan, it depends a lot on how a teacher tells the subject of the concept and plan. We will probably follow this route. The subject team also has a budget for us, and the school is happy to accept some innovative ideas. In the case of LittleBits, we only need one set for each group. The students work together and do not need a lot of tools. This is a teamwork project. We teach in small classes and the demand is not great, so there is not much difficulty in budget.

Q: Do students and teachers have a high degree of acceptance of STEAM's teaching mode/methods?

A: Students are very interested in electronic equipment. Compared with traditional musical instruments, it is easier to learn than using musical instruments. The

GarageBand and LittleBits used in our school are very easy to use and you can see results soon. When students can see the progress of their studies, they will be happy to continue learning. If it takes too much time and no progress, the students will not be willing to continue. So it is very acceptable at the student level. On the contrary, on the side of difficult schools or teachers, the problem is not about the purchase of equipment, acceptance, classroom design, etc. The most difficult thing is how to help the teacher learn the electronic tool, use the electronic tool to teach, and how the school trains the teacher. In the music subject, we have a lesson preparation meeting, which allows teachers to learn how to use electronic tools and how to achieve our teaching goals, so that the classroom is smoother.

Q: What do you think the students have gained?

A: The topics I just mentioned, such as the four major families, film music, and electronic music, are actually hard to come into contact with. We think back to the past, when we were studying these topics, we watched the videos at most. The teacher demonstrated it to the students once, but the students seldom had any personal touch. But the advantage is that if you can use STEAM to give them the opportunity to create, to experience and to explore, compared to just listening, they may soon forget. However, this learning mode will allow students to remember knowledge and at the same time bring interest and The extension after class is also very helpful, students can learn more. The gains are not based on individual students. From the overall effect, the improvement of learning differences also has obvious effects. Like electronic music, they are difficult to understand, but in small groups, students with different learning abilities can also learn from each other. We can also see in the assessment that the difference in learning is small.

Q: In addition to the topics mentioned above, what other topics can be used in STEAM education, and how much time is spent on this topic-based learning in a year or a semester?

A: We have independent topics and will do group study. When we were learning chords, it was difficult for students to explore in real instruments, but in GarageBand guitars, all students could try and explore. The subject-based learning just mentioned spans two-thirds of a semester. Of the three musical instruments in a year, large and small subjects add up, and one semester is doing such a project. But we are still in the development stage, because I think there are still many things we can try in STEAM. We use STEAM tools to teach, it is also difficult to define what is not STEAM teaching, it depends on how you define it. But it uses a lot of electronic equipment and software to help students learn and create.

Q: If STEAM is implemented throughout Hong Kong, what difficulties will it encounter?

A: When the difficulty is implemented at this time, the problem that will be faced is the teacher. For a teacher who has been teaching for many years, STEAM is a new product. They will understand less and are used to their own teaching methods. They will find it difficult to understand how to apply the new teaching model, tools are available, but how to use tools to improve classroom efficiency is confusing for some teachers. Resources are a matter of school deployment and will not be a major issue. The main reason is that teachers will not apply existing tools to the knowledge to be taught. We need to disassemble all the topics and recombine them. Some teachers will not understand why they need to be recombined. The method may be effective to help is whether there are some tools to explain how to apply to the music curriculum in Hong Kong, or provide some teaching design for teachers to refer to and follow, so that the school can organize their own set of courses. This is what I think is most needed now.

Q: Do you think STEAM is popular in Hong Kong primary and secondary schools?

A: This is a general trend, and it is difficult. Many schools are trying to do it, but we don't know how effective it is, and it is not clear whether it can help students. But maybe we need continuous improvement to get better results. I don't know if

other schools have teaching designs that can be shared with everyone, so as to improve or absorb experience. Because some schools are dealing with booksellers, but they come and go to make musical instruments, but what can they help students after making musical instruments? Whether there are more benefits that can be brought to students is what we want to explore, and how to slowly change in the past few years.

Q: Is there any way to improve the current practice of STEAM in Hong Kong?

A: In the Education Bureau, there is a similar plan. Ask some experts or experienced teachers to have a meeting with the current teacher to discuss the unsatisfactory part of the teaching, but not in the music subject. I think this plan is very effective. It is very good to explore with an expert what tools are available, such as teaching design, how to plan STEAM courses, etc., to design a teaching activity that belongs to that school. When the results are obtained, they can be shared with everyone and become a kind of reference, which is very helpful for art subjects. There are many tools in the market, but the teacher does not know how to start and which one is better. In many cases, there is a lack of experience sharing. Only when we communicate more, STEAM can be better developed in Hong Kong. For better results, I think class observation is also a way to improve. Many teachers do not know how to implement even if they have a classroom design. STEAM also includes a change in the role of the teacher. The teacher used to be a leader, what the teacher said and what the student did, but now it may become a facilitator and give advice to the student based on what the student completes. Teachers also need to learn how to change their identities. For interdisciplinary, teachers themselves also need to be trained. For example, the head of the section chooses a tool, and then needs to help with the training so that the teacher can learn. The cooperation of different subjects is also very important. When it is a project, the help of each subject is needed.

