Paradigm for Junior Secondary Design and Technology in Hong Kong

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Abstract

After the publication and issue of Information Technology for Learning in a New Era and education reform policy by the Hong Kong Government, the terms "paradigm" and "paradigm shift" can be heard everywhere in the Hong Kong education field. The terms have become increasingly popular, although most teachers do not understand their actual meaning. Technology education has become a highly popular topic here, as in most countries, however, few in Hong Kong seem to be willing to pay attention to an essential element of technology education: design and technology, a compulsory and comparatively expensive subject in Hong Kong junior secondary schools. By studying the historical development of the subject, definition and meaning of paradigm and how paradigm shift occurs, this paper tries to establish a paradigm for the subject in junior secondary education in Hong Kong.

Introduction

- "Why does our government spend a lot of money on the subject design and technology? It is comparatively more expensive than other subjects."
- "Why is so much time given to this subject?"
- "Our children do not need to learn handicraft!"

These are the comments of many parents and school authorities. They think that design and technology has no educational value for our children in the 21st century. This is because in their minds design and technology is synonymous with "Woodwork" or "Metalwork". One main factor is that no well-recognised paradigm can be seen. This paper will attempt to discover the meaning of "paradigm" and "paradigm shift". It will then try to establish a paradigm for the subject and explain that through this paradigm, our children will become technologically literate and the public cannot deny the educational value of the subject.

Paradigm and Paradigm Shift

There is a very important phrase: *"... our school education needs to see a paradigm shift"*, in the *Information Technology for Learning in a New Era* (Education and Manpower Bureau, 1998)(p.1). After the publication of the document, the term "paradigm" and "paradigm shift" have become well-known in the education field in Hong Kong. However, there is a lack of explanation or thorough understanding in teachers' minds, concerning the terms "paradigm" and "paradigm shift". It is a common phenomenon in the education field in Hong Kong that terms are used with little deeper understanding.

To understand the concept of a paradigm shift, we must first understand what a paradigm is. *Chambers Concise Dictionary* defines "paradigm" as *"... a conceptual framework within which scientific theories are constructed"*. Thomas S. Kuhn was responsible for popularising the term paradigm, which he described as essentially a collection of beliefs shared by scientists; a set of agreements about how problems are to be understood (Pajares F, 1998). In *The Structure of Scientific Revolutions*, Kuhn argued that a paradigm is a set of beliefs, theories, or a worldview that is unquestioningly accepted. A paradigm is a way of seeing the world that has become established as "truth" (Stfihs MgidaraP). The corpus of knowledge, incorporating a number of widely accepted beliefs is, in each instance, called a "paradigm" (Ramachandran, V.S, 1998).

We now have a brief understanding of paradigm for education, or narrowly, for primary and secondary schools in Hong Kong. The paradigm is the widely accepted pedagogy and beliefs in the teaching and learning process together with the "truths" embedded in the school activity.

We are all familiar with the phrase "paradigm shift" today. It is a popular topic amongst teachers. However, few actually understand the philosophical meaning of "paradigm shift": a sudden and fundamental change in the way we look at

or think about something (Davies, D, 2002). The paradigm works as long as all observed phenomena fit into the paradigm. If there are no anomalies or crisis, the paradigm is still the paradigm (Stfihs Mgidara P, Forster, M.R.). Paradigm shift does not occur after every anomaly appears. Observers may ignore the anomaly (effectively sweeping any contradictions out of sight) or will try to refine their theories within the paradigm to explain the anomaly. However, when the discrepancy becomes crisis, paradigm shift will occur. A "shift" in professional commitments to shared assumptions takes place when an anomaly "subverts the existing tradition of scientific practice" (Pajares F). Moving from Ptolemaeus' system of astronomy to Copernicus' system is a good example of paradigm shift.

We can see that paradigm shift will not occur due to external authority or force. The shift will occur only from the promotion of scientists or observers practising within the paradigm.

