Why fail? Experience of technology education in Hong Kong

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ABSTRACT: Technology education in secondary schools is a subject that aims to develop students' problem-solving and higher order thinking skills. Yet despite its significant educational values, it is not deemed necessary to attain a high degree of success in the education system, and the decline of technology education in Hong Kong has explicated the issue. Even though technology education in Hong Kong is no longer a skill-based subject, it seems that some policymakers and school administrators do not treasure the values of technology education. In this paper, the reasons for the failure of technology education in Hong Kong are suggested. Possible recommendations and suggestions are provided in redeveloping technology education. The experience of technology education in Hong Kong is an integral part of the entire curriculum development process, and its future largely depends on how educators and researchers interfere with the education system. The article aims to explicate the case of Hong Kong, and serves as a platform to share local experiences with other researchers from around the world who encounter similar problems.

INTRODUCTION

Technology education possesses some educational values that cannot be replaced by other academic subjects. It provides students with opportunities to develop problem-solving and higher order thinking skills by realising their ideas in the design process [1]. It is a *multidisciplinary subject with potential for cross-curricular activities* [2]. It engages students both inside and outside the classroom by allowing them to provide real solutions using real materials [3]. It also enhances *employability and commitment to personal relationship*, and helps low achievers to perform in other subjects such as English, mathematics and science [4].

Technology education has been implemented in many countries around the world, and many governments have made technology education a compulsory subject for primary and secondary students. Governments have also put a considerable amount of effort into optimising the curriculum of technology education in recent educational reforms. Different national organisations and annual international conferences are established in connecting technology educators and researchers as a confluence of knowledge and experience. However, the seemingly optimistic development of technology education does not imply that international technology education has come to be a success in its establishment over the years. Some researchers from countries where technology education is well established have also commented that technology education in their education systems has different problems and issues from different perspectives [5-7].

For the past few decades, technology education has been seeking its own identity, since industries do not need a large number of skilled workers, and the economies of developed countries around the world have shifted away from manufacturing industry. Governments might have altered the curricular focus to either academic or general education in recent educational reforms all over the world. However, this has been due to the failure of the development of technology in some countries, including Hong Kong.

Taking Hong Kong as an example, technology education has always been considered to be a second class school subject designed for students with low academic abilities. In spite of the rapid development of the new technology education at the senior secondary levels, most of the newly established schools do not offer technology subjects to students, since subjects related to technology education such as Technology Studies, and Design and Technology are not mandatory in Hong Kong schools [8]. The only teacher training institute for training technology teachers in Hong Kong even closed its technology programme in 2006. Obviously, technology education in Hong Kong is in a crisis of extinction in the education system. However, from a different point of view, the crisis is an opportunity for researchers to review the entire development of technology education in Hong Kong. By finding out the reasons for its failure in the education system, technology education might be rekindled. The failure may simply be related to the educational reform in the last

few decades. Under these circumstances, this article discusses the technology education development around the world, and particularly in Hong Kong, and shares the experiences and failures that might be learnt by other countries or parties.

TREND OF SECONDARY TECHNOLOGY EDCATION AROUND THE WORLD

In common with many other western countries, technology education in Hong Kong is a relatively new subject, in spite of the long history of its origins in craft training. However, western countries such as the United Kingdom, the United States, etc, have better and more detailed technology education programmes for young students than Hong Kong. These countries have made significant gains in their educational practice, and the implementation of technology as a curriculum is actually diverse at the national, state, provincial and local level.

In England, *Design and Technology* is a compulsory subject. The overall rationale for design and technology education is to prepare pupils to participate in tomorrow's rapidly changing technologies. Through needs, desires and opportunities, students develop a range of ideas in order to design and make products and even systems. Through *Design and Technology*, they become innovators, and discriminating and informed users of products. Specifically, pupils should be taught to develop, plan and communicate ideas; work with tools, equipment, materials and components to make quality products; evaluate processes and products; and know and understand materials and components [9].