Q: Will you promote STEAM education?

A: I will support it. You will always see that technology is a trend, and technology can improve the effectiveness of students' learning, which is very important. As an educator, I want not only the students in my school to learn well, but also hope that all students in Hong Kong will have the opportunity to learn.

Interviewee C (teacher C)

(Q= Question (interviewer), A= Answer(interviewee))

Q: Hello C, I am honored to invite you to visit. I am a final year student of EdUHK and I am studying STEAM education. The Hong Kong Music Curriculum Guide for Primary and Secondary Schools also mentions that students are expected to develop their problem-solving skills through music courses, have a broad vision, innovative thinking, and the courage to assume. I know you have some experience in STEAM education, can you briefly introduce yourself about the school you are in, teaching age, school size, school support for STEAM, etc.

A: I taught at a primary school in Tseung Kwan O for one year. I was the vice director of the music subject. I was responsible for teaching ten classes of music. The school supported our development of STEAM. New projects were injected into different subjects. The school also required interdisciplinary learning. But because of the epidemic this year, we have not been able to do too many projects. I am instructed to teach STEAM in music, and I also strive for more opportunities for STEAM education. We also started with the ipad and taught how to use the software step by step to slowly complete their tasks. In our teaching, we will use GarageBand to teach Japanese and Korean songs. We have previewed it with students before the class is closed, and students are looking forward to it. Next year, our school plans to produce school-based courses, including handbell handchime in music, and STEAM education. We will also refer to the teaching methods of another school, including music theory and the teaching methods adopted. But for elementary school students, our software will

be relatively simple to use, and it is preferred for elementary school students to get started. For example, Chrome Music Lab, with more graphic and its easy for students to utilize.

Q: STEAM education includes other subjects. How does your school apply interdisciplinary teaching?

A: We have a STEAM team, and I am also one of them. In the music department, we will include these elements: making musical instruments and using waste. I also teach mathematics, and mathematics will also participate in STEAM. And integration with mathematics is the embodiment of teaching philosophy. For example, the rhythm of music and the score of mathematics are studied together, and the concept of time value is combined with the score to enhance students' understanding. In addition, derivation and logical thinking are more important in mathematics. In the lower grades, I will start to develop students' ability. When I think about what is in music that is similar to mathematical derivation and logic, I think of music's melody and style. They all have certain laws, such as the law of repeated melody. The students in higher grades try to find the rules of the chord composition by themselves. I taught fractions with music and explained time value with Math understanding. For the music form and basic chords, it applies a student-centered approach and allows students to predict and observe what will happen next, sometimes guiding students with math logic.

We still have robots in our STEAM team, but we can't implement them this semester because of the epidemic. In our lesson plan, students will be divided into groups, and then design tasks for students, such as some students use software to compose music, such as logic pro, GarageBand, and then export MIDI to the programming students, put the music into the robot, and let the robot play music. We can show the robot to others on open days or festivals. Although students are allowed to work together to complete different steps, at the beginning we all need students to master the knowledge of different steps, such as creation, programming, etc.

Q: There are different subjects in STEAM, how can teachers equip themselves to be proficient in other subjects?

A: Indeed, this subject has a wide range of subjects. To cross over music and other subjects well, my own way is to have a certain understanding of music technology. For example, frequency, music production software, pitch, tone row, tempo, and time must have a scientific level of understanding and theoretical knowledge, so that we can do well. If we don't have this knowledge, it's actually the same as playing an instrument without a soul. The same effect. Playing with ipad, you need to have a familiar understanding of effects and filters in order to play more soulful songs. Learning music production is a good way. It requires not only MIDI production, but also mixing in the later stage, so that music will be more closely linked to STEAM and easy to achieve.

Q: Will the teachers in that school have more exchanges because of cross-subjects?

A: Yes, we have a lot of exchanges. In our school, whoever can do it can do things. Fortunately, the principal of the school and the senior management are willing to let the teachers try, even if it requires a large amount of funds, as long as the matter is well-planned. Gradually, colleagues are very active in school projects, and they are willing to share the knowledge they know, and they are also willing to help when they need help.

Q: what do you think Hong Kong will encounter when doing STEAM education?