In traditional Chinese education, the instructional teacher-centred approach is the paradigm. This has been the case throughout the past century in Hong Kong. The teacher is the sole knowledge source and the teacher has absolute authority for learning. After the publication of the *Information Technology for Learning in a New Era,* our government expects there to be a paradigm shift from teacher-centred approach to learner-centred approach (p.1). However, as described previously, a paradigm shift cannot occur due to external force or expectation. There should be anomalies and crisis. In Hong Kong, there is no such crisis within primary or secondary schools. The "well-known" primary or secondary schools are still well-known. Most of them, maybe all of them, are still practising within the original paradigm: instructional teacher-centred approach. Most parents still expect their children to be able to study in these "well-known" schools. Within the existing public examination system, the students come from those schools still can attain high grades. Although our government, educational and industry voices urge the paradigm shift, the principals and teachers of these "well-known" schools do not face any crisis. It is difficult, or maybe impossible, for a paradigm shift to occur. Paradigm shift does not occur due to the expectation or insight of a minority of our society. Perhaps, the drop-down of our economy and competitive power can lead the majority of us: parents, principals and teachers, to realise and face the crisis. This is when paradigm shift occurs!

Historical Perspective

In 1841, sovereignty over Hong Kong was given to Great Britain. Since that time, Hong Kong's educational system has been inextricably linked to its colonial master. As a recent example, the relatively recent subject of design and technology essentially mirrored the programme that existed in the U.K. (Volk, K.S., Yeung, K.H. and Siu, K.W., 1997). Therefore, before we discuss the development of this subject in Hong Kong, we should consider the development of the same subject in the U.K.

In the U.K., "handicraft" was a recognised subject in the national education system almost a century ago. Early handicraft teachers were usually classroom teachers who became craftspeople, or practising craftspeople who, by taking a short course, obtained a qualification to teach only that subject. The name of the subject has altered from "Handicraft", to "Woodwork", "Metalwork", "Manual Training", "Craft", "Technical Subjects", "Design and Technology". The development of the subject was slow. For the first fifty years, courses in manual training were provided in certain schools for less academically able boys, while girls were allowed to study Domestic Science and Sewing, with little or no alteration as to how or what was delivered. After World War II, the economy of the U.K. required a substantial increase in the skilled labour force. This led to an increase in the craft and technical training that was provided for the less academic in secondary schools, albeit essentially for male pupils (Atkinson, S, 1990).

Until the 1970s, the changes in the U.K. society forced those responsible for the pattern of education to develop a new philosophy with regard to the education of future generations. One of the main thrusts was towards the need for pupils to process a greater understanding and awareness of technology, its future implications, its potential, and its exploitation. Besides, this aspect of education should be accessible for all pupils (Atkinson, S, 1990). Pupils were not only taught craft skills but were also encouraged to design whatever they made. In 1988, the U.K National Curriculum ensured that all children study essential subjects, thus providing a better all round education. It was designed to ensure that children couldn't opt out of subjects too early, and thereby close doors to future job opportunities and personal development. As a result, starting from September 1990, design and technology must be taught, to all pupils of all abilities, starting with Key Stage 1.

In Hong Kong, the year 1932 can be considered the beginning of technical education, marked by the appointment of an officer from England especially for the purpose of establishing of a junior technical school (Hong Kong Education Department, 1952). The first technical school, the Aberdeen Industrial School, was established in 1935. At that moment, the school provided technical training, including pattern making, technical drawing, furniture making, metalwork and shoe making, for students completing primary 6 (Volk, K.S., Yeung K.H. and Siu K.W.M, 1997) (Siu, K.W.M, 2002).

During and some time after the World War II, technical education in Hong Kong was at a standstill. During the early 1950s, technical education was again re-established. In 1952, the original Aberdeen Industrial School was renamed as the Aberdeen Trade School. More technical skills were provided in the new school. In 1957, the school became a secondary level technical school: Aberdeen Technical School.

Afterwards, more technical schools were established. Some of them claimed to provide pre-vocational training at the secondary level. During the 1960s to 1970s, there were three secondary programmes: grammar, technical and pre-vocational. Technical skills were taught in the later two. Only the former concentrated on those students preparing for further university studies.

The year 1975 can be considered the beginning of design and technology programmes in Hong Kong. The 1974 White Paper (Hong Kong Education Department, 1974) recommended that design and technology be a component in general education. The 1978 White Paper recommended nine-year compulsory education up to Form 3, with design and technology facilities being provided in all new schools (Hong Kong Education Department, 1978). Actually the subject mirrored the programme that existed in the U.K. At that time, enthusiasm for the subject was relatively high. However, the enthusiasm soon waned as traditional approaches of woodcraft and metalworking continued. Students were still taught craft skills.