In the United States, in 1996, an initial statement and policy document called *Technology for All Americans: A Rationale and Structure for the Study of Technology* was published. This publication provided the basis for technology education in the United States and became the philosophical foundation for the Standards for Technological Literacy: Content for the Study of Technology [10]. These two documents are intended for state and local curriculum planning. In the Standards for Technological Literacy, there are twenty standards. Meanwhile, throughout the last century, more and more technology educators and researchers suggested that technology should be taught in an integrative manner with other subjects (the science, technology, society - STS and the science, technology, engineering, mathematics - STEM). Some related projects have been implemented in some areas.

In Australia, technology is one of eight subject areas studied at school. Technology is divided into four content areas, called strands: designing, making and appraising, information, materials and systems. The goal of this curriculum is to enable students to become more innovative, knowledgeable, skilful, adaptable and enterprising. There is some federal influence on curriculum, although it is mainly a state responsibility. The disconnection between having a curriculum and being slow to implement professional development opportunities for teachers has been raised, and there is a need to draw more attention to the importance of co-operation between researchers, administration, schools and teachers [11].

New Zealand has a national approach due mainly to its small size. Since the late 1870s, New Zealand has had a long history of technical education. In the 1990s, technology emerged as an area. From 2006 to 2008, there was a big stride to reinforce the notion of technological knowledge and practice along with students developing an understanding of the nature of technology. At the same time, postgraduate research culture in technology education, including a focus on classroom studies emerged. Some resources for senior secondary technology have expanded to lower secondary level. And the government introduced scholarships for pre-service teacher qualifications to address the technology teacher shortage [12].

Throughout such curriculum developments in these countries, it is obvious, to a large extent, that technology related subjects are relatively new, so probably there is currently no school subject around which there is so much debate as there is around them [13]. The changes that have happened in these subjects are fundamental. In this sense, some generic issues (i.e. problems) have inevitably appeared. Moreover, design is justifiably the most common and popular of the processes appropriate to technology education, and has been identified as such in the US Standards for Technology Education [10]. It is a fact that the terms design and problem-solving are often used interchangeably in technology education.

The issues and debates, which are encountered in technology education in Hong Kong, might be more severe than those the other western countries are facing. There are many different concerns in this compact and international city. There are also some issues that might not be experienced by other educators, researchers and governments in other places. Subsequently, it might be worthwhile in explicating the special case of Hong Kong, and putting it up for discussion.

CASE STUDY OF TECHNOLOGY EDUCATION IN HONG KONG

In Hong Kong, the latest junior secondary school syllabus of technology education was established in 2000. Its aim is to *develop the technological awareness, literacy, capability and lifelong learning patterns* of the students [14]. Students have to study four areas of learning: *the nature and impact of technology for yesterday, today and tomorrow*, *design and communication*, *the tools and machines of technology* and *resources of technology*. For the senior secondary school curriculum of technology education, the latest curriculum was established in 2007 and put into implementation in 2009. In the curriculum of senior levels, more advanced technology, such as electronics, automation, etc, are involved. Students have to study three cores (technological principles, design and innovation, and value and impact), and opt for another two from the five elective modules (electronics, automation, creative digital media, visualisation and CAD

modelling, and design implementation and material process) [15]. Innovation and entrepreneurship are the two core concepts to be developed in the curriculum.

Regardless of these well designed curricula, there are many hidden problems and issues in the technology education of Hong Kong. Since the syllabus at the junior secondary level is not bonded with any public examination, the government offers a high level of flexibility for schools and teachers in planning the curriculum according to the funding and facilities available in schools. Technology education is not mandatory at any level of education. Currently, there are 459 secondary schools in Hong Kong, yet only about half of them offer technology education to students [16]. Schools that offer technology education are reducing their technology facilities, and some of them have even reconstructed a part of the workshop to be a study room or a computer room. Some storage rooms have also been renovated to be a meeting room or guidance room. With the exception of computers, most of the machines currently used by schools are bought to last about twenty years.

Most textbooks used in technology lessons now do not fit the latest junior secondary curriculum established in 2000, since these textbooks were published in or before 1997. There are some recently published textbooks, but their qualities are questionable. It seems that publishers did not put effort into publishing a set of textbooks with higher quality for the small market need. Most of the time, teachers use self-designed worksheets or learning materials for students to learn the necessary knowledge required in a technology lesson.