A: To be honest, the biggest problem right now is that classes are not still being suspended. It is difficult to practice STEAM without a face-to-face classroom, because the project will definitely do group activities and requires cooperation, which cannot be done by one classmate. Of course, there will be some teachers who do not know how to operate STEAM, especially the older teachers, they are used to their own teaching mode, it is more difficult to understand new teaching methods, and it is not so repulsive to young teachers. But no matter what the teacher is, you need to have the courage to try. At the same time, the degree of

freedom and support given by the school is also very important. If there is not enough space, teachers cannot try new courses. It is difficult to practice on their own. But the school is willing to give teachers space to play, and colleagues actively cooperate, the chances of success will be much greater.

Q: Practicing STEAM requires some tools or purchases of some software. Do you think these expenses will be a big expense or are generally unaffordable by schools in Hong Kong?

A: Actually, it can be done. If the school does not have sufficient resources, there are still funds to apply for, such as Quality Education Fund, Life-wide Learning Grant. As long as you are willing to apply, you can generally apply. Therefore, funding is not necessarily a big issue. The most important thing is whether the principal supports it,

Q: When it comes to the implementation of STEAM in Hong Kong, apart from just the resources and the support of the principal, what else needs to be considered?

A: If a school is well-developed, it will pay more attention to academic performance and focus on examinations and will seldom think about innovation. My school is a developing school, but I want to make the school more shining. Of course, I am not saying that those schools will not do STEAM, but most of their funds will be spent on studies. So, this also depends on the school's development policy and orientation, whether STEAM is included in the scope of development. It is also important for the teacher to be familiar with STEAM. The early teacher training courses did not involve STEAM. Naturally, they knew less about the teaching methods and methods of STEAM. Graduates in recent years will be familiar with it. If you are interested, further studies are also a good way. I believe there are also many STEAM workshops or courses that can be taken. Music technology will be a good choice, and then relying on the individual's ability to master and apply the principles of the teaching method, you can also come up with more teaching plans, maybe there will be more possibilities.

Q: What is the ratio of the student's exploration time to the teacher's teaching time?

A: I may not be able to answer very accurately. Because classes have not resumed yet. It depends on the teacher, the teacher is willing to trust the student more and leave it to the student to explore.

Q: Will STEAM's group learning mode affect learning differences?

A: Yes. This learning mode will have an impact on students' learning motivation, and students who don't usually like to listen to classes can answer the questions accordingly, and they are more focused. SEN students will be very smart in music classes. In the group, the stronger ones will help the weaker ones, and the weaker ones also have the opportunity to see how the stronger ones practice, so as to improve their own situation. In addition, each has its own strengths, which can train them to appreciate each other. Teamwork can make them more of what they can achieve.

Interviewee D (teacher D)

(Q= Question (interviewer), A= Answer(interviewee))

Interviewee D

(Q= Question (interviewer), A= Answer(interviewee))

Q: Hello Miss Lee, I am honored to invite you to visit. I am a final year student of EdUHK and I am studying STEAM education. The Hong Kong Music Curriculum Guide for Primary and Secondary Schools also mentions that students are expected to develop their problem-solving skills through music courses, have a broad vision, innovative thinking, and the courage to assume. I know you have some experience in STEAM education, can you briefly introduce yourself about the school you are in, teaching age, school size, school support for STEAM, etc.

A: Thanks for your invitation to the interview. Let me introduce myself first. I am xx, graduated from EdUHK. Now I am a music teacher in a direct-funded school in Cheung Sha Wan and I have been engaged in music education for 16 years. There are music classes in Secondary One to Secondary Three. Designing curriculum in subjects is supported by the school. There is only one music teacher in the school, so I have a relatively large space to develop innovative courses.

Q: I would like to ask you how you apply STEAM education to teach in music classes?

A: There are some elements in STEAM, including science, technology, music and so on. About five or six years ago, the school began to promote e-learning such as iPad. At that time iPad was still not very common, our school only had about 30, we took turns. Our school teaches in small classes, about 20-25 students per class. There are certain benefits when conducting activities, and the small-scale format can cater for students with different learning differences. Every year we will have a module, use an iPad Garageband to do the arrangement activities. We use this as a starting point, and after experimentation, we slowly let students begin to create and make good use of information technology. About two years ago, we participated in the project e-orchestra by the University of Education in Hong Kong and the Leisure and Cultural Service Department. From this we extended to let students perform their own works. In addition to the arrangement, we also have shooting, film, film scoring, arrangement and then expand to other aspects. Utilize universities and other resources such as external tutors to provide support. Nowadays, science and technology are changing with each passing day. We have no interdisciplinary learning experience when we are studying, but we can also learn with students through external resources. After the completion of this project, we also had a performance in Tsuen Wan Town Hall. About 20 students could have different orchestra experience. Thanks for the support given by the Education University.