The main reason came from the subject teachers. Similar to that in the U.K., teachers of the subject were usually practising craftsmen, who, by taking a short course, obtained a qualification to teach only that subject. Systematic teacher training for design and technology was begun in the late 1970s after the establishment of The Hong Kong Technical Teachers' College. Unfortunately, some instructors or even lecturers of the college were traditional craft teachers. Besides, all of the student-teachers came from pre-vocational or technical schools. Their background did influence their future pedagogy. Worse still, because of diminishing of primary pupils, some primary teachers were retrained to teach design and technology. They had not any technological or academic background or knowledge and initiative to teach the subject.

Another main factor influencing the development and quality of design and technology at that time was lack of complete syllabus or guiding philosophy for the subject. Unlike in the U.K., at that time there was no general insight from the public in Hong Kong to urge to develop a new philosophy for the subject. Parents, principals and teachers could not see the need for students to possess a greater understanding and awareness of technology, its future implications, its potential and its exploitation. Perhaps, there is little improvement today!

Until 1983, the design and technology syllabus for lower secondary form was published (Curriculum Development Committee, 1983). Despite the claim that *"It suggests a move away from work narrowly concerned with the appreciation of manual skills towards that which also stresses the creative, aesthetic and intellectual aspects of working with materials" (p.5),* the subject continues to rely on the existing approach. Prescriptive, repetitive and manual craft skills remained standard in many schools. Until the mid-1990s, the public continued to have very limited perception of design and technology. Pupils, parents and even school authorities view the subject as having no great value. Parents still associate the subject with traditional skill training (Chow, S.C, 1996).

Political and economic environments do influence the content, curriculum and instructional methods of a subject. In the1970s Hong Kong's economy relied heavily on industrial production and manufacturing. Afterwards, it changed to a combination of manufacturing and service industries, and finally to become the international financial centre it is today (Siu, K.W.M, 2002). Besides, due to the relocation of local industry to border industrial zones in mainland China, the number employed in manufacturing from 898,947 in 1983 to less than half that in 1995 (Cheung and Sze, 1995). Despite these economic changes, before Hong Kong became the Special Administration Region of China, design and technology education continued to rely on the syllabus published in 1983, which continued to reflect a craft tradition.

Paradigm for Junior Secondary Design and Technology

From 1975 to July 1997 and beyond, the introduction of design and technology to lower secondary schools had no obvious Hong Kong-based paradigm, merely a duplication of that of craft skills training. After July 1, 1997, in the Policy Addresses, the first Chief Executive of Hong Kong SAR, Tung Chee Hwa, clearly indicated that technology is the major driving force of economic growth. Hong Kong people need to be prepared to cope with technological change (Siu, K.W.M.). In 2000, the draft of a new syllabus for Secondary 1-3 Design and Technology was published. The opening sentence of the syllabus is "Technology is a dominant force in today's society" (p.4). As the government and the public start to realise that technology becomes so important that our economy depends on it, technology education (in the past, technical education) again becomes important and essential in our education system. This is re-emphasised in the *Technology Education Key Learning Area Curriculum Guide* (Primary 1- Secondary 3): *"TE [Technology Education] is one of the eight KLAs [Key Learning Areas] that each student is entitled to study." (p.5)*.

Unfortunately, after the publication of *Information Technology for Learning in a New Era Five-Year Strategy,* the focus of all is pointed to information technology. Rare discussions on the existing technology subjects, especially design and technology as a compulsory subject in Secondary 1 to 3, were raised. It is also a common phenomena in other countries as stated by Harrison, S, (2000): *"… it appears more people are viewing technological literacy as purely related to new technologies, specifically computer literacy."* and *"It [popularity of computer and new technologies] has also, however, overshadowed and perhaps even undermined existing technologies and their associated importance and relevance to the field of technology education."*

As stated previously, there is no well-known recognised paradigm for design and technology, it is the time for creating and establishing a paradigm for the subject that is fulfil the technology education aims and overall education aims.

When generating a paradigm of design and technology for junior secondary school in Hong Kong, the following needs must be considered:

- Begin from its initial background philosophy.
- Create a paradigm that is flexible in order for future changes in technologies to be accommodated immediately.
- One that is appropriate for our culture, political and economical environment.
- Building on this, appropriate paradigms can be generated for senior secondary and higher education.
- Show explicit links between the subject and other subject areas.
- Ensure that it is appropriate for all children who come from various backgrounds and have different abilities and experiences.
- Ensure that it coincides with the "Education Reform".
- Fully utilise the advantages of Information and Communication Technology (ICT) especially at the existing weaknesses: design, materials and products analysis and evaluation, assessment.
- Ensure that it reflects the importance of the subject as emphasised in the Key Learning Area Curriculum Guide.
- Building on existing, valuable experiences.

Unitary Concept

In Hong Kong, the public and school authorities or even design and technology teachers do not know an essential background philosophy of the subject: unitary concept. The unitary concept is an important feature of the paradigm of the subject in the U.K.

In one sense, the introduction of design and technology to the school curriculum was an attempt to reconcile the perspective bound up with the 'Arts' versus 'Science' divide in education and society as a whole (Snow, 1959).

'Our use of design and technology as a unitary concept, to be spoken in one breath as it were, does not therefore embody redundancy. It is intended to emphasise the intimate connection between the two activities as well as to imply a concept which is broader than either design or technology individually and the whole of which we believe is educationally important.' (National Curriculum Design and Technology Working Group 1988:2).

Design and technology education is not another name for technical education. It tries to embrace the best of designers' aesthetics together with technologists' feasibility. The holistic process of the subject enables pupils to bridge the divide between the two cultures. Design and technology education provides a means for pupils to embrace the essential element of two aspects of human knowledge. Its composite activity is indeed to be greater than the sum of its parts.

The two cultures intersect at the heart of the paradigm. The expanse of the paradigm moves towards both cultures and is wider than the combination of them.

Product Analysis and Evaluation

At the heart of the paradigm is material and product exploration, analysis and evaluation. In the present situation in most secondary schools in Hong Kong, these activities are either marginalised or excluded. However, these activities are at the heart of design and technology education. Through these activities pupils gain knowledge, including information about materials, how the product is made, whom it is for, why it is made in the way it is, and sometimes something about the people or company that made the product (Benson, C, 2002). As well, through the activities, pupils can develop critical thinking when they investigate the influences of materials and products to the society, human being and environment. This awareness of modern technology and its impact on society is one of the objectives listed in the new syllabus for Secondary 1 - 3 Design and

Technology (p.5). Furthermore, in the *Technology Education Key Learning Area Curriculum Guide* (Primary 1 – Secondary 3), it states that *"to appraise the impact of technology on society and the environment"* is the Curriculum Aim of Technology Education (p.16). At the heart of the paradigm, pupils do not just obtain knowledge of materials and productions but also the skills of communication, critical thinking ability and appraisal of others' opinion, culture and inventions.

Explicitly, the contents carried out in relation to the products that the pupils are investigating should include:

- properties and nature of materials used;
- human needs;
- purpose;
- construction;
- function;
- aesthetic features;
- values to economy and community;
- impact on society and vice versa;
- impact on environment;
- historical development;
- impact on human innovation;
- limitations;
- links with business and industry.

When pupils are engaging the investigating activities with contents listed above, they will start from 'Science' view or 'Arts' view. The unitary concept is here!

Technological Capability

Expanding from the heart of the paradigm, pupils will become technologically capable people. In the *Technology Education Key Learning Area Curriculum Guide* (Primary 1 – Secondary 3), it states pupils' technological capability (p.15):

Students are enabled to:

- develop their abilities in identifying needs, problems and opportunities, their respective constraints and preferences.
- Develop, communicate, implement and evaluate solutions creatively.
- Develop their abilities in making informed decisions in creating, using and modifying artefacts, systems and environment.

Nelson (2001) wrote:

Technologically capable people are able to:

- recognise problems needing practical solutions;
- Develop and evaluate a variety of alternative solutions to a perceived problem;
- Select, optimise, and apply knowledge and other resources to solve practical problems;
- Work within imposed constraints and with limited resources;
- Assess the effectiveness of technological solutions;
- Make value judgements regarding possible and actual actions taken while solving problems;
- Feel comfortable learning about and using systems and tools of technology in the home, in leisure activities, and in the workplace.

It should be noted that being technologically capable does not mean possessing job specific skills. Design and Technology education should not be considered to provide training programmes for job specific skills. It is not necessary that pupils become expert 'repair persons' of any one particular piece of equipment, but they must be able to make intelligent decisions regarding the selection of appropriate systems, and be able to use them effectively (U.S. Department of Labor, 1991). Technological capability is developed in students through their participation in a series of technological design problem. These 'set the stage' for learning by providing contexts (or problem situations) within which students think and act systemically to solve problems (Nelson, D, 2001). This coincides with the central theme of learner-centred learning mode.

The actual programmes carried out should be knowledge-based, not just tools and processes. Through creating solutions for designated design problem, students should show genuine interdisciplinary connections to other school subjects, the world of work, and to life experiences. Therefore, adequate design problems should be set by the teachers by referencing the overall curriculum and activities of a particular school.

However, it should be emphasised again that learning is best reinforced by doing. To be technologically capable, working through hands-on activities is the one and only path. In the new syllabus for junior secondary design and technology (The Curriculum Development Council, 2000), it states, *"During the elementary school years, students' experiences with technology should be hands-on and exploratory." (p.4)*. The Council re-emphasised this in *Technology Education Key Learning Area Curriculum Guide* (Primary 1 – Secondary 3). *"... involve the co-ordination of the mind (problem-solving) and hands (hands-on experiences)" (p.v)* and *"Engage in authentic, hands-on problem-solving learning activities using easily available materials and equipment" (p.10).* Although authentic hands-on activities are always emphasised and strengthened by design and technology educationists and teachers, they are marginalised by traditional teacher-centred learning mode. Undoubtedly, authentic hands-on activities compose essential elements of the learner-centred learning mode.

Besides sufficient knowledge from other subjects, students should acquire certain technological knowledge and skills that will be needed for students to create solutions for technological design problems. Thus, such as manipulation of basic hand tools and machines, knowledge in control technology, structures, health and safety, technical vocabularies should be introduced.

Technological Literacy

Developing from the heart of the paradigm, this paper suggests that the aim of junior form secondary design and technology education is to develop the technological literacy of all students. In the past, the term "technological literacy" was strange to students, parents, teachers and school authorities in Hong Kong. Technological literacy becomes more and more important because it affects the economic and competitive power of a society. Technological literacy is an essential quality for all people who live in the increasingly technology-driven 21st century (The National Academy of Sciences, U.S., 2001). It is an important objective that our school curriculum should be able to develop our students' technological literacy. Nelson (2001) pointed that a major goal of the U.S. technology curriculum is to develop the technological literacy of all students. The ultimate goal of a school programme that involves the study of technology is to provide technological literacy to all students (William E. Dugger, 2000). In Hong Kong, the Curriculum Development Council states, in the *Technology Education Key Learning Area Curriculum Guide* (Primary 1 – Secondary 3), *"Technology education aims to develop technological literacy in students ..." (p.15).*

However, as Gagel (1997) confirms, *"defining technological literacy has proven to be an unexpectedly complex and difficult task."* Some educationists have given their suggestions. William E. Dugger, (2000) argued that *"technology literacy means the art of making or crafting, but more generally it refers to the diverse collection of knowledge and processes that people use to extend human abilities and to satisfy human wants and needs."* Nelson, (2001) argued that technologically literate people are able to:

- understand the nature and role of technology;
- understand how technological systems are designed, used and controlled;
- value the benefits and assess the risks associated with technology; and
- respond rationally to ethical dilemmas caused by technology.

Harrison, S. (2000) quoted *"The point of technology literacy should be to prepare students to be morally responsible citizens, actively participating in creating the nation's technological future, rather than merely reacting to it as passive consumers (Talbott, 1999)."* In the *Technology Education Key Learning Area Curriculum Guide,* Primary 1 – Secondary 3 (p.7), technological literacy is defined as *"the cultivation of technological understanding and technological awareness to deal with the challenges of the future".*

RESEARCH

Finally, the paradigm introduced by this paper tries to direct our students to be technologically literate young people who are able to:

- make informed decisions and judgement involving technology;
- actively create solutions for simple technological problems logically, responsibly, creatively and aesthetically with knowledge and technical skills;
- understand the nature and role of technology and its impact on our society economically and politically;
- assess the benefits and potential risks, raised by technology, to human being;
- understand how simple technological systems are designed, used and controlled;
- identify abuse of technology;
- deal with the ever-changing technology-driven 21st century.

As technology is dynamic, our students' learning must also be dynamic in order to become and remain technologically literate. So, as the paradigm has no boundary as technological literacy has no boundary.

Conclusion

In Hong Kong, although design and technology has been taught in junior secondary school for over 25 years, the perception of the subject is still very low. Most parents and school authorities still consider it as a traditional technical subject. In their mind, it is merely a manual technical education, not design and technology education. However, if the paradigm established by this paper actually becomes the paradigm of the subject and the contribution of design and technology to our children's whole education can be seen and recognised, no one can deny the value of the subject as no one can deny the value of project-based learning and learner-centred learning approach.

The study of design and technology is fundamental to being a well-educated person in the 21st century.

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