Assessments are mostly done by coursework at junior levels. Teachers only mark on the artefacts or some drawings done by the students. Unlike academic subjects, which have numerical marks in the academic reports, most schools only give a grade to students. The grade is not taken into account in any calculation of average marks. Some schools even combine all technical subjects such as Art and Design, Home Economics, etc, and give a collective grade to students.

Most schools place heavy emphasis on the technology element of the curriculum. Projects that involve designing and making activities such as *design and make a photo frame*, *design and make a key chain*, etc, are very popular for junior secondary students. However, teachers and students generally spend more time and focus on the making section of the project, rather than the design process of the artefacts. Teachers seem to be more concerned about the tangible outcomes of the learning activities. Some schools, which are better funded and have more facilities, might introduce more advanced technology and equipment. For instance, some teachers have been teaching robotics and electronics as the core topics at junior secondary levels. Schools with a specific focus are able to facilitate the technology students to enable them to win international awards. There are also some schools that put more focus on the aesthetic design in technology education. However, the design track of technology education is not very popular in Hong Kong.

Regardless of the different emphasis of the technology education in secondary schools, equal opportunities have been given to both genders in learning technology since 1999. Before that, only boys could study technology education, and girls were directed to study home economics. After some researchers in Hong Kong addressed this inequality, the Equal Opportunity Commission of Hong Kong suggested that secondary schools that offered a technology course should provide opportunities in learning technology for both boys and girls [8]. Even though the policy was enacted later than in neighbouring countries such as Singapore, it was definitely a breakthrough in the development of technology education in Hong Kong. However, the inclusion of girls has generated another issue in technology education.

In the past, boys did not have to study home economics, and girls did not have to study technology education. After the inequality was addressed, both genders now have to study both subjects. This means each subject has to take up double the number of students. Since the time slots in the school timetable are already occupied by many academic subjects, it is difficult for schools to make room for non-academic subjects such as technology education and home economics. Consequently, the curriculum time for each subject has been cut in half, and students can no longer study technology for the whole academic year [8]. Currently, junior secondary students in most schools, which offer technology education, are only able to study technology for half a year. For the other half, they have to swap with other students from home economics.

The same issue does not exist at senior secondary levels, since technology education is an elective for students. In 2009, the new academic structure of senior secondary education was put into practice. In this new academic structure, the new curriculum of technology education at senior secondary levels with a new focus was established. The curriculum is much more associated with the future prospect of students than the previous curriculum. However, the establishment merely shed a light onto the development of technology education in Hong Kong. In practice, most schools have failed to offer the subject because schools, which used to offer technology education at senior secondary levels in the previous academic structure, do not have adequate facilities and machines required by the new syllabus. Some of the technology teachers are not even able to teach the elective modules in the syllabus. The result is that a number of schools have omitted the technology education at senior secondary levels. Currently, there are only about fifty schools offering technology education at senior secondary levels, and most of these schools have previously been considered technical schools, which do not attract students who have higher academic abilities.

A few decades ago these technical schools were very popular among primary school graduates. The craft-based technology education was once attractive to students and parents. This was because from the 1950s to the 1980s, the economy of Hong Kong was primarily based on the manufacturing industries. However, as the industries declined, students were more tempted to study more academic subjects for a better prospect in the knowledge-based society, though technology education is also changing towards a less skill-oriented approach. Thus, technology education has gradually been seen as a second-class subject in secondary schools.

Even though the earliest technology education in Hong Kong can be traced to the 1930s [17], the long tradition has still not helped promote technology education in the society after fifty decades. The reasons for the decline of technology might not only be associated with the industrial decline in the 1990s, but also other internal factors of current technology education and some beliefs held by Hong Kong people.

DISCUSSION: FAILURE AND EXPERIENCE

The unique educational values in technology education are undeniable. Technology education in Hong Kong has also facilitated teachers and students to win numerous awards in Hong Kong and around world. However, the decline and failure of technology education in Hong Kong is evident. The number of schools offering technology education is decreasing. Schools are cutting budgets for technology education. In addition, there is no training institute responsible for training technology teachers, and that means there will be no new technology teachers in Hong Kong in the next few years. Even though the syllabus is well-designed, very few schools are able to implement it properly and successfully. The reasons for the failure might be due to the beliefs held by Hong Kong teachers and school administrators. Some of these reasons are suggested below.