Q: You just mentioned that STEAM is used in soundtracks and other topics. In addition, what other topics can be applied to STEAM?

A: We have always been a music subject, and our starting point will always be music.

We add technological elements on this basis. Students do not need to learn too much music theory knowledge, but their creativity can be quickly presented through technology. In addition to film scoring and music arrangement, this year we also added elements of composition, coordinating visual arts and physics.

The students used the software to arrange the music. Among them, the students add the color matching, tab to the music on the color, and then spell out the picture, and then make the future musical instrument. This is a very new subject, using Specdrum and it is also true for me. This is also the stage of operation.

There is a little musical ring device that can sense colors and turn them into music and it's an initiative to create coding music type experience. The ring is rechargeable when it scans the color, it turns that color into an assent aesthetic experience converting that into sound it comes with a mat and you can pair the ring with an app on your phone that then plays the music. You may also build up different set lists by using the sounds inside the software or record your own voice samples and assign them to different colors. Specdrum is not limited by the color on the keyboard, it works on any colors.

The project is a combination of music, visual arts and programming elements. The students will form a group and then work on the project. Music recording and editing are designed, recorded and performed by students. It's also a kind of creation. The pictures are also made by each group. After the completion of the programming part, the students can use the rings to sense the colors on the works, so as to make a sound and perform a visual and auditory performance. Usually we use Garageband, which not only includes the sound of musical instruments, but also records the music we need. In the software, some settings can make students who are not so knowledgeable in music theory follow in the steps of everyone to create and score music together.

Specdrum Reference link: https://www.youtube.com/watch?v=jV16Gnnj_Hk

You will see that if teachers are willing to try and encourage, students will have unlimited possibilities. This time we added visual art, how to present music in aesthetics, and make musical instruments. From a scientific perspective, what is the sound source like? How is its tempo handled? Thus, we enable students to deepen their learning content through the knowledge of different subjects. The project learning enriches their learning experience. GarageBand can't record sound by itself, so there is a lot of room for creativity.

Q: How is the content of teaching distributed across disciplines?

A: Of course, I really need the help of my colleagues. I also invited the physics teacher to explain some physics principles, such as the transmission degree of the sound, and the power transmission. The knowledge of music is taught by the music teacher, but other knowledge is taught by teachers of other subjects, so that each individual's expertise can be used.

Q: In the time of one class, did you say the time to divide different subjects?

A: We plan the time from the plan of the entire project. We need to tell the students what the purpose of the class is at the beginning, because our ultimate goal is the teaching goal, and then we will tell the students what we will do. We will let students experience what it is like to create, and then cooperate with the elements of science, so as to let students know what the principles of his creation are. My teaching is to experience first, and then deepen into the theory. This will make the student more aware of the content to be taught, because he has already experienced it. This will attract students' interest in learning.

Q: Compared with the traditional music lesson, is it gaining a better effectiveness in music?

A: In my teaching, experience is always first, and I may not tell the theory behind it at once but give more space to students to try. As a music teacher, you have to be big-minded and more accepting, allowing students to have unconstrained ideas.

This can stimulate students' creativity. Of course, they will, they need to take action. For example, if students want to arrange music, they need to record the melody and add the base line, they will find that there are some places that are not aligned, and the students can perceive it, so they almost know the importance of accurate rhythm. However, if it is an ordinary teaching method and students say that rhythm is very important, the effect is not great, and GarageBand has images, which can help students find problems visually. Experience learning is the most important. learning by doing. It can also be used in elementary schools especially elementary school students are less worried and better put in their creations and give full play to their creativity. Teachers should let their students try, and they also need to believe that students can do it. Every student has unlimited creativity. Teachers need to convey information to students, and they can do it, even if they have poor grades and have not learned a musical instrument. When a student succeeds, he will believe that he can do it and is more willing to try it next time. So technology is also a way to help students express their ideas and creativity.

Q: Did students give any feedback to you?

A: In teaching, feedback from both parties is very important. When I finish a project, we will ask the students how they feel and how they learn from their reflections. We have all found that students have a sense of satisfaction, and we believe that students' sense of ownership and belonging to the work is very important, and students will cherish and be more interested in learning opportunities. Students also learn from the activity that they can also become a composer, and they can also have creative experience, and they can also perform things they have never experienced before with their classmates. In addition, I also encourage students to share with each other. I will also present the work of my classmates through different platforms. Students can refer to other people's works so that everyone can develop in a good direction.