First of all, the learnt skills in a technology lesson, such as problem-solving and higher order thinking skills, cannot be easily noticed unless a specific scenario is given to the students in applying the skills. However, other teachers and school administrators might only be able to observe the most explicit skills, the technical skills, acquired by students in a technology lesson. Since some school administrators might not be able to understand the educational values of technology education, and some might still perceive it with a skill-based nature, they fail to establish and maintain the subject. This might be because most of the current school administrators were educated in the time of industrial development in Hong Kong. The perceptions that technology education is a skill-based subject for training industry workers instead of a subject of general or academic education for active problem-solvers might be rooted in their minds. Even though the new technology education syllabus has been established for about a decade, misunderstanding still exists in the management teams of secondary schools.

In addition, it is easier to cultivate the explicit educational outcome in technology education, and in contrast, the *implicit* outcome is much more difficult to achieve by superficial learning and teaching. In some cases, some teachers are tempted by the short-term victory of teaching. The projects designed by the teachers heavily emphasise on the product, instead of the process of thinking and design. Teachers seldom discuss with students about why they would choose a particular idea or method in making the products. Consequently, very few students can rationalise their own ideas. The educational value of technology education in Hong Kong is not significant.

Furthermore, some technology teachers in Hong Kong only focus on the teaching of a particular stream of knowledge in technology, and fail to give a holistic view of technology to students during their study. This affects the image of technology education in that the subject is associated with specific knowledge that might or should be learnt in tertiary education instead of secondary education. The idea questions the value of the existence of technology education in secondary education. Besides, the schools that have won awards or recognition in technology competitions often have more advanced machines such as a laser engraver. This gives an impression that other schools, which do not have these machines, are not able to win or excel in technology competitions. Some teachers might even have a perception that a more advanced machine is the key to success in technology education in their schools. However, technology education is not solely based on the machinery, but also the designing and the making process that students go through.

However, teachers' overemphasis on technology and machinery is not groundless. Currently, most of the technology teachers in Hong Kong are graduates from engineering, woodwork or metalwork programmes. Teachers' natural tendency to teach technology is tolerable. The government should provide more professional training for teachers to extend their horizons to other aspects of technology education. Yet, most of the programmes and training recently provided by the government focus on the senior secondary levels only. The professional development of junior secondary technology teachers is not adequate. This is ironic, since not all schools that offer junior levels of technology education would also offer the subject at senior levels. There are many junior technology teachers who are not able to join any subject-related professional development courses.

As for senior secondary levels, even though the new syllabus is well planned and is suitable for Hong Kong's economical and business environment, it overlooks the current issues of technology education in Hong Kong. The new syllabus includes knowledge of more advanced technology such as automation, CAD modelling, etc [15]. However, the machines related to these technologies cannot be afforded by some of the schools, and this causes these schools to close the senior secondary course of technology education. Support and backup from the government is not enough to allow

more schools to be involved in senior levels of technology education. If this problem persists, most probably schools that only offer a junior course will not be able to extend and provide technology education to senior secondary students in the next few years.

Hong Kong, a metropolitan city where people place emphasis on economic effectiveness, does not favour technology education. The huge space taken up by technology workshop in schools, the large budget used in machine maintenance and materials, the amount of time the subject occupies in students' school timetable, and the extended period of the educational outcomes hinder the development of technology education in Hong Kong. However, the educational values of technology education should be treasured, since in the current education system, they are not substitutable by other academic subjects.

In order to sustain technology education in Hong Kong, researchers should put more effort into research on the topic of the unique situation of technology education in Hong Kong, and thus draw more attention from the government. Currently, research about the related area for Hong Kong is not adequate, and the government does not underscore the importance of academic research in technology education. Unfortunately, even though education is a profession with specific knowledge, there are people who are not experienced enough in this field or who simply do not understand education governing different parts of the education system in Hong Kong. In addition, some policymakers and school administrators do not understand the hidden values of technology education. Further education or professional development on the topic of education should be provided to these indirect parties, since a government decision is not made by a single party, but collectively by different personnel and experts from different areas. Making decisions in technology education in terms of the past perspective of technology education might not be appropriate.

Besides, a holistic approach to technology education in secondary schools should be promoted, especially at junior secondary levels. In the current technology education, some students are limited to a specified knowledge area. The seemingly successful development of the teaching of the specified knowledge area affects the general perception of other teachers and policymakers towards technology education. Technology education of some schools in Hong Kong is no longer a cross-curricular subject; instead, it is a subject with specified knowledge. This deviates from the multi-disciplinary nature of technology education, and gives a wrong perception to outsiders and sometimes other parties in policy making. In addition, more design elements, which are essential in the development of students' problem-solving skills, should be included at junior secondary levels. This enables students to enjoy the benefits that technology education is able to provide.

Since the teacher training institute for training technology teachers in Hong Kong closed its technology programme in 2006, no new teachers have been supplied to schools. This might be due to many factors such as a decrease in the growth rate, etc, in society. Nevertheless, it is questionable whether the number of technology teachers has reached saturation in the market. Most probably, schools that offer junior secondary technology courses only have one or two technology teachers, and every year experienced technology teachers retire. If the only technology teacher in the school leaves their teaching position or retires, the school might not be able to fill the vacancy. In some cases, some schools might even terminate the technology course. Consequently, reopening the programme for training technology teachers is essential to advance the development of technology education in Hong Kong. The programme might also include some teaching strategies, such as intentional learning, which are proven to be conducive to technology education [18]. In addition, in the technology teacher training programme, it is important to increase the competitiveness of technology teachers, and provide other relevant learning opportunities for the in-service teachers, since some elite secondary schools, which use English as the medium of instruction in Hong Kong, often have difficulty in employing technology teachers who have attained the required English proficiency level.

In the process of redeveloping technology education in Hong Kong, as well as in other places, some challenges, such as different parties reaching a consensus, resolving the supply of resources, etc, might be encountered. Even though technology education has its unique educational values, it is still questionable if it is worthwhile to invest the time and resources in its redevelopment. The burning question is if the reciprocation is large enough to compensate what has been invested. No one is able to guarantee the success of any policy; however, it is extremely significant to initiate the first step for the breakthrough of technology education.

The experience of technology education in Hong Kong, from its development to its decline, is a kind of process that is possibly encountered by other countries to different extents. What is more important in this regard is how educators and researchers should interfere in the process and relaunch, redevelop or rekindle the technology courses in secondary schools. Actions have to be taken for a better technology education, so that students can enjoy the true benefits provided by the curriculum.

CONCLUSIONS

The difficulties encountered by technology education are not regional. Many other countries have also experienced similar or different issues depending on the different cultural perceptions of the parties related to the education systems. The problems encountered are one of the elements in the development of technology education, and the responses to these problems govern the directions and approaches of future technology education. Policymakers, school

administrators and other parties involved in the education system should confront these issues with caution. Otherwise, the curriculum of technology education will begin to become extinct in the education system. Hong Kong is a convenient example in revealing this issue.

In Hong Kong, technology education is not a compulsory subject in secondary schools [8]. No obvious educational outcome other than technical skills can be easily observed in technology lessons. For several reasons, fewer and fewer schools offer the subject for students at both junior and senior secondary levels. Facilities and budgets are limited, and no new technology teachers are being trained in Hong Kong. The old perception of technology education as a skill-based subject still exists with some parties within the education system.

Due to the industrial decline of Hong Kong, the focus of the current technology education should be changed to either academic or general education, instead of a technical one, as the current technology education is designed for cultivating students' problem-solving skills. Its educational values are beneficial to students in developing their higher order thinking. However, by looking at the case of Hong Kong, it is not necessary for the course to attain its success in an education system. There are many reasons that have led to the current situation, such as the outdated perception and the misunderstanding of technology education held by different parties, the lack of further professional development for teachers, etc. Even though some of the reasons are old issues, which have been considered around the world, they truly exist in the context of Hong Kong. Some unique reasons in Hong Kong, such as the closure of technology teacher training programmes, the background of the technology teachers, etc, are also taken into account. Recommendations on the current situation in Hong Kong, such as having a holistic approach to technology, reopening of the teacher training programmes, etc, are suggested in the article. The experience of Hong Kong and its development process of technology education reported in this article surely provide a case for learning and sharing with other researchers, who are devoted to optimising technology education in their countries. Educational researchers are inevitably responsible for taking the initiatives in cultivating a better education for the next generation.

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