Q: In the case of Hong Kong, do you think STEAM education can be achieved?

A: I think it can be done. The space for music courses is larger than test-oriented subjects. Some teachers think that the courses are compact and a lot of content needs to be taught. This is true, but there can be a sort of priority and secondary. For me, the knowledge that students have to learn is limitless, but many students can learn by themselves, but some experience can only be obtained by cooperating with classmates and generating sparks. Therefore, I will give students the opportunity to cooperate first. This is also in line with 21st century education. Students not only need knowledge, but also need the ability to solve problems, communicate, and create. So, in the music class, I will focus on cultivating the abilities of classmates, skill-based people, rather than just about knowledge.

Q: Did the students encounter any problems during the process of cooperation, and how did they solve them?

A: There is no big problem in cooperation. Usually I will consider two aspects. In a group study, I arrange a group for the students or choose and combine them by themselves. In these two modes, I will debug. I will let the students choose first, so that the students' motivation is greater. If necessary, I will fine-tune the students' learning ability and level based on their choices, so as to respect each other. . This effect will be better. We also look at the ability and personality of students.

Q: In this process, has the students' communication skills improved?

A: Of course, students must communicate and cooperate to complete this group assignment. When they have conflicts, they also need to communicate and resolve to continue. Therefore, both problem-solving skills and communication skills are needed. If the students are troubled by the division of labor, the teacher will also explain the truth to the students. For example, everyone has their own strengths and is responsible for different parts. Because in the future work, these are all they need to face, now let the students experience it in advance.

Q: How do you evaluate their performance after the project is over?

A: First of all, I will make a judgment based on the ability of the classmate, whether the student has achieved a better position in his space. Of course, there will be some basic criteria to see if they are all met. For example, whether there are eight bars, a complete session, etc. These are all indicators for students. Whether he can do better above the target, the score will be adjusted. But I pay more attention to whether students can enjoy this learning process, which is more important than grades. What I want to add is that when you want to give students a project, you need to help break down the activities into small goals so that students can have confidence in unfamiliar fields to achieve them, instead of directly giving them a big challenge to complete by themselves, so that students will be deterred. of.

Q: How long does it take to complete a project?

A: In my school for about half a semester, there is one class each week, and one class is about 40 minutes. I think it takes eight to one week to complete a project. The work itself is not difficult to complete, but I will let the students continue to improve their work and deepen their work and knowledge, not to complete the work.

Q: How about the student background?

A: The families are wealthy, and the parents support their child to develop multiple interests. At least one-third of the students in my school are learning musical instruments, but it is not that every one of them can perform well. But now everyone learns to create from scratch, so it has nothing to do with their music learning background.

Q: When it comes to the practice of STEAM education in Hong Kong, some teachers think it is more difficult to understand and practice. What are your views or suggestions?

A: I think that to be a teacher is to keep up with the times and learn for life. Take me as an example. I didn't know it at the beginning, even now I am still learning. Teachers need to study with students and make progress together. Teachers can communicate with colleagues more, so that more new ideas will emerge. The mentality of the teachers is also very important, whether you want to try something new or not. Repeating a single teaching content will be boring. It is not difficult for teachers to learn. Now that information technology is very developed, there are also cases on the Internet platform, there are also resources in the market, or participating in some cooperative activities, you will have great gains. If the school does not support the teacher to do innovative activities, the teacher must be able to sustain it, and then think about the responsibilities of art teachers and the value of art subjects, so as to do things that can best benefit the students within the limited resources and space. In fact, every discipline has its own space and resource constraints.

Q: Will you promote STEAM

A: Yes, we also want to share our successful experience with music educators and learn from each other.

Appendix C: Consent Form

THE EDUCATION UNIVERSITY OF HONG KONG

Culture and Creative Arts

CONSENT TO PARTICIPATE IN RESEARCH

Practicability and Challenges of Applying STEAM (Science, Technology,
Engineering, the Arts and Mathematics) Approaches and Concepts in the Music
Education of Hong Kong Primary and Secondary Schools

I _____ hereby consent to participate in the captioned research supervised by Dr. Ng Kwok Wai and conducted by Cai Yiting, who are student of Culture and Creative Arts in The Education University of Hong Kong.

I understand that information obtained from this research may be used in future research and may be published. However, my right to privacy will be retained, i.e., my personal details will not be revealed.

The procedure as set out in the attached information sheet has been fully explained. I understand the benefits and risks involved. My participation in the project is voluntary.

I acknowledge that I have the right to question any part of the procedure and can withdraw at any time without negative consequences.

Name of participant:

Signature of participant:

Date: