Technology education for Hong Kong in the twenty first century: Curriculum change and teacher education

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TECHNOLOGY EDUCATION FOR HONG KONG IN THE TWENTY FIRST CENTURY: CURRICULUM CHANGE AND TEACHER EDUCATION

by

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DECLARATION

I confirm that no part of the material offered in this thesis has previously been submitted by me for a degree in this or in any other University. If material has been generated through joint work, my independent contribution has been clearly indicated. In all other cases material from the work of others has been acknowledged and quotations and paraphrases suitability indicated.

Ting-kau LO

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LIST OF ABBREVIATIONS

ACTEQ	Advisory Committee on Teacher Education and Qualifications
ACTE	Advanced Certificate of Teacher Education
AD	Associate Degree
ASL	Advanced Supplementary Level
AT	Attainment Target
BEd	Bachelor of Education
CAD	Computer-Aided Design
CAD/CAM	Computer-Aided Design and Manufacture
CAM	Computer-Aided Manufacture
CDC	Curriculum Development Council
CDI	Curriculum Development Institute
CDT	Craft, Design and Technology
CTTE	Council of Technology Teacher Education
D&T	Design & Technology
DATA	Design and Technology Association
DFE	Department for Education
DfEE	Department for Education and Employment
DfES	Department for Education and Skills
DSS	Direct Subsidy Scheme
EC	Education Commission
ED	Education Department
EMB	Education and Manpower Bureau
EMI	English Medium Instruction
EOC	Equal Opportunities Commission
GS	General Studies
GTP	Graduate Teacher Programme
HE	Home Economics
HK	Hong Kong
HKAL	Hong Kong Advanced Level
HKCE	Hong Kong Certificate of Education
HKEAA	Hong Kong Examinations and Assessment Authority

HKIEd	Hong Kong Institute of Education
HKSAR	Hong Kong Special Administrative Region
HORSC	Holistic Review of the School Curriculum
ICT	Information and Communication Technology
IT	Information Technology
ITEA	International Technology Education Association
ITT	Initial Teacher Training
JTS	Junior Technical School
MMBEd	Mixed-mode Bachelor of Education
MOI	Medium of Instruction
NBPTS	National Board for Professional Teaching Standards
NC	National Curriculum
NCATE	National Council for Accreditation of Teacher Education
NQT	Newly Qualified Teacher
NTC	New Technical Curriculum
OECD	Organisation for Economic Co-operation and Development
PGCE	Postgraduate Certificate in Education
PGDE	Postgraduate Diploma in Education
PRC	People's Republic of China
PSHE	Personal, Social and Humanities Education
QAD	Quality Assurance Division
QCA	Qualifications and Curriculum Authority
QEF	Quality Education Fund
QTS	Qualified Teacher Status
SCITT	School-Centred Initial Teacher Training
SSPA	Secondary Places Allocation Scheme
STL	Standards for Technological Literacy
TCF	Teacher Competence Framework
TE	Technology Education
TEKLA	Technology Education Key Learning Area
TTA	Teacher Training Agency
TTC	Technical Teachers' College
UGC	University Grants Committee

ABSTRACT

Purpose

Technology is widely recognised as one of the major contributing factors to the cultural, social and economic development of a nation. Technology education is also being considered vital for students to learn, live and work in a technological society in the 21st Century. The primary purpose of this study was to investigate what and how technology education could contribute to the personal needs of Hong Kong students and that of Hong Kong's society. The objectives of the study were to (1) identify the status and roles of technology education in Hong Kong, (2) identify and analyse major factors that would facilitate or impede the implementation of technology education into the Hong Kong secondary school curriculum, (3) the professional knowledge, skills and attitudes that newly qualified teachers of technological subjects need to possess for effectively educating students of all traits, and (4) implications of the above changes on technology teacher education programmes.

Method

A stakeholder survey and follow-up interviews were used to collect data from secondary school administrators and technological subject teachers. A seven-section questionnaire was developed to measure the extent of agreement of the administrators and teachers regarding their perceptions towards (a) technology education, (b) technology education curriculum elements, (c) and (d) factors that would facilitate or impede the implementation of technology education in schools, (e) competences desirable for newly qualified teachers of technological subjects, and (f) technology teacher education programmes.

Findings

Evidence provided in the study showed that technology education in Hong Kong is shifting from a trade-oriented curriculum towards one that emphases technological literacy for all. Factors facilitating the implementation of technology education in schools being identified were adequate financial support, quality instructional materials and teaching resources, availability of necessary facilities, and appropriate professional development activities for teachers. School administrators and technological subject teachers differed in their perceptions on barriers to successful implementation of technology education in schools. High on the administrators' priority list were lack of teacher expertise and leadership in schools; whilst those for the teachers were relating to school administrators' unfavourable decisions made on technology education programmes, lack of understanding of technology education from the school administration, and lack of appropriate facilities and resources.

A set of desirable competences for newly qualified teachers of technological subjects were also being identified. Findings from this study support the notion that technological subject teachers need more than just subject matter knowledge. Initial teacher education programmes must therefore ensure that student teachers have sufficient depth and breadth in subject matter knowledge, and help them transform this into pedagogical content knowledge so that they can teach confidently and effectively.

Conclusions and Implications

This thesis is a status study of technology education in Hong Kong. The study has added to the growing body of literature on technology education, technology teacher education, and curriculum change. The results of the study provide essential information about technology education in Hong Kong as regards to its historical development, status, and processes of implementation in secondary schools. Outcomes of this study can inform policy-makers and curriculum developers about stakeholders' expectations on technology education, and assist in goal setting, planning, resourcing, and professional development provisions for teachers and other key change agents. It is anticipated that some of the problems confronting the adaptation and implementation in Hong Kong would be useful for education systems of similar social context or stage of economical development. Besides, the set of desirable competences for newly qualified teachers of technological subjects being identified will be useful as a guide for developing teacher competence framework and initial and in-service teacher education programmes in future.

CHAPTER 1

INTRODUCTION

1.1. Introduction

The significance of technology in today's society is self-evident; it is present in virtually every facet of our lives. The growth and use of technology have altered our society in many positive and negative ways. It is believed that appropriate technology education provides people with tools to understand the made world and the sense of responsibility to develop, apply, and control technology in ways that enhance their sense of personal worth, and direct the use of technology towards achieving social goals and conserving the natural resources (International Technology Education Association, 2000a).

Technology is also widely recognised as one of the major contributing factors to the cultural, social and economic development of a nation. Faced with the intense globalisation of world markets and acceleration in deployment of high-technologies, many developed nations (e.g. the U.K., U.S.A., Australia, and many nations in the Organisation for Economic Co-operation and Development [OECD]) are reviewing and reforming their education provisions (ITEA, 2000a; OECD, 1985; Skilbeck *et al.*, 1994; Treagust & Rennie, 1993, 1996). As for developing countries in South East Asia and the Far East, the impetus driving such reforms stems from the economic necessity to compete for the increasing share of the global trade (Aron, 1994).

Hong Kong, after its reunification with Mainland China on July 1, 1997, becomes the Hong Kong Special Administrative Region (HKSAR) of the People's Republic of China (PRC). As Hong Kong moves into an internationalised information-based economy, the HKSAR Government considered that a well-educated and technologically literate workforce is a key ingredient for maintaining its competitive edge. The Government in many occasions expressed its great concerns about the importance of education towards human capital development for Hong Kong's economy in meeting the challenges of the 21st Century, and urged the need to review and reform its educational provisions (Curriculum Development Council, 2000b).

In response to economic changes, rising aspirations and explosive growth of technology, the Education Department (ED) of Hong Kong, in its report entitled *Review of Prevocational and Secondary Technical Education* (ED, 1997a) recommends major revisions in the technical curriculum in prevocational and secondary technical schools. The review recommends a new technical curriculum that aims to impart to students' generic and transferable skills and to prepare them for further studies and a changing workplace, through studying newly-designed business and technological subjects and wider use of Information Technology.

Recognising the importance and urgency of technology education for Hong Kong future citizens living and working in a technological society, the Curriculum Development Council (2000b) asserts that it is essential to entitle every Hong Kong student to learning opportunities to acquire know-how and knowledge of technology, to develop their ability to critically appraise the impacts of using technology, and to become technologically innovative. Consequently, Technology Education is being positioned as one of the eight Key Learning Areas (KLAs)[1] in the new Curriculum Framework (CDC, 2001a).

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[1] Key Learning Areas (KLAs) are major knowledge domains in the school curriculum. Existing subjects in the school curriculum are grouped into eight KLAs, namely: Chinese Language Education, English Language Education, Mathematics Education, Personal, Social and Humanities Education, Science Education, Technology Education, Arts Education, and Physical Education.

Technology, in plain terms, is how human beings modify the man-made and the natural worlds around them to meet their needs and wants or to solve practical problems (ITEA, 2000a). In view of the growing importance of technology that shapes our society, many educators argued that our next generation should receive an education that prepares them for a technological world. There are also voices that called for technology education to be a core learning area in primary and secondary schools, but it has never been a basic component of education for most students in Hong Kong and in many other countries around the world (CDC, 2000b; ITEA, 2000a).

In Hong Kong, as a field of study that has evolved over the past seventy years from craft-oriented programmes, technology education is just beginning to establish a new identity that people outside the field recognise and understand. For many teachers, school administrators and parents in Hong Kong, the substantial proposed changes in the Technology Education Key Learning Area (TEKLA) brought about by the restructuring of the school curriculum are even something more bewildering. The focus of the present research is to study the perceptions of school administrators and technological subject teachers on technology education in the Hong Kong context. Government officials and curriculum developers were also being consulted. Other potential stakeholders such as students, parents, tertiary institutions, and employers in the private sector would not be included in this study because of time and other resources constraints.

Previous researches and writings on curriculum development and teacher change (e.g., Fullan, 2001; e.g., Goodson, 1985; Jones & Carr, 1993; McLaughlin, 1998; Morris, 1995a) have a major influence on the design and development of the proposed research study. According to Goodson (1985), teachers have a subjective view of the practice of teaching within their concept of a subject area. This is often referred to as "subject sub-culture" which leads to a consensual view about the nature of the subject, the way it should be taught, the role of the teacher, and what might be expected of the student. Fullan (2001) also suggests that for teachers to be able to create and maintain changes in their practice, they must have an acknowledged, legitimated and rewarding role in the change process.

In the literature, there is a modest volume of research studies pertaining to curriculum change in technology education: For example, difficulties inherent in the change process, pathways available for curriculum developers, and commentaries made on curricular trends. According to Lewis (1999), curriculum change from industrial arts to technology education can be studied from both the micro and macro levels. Micro possibilities include examination of curriculum documents such as curriculum rationales and course outlines; facilities and equipment; class observations; and conversations with technology teachers and students. Macro possibilities include examination of the context of change, where school principals, parents, and teachers of other subjects, are potential key informants.

At the time of doing the research study, the present author was a lecturer in a teacher education institution in Hong Kong, actively involved in the design and development of technology teacher education programmes. To conduct research on recent developments of technology education and technology teacher education satisfies both professional needs and personal interest.

1.2. The Research Questions

In the present study, technology education is concerned with such matters as the technology curriculum, the ways in which technology is to be taught and assessed, the initial and in-service education of teachers, teacher supply, and the provision of laboratories, workshops, equipment, instructional materials and other resources. In view of rapid changes on the educational, technological, social, economic, and political fronts in recent years and the challenges ahead in the 21st Century, this study seeks to answer the following research questions:

(1) What direction and goals should technology education pursue in Hong Kong secondary schools in order to cater for students' personal needs and that of Hong Kong's economy in a knowledge-based society?

(2) What are the perceived major factors that would facilitate or impede the implementation of technology education reforms in Hong Kong secondary schools?

(3) What are the desirable competences for newly qualified teachers of technological subjects, which are conducive to recent technology education curriculum reforms?

(4) What are the implications of these changes for technology teacher education programmes?

1.3. Significance of the Study

An investigation into the school administrators and teachers' perceived goals and direction of technology education for Hong Kong will prove valuable to many people.

These include government policy-makers, school decision-makers, teacher educators and frontline technology teachers, as they collaboratively address the educational needs of children facing an increasingly complex technological society in the 21st Century.

The outcomes of this study will provide government officials, reform initiators and curriculum developers with information that would enable them to target potential constraints to the adoption and implementation of technology education in schools, thus optimising the allocation of overburdened financial and human resources at a time of difficult economic circumstances.

1.4. Organisation of the Thesis

The following represents the organisation of this thesis. Chapter 1 gives the background and overview of the study. Chapter 2 illustrates the context of the study. It gives a brief account of Hong Kong's history, its education system and development of technical/technology education in the territory. Chapters 3 to 5 include a thorough review of literature related to the study, including technology and technology education, technology curriculum reform, teacher competences, and technology teacher education. Chapter 6 discusses the research design and methodology employed for a survey on Hong Kong school administrators' and teachers' perceptions on technology education and technology teacher education. Chapter 7 presents statistical data analysis results of the survey and discusses some of the major findings. Chapter 8 deals with qualitative data collected by the follow-up interviews for further discussions. Chapter 9, the final chapter, provides the summary, conclusions, implications and recommendations for policy, practice and future research.

CHAPTER 2

CONTEXT OF THE STUDY

2.1. Introduction

This chapter aims to provide the context for the research undertaken. It first gives a brief account of Hong Kong's history and its education system. The chapter also reviews the background and development of technical/technology education in Hong Kong. By tracing the development of technical/technology education since the 1930s, the chapter explores the impacts of socio-economic and political factors on the development of technical/technology education in the Hong Kong context.

2.2. The Hong Kong Context

Hong Kong is located on the south China coast. It is a tiny place of less than 1,100 square kilometres. It has a population of over 6.8 million by 2003, of whom about 95 per cent are ethnic Chinese (Census and Statistics Department, 2003). Being a British crown colony for over 150 years, Hong Kong has often regarded itself a separate entity from China, with its distinctive identity and "personality". Hong Kong's reputation, to a large extent, rests upon its economic success which lies in the hard work and adaptability of its people.

Pre-1950: From Fishing Community to Entrepôt

During the first one hundred years' of British rule, Hong Kong transformed itself from a small fishing community into an important entrepôt in the Southern China region. Before the Second World War, the growth of Hong Kong's economy was in the main entrepôt trading. The social situation changed significantly after the Second World War. The Chinese civil war during 1946-49 caused a huge influx of refugees from Mainland China. During this post-war period, Hong Kong quickly restored itself as a premier entrepôt for the China trade.

1950s: From China's Entrepôt to Industrial Colony

In the 1950s, the United Nations' trade embargo and the effect of the Korean War caused damage to Hong Kong's entrepôt trade and led to the territory's industrialisation with an emphasis on manufacturing. Subsequently, within a decade or so, Hong Kong succeeded in transforming itself from its long-established position as China's entrepôt into a highly industrialised colony.

1960s: Manufacturing-oriented Economy Take-off

The industrialisation of Hong Kong started in the early 1960s. The territory's economy took off towards the end of the decade. However, associated with the Cultural Revolution events in the Mainland, the territory was thrown in turmoil in 1967, affecting all aspects of life and temporarily paralysing the economy. The flow of refugees from China continued throughout the late 1960s and into the 1970s, adding human resources to Hong Kong industry.

1970s: Diversification - Services and Industrial Economies

Hong Kong became one of Asia's fastest-developing economies in the 1970s, with a flourishing manufacturing and industrial sector. When the Mainland began to open its economy and set up special economic zones (SEZs) in the neighbouring Pearl River Delta in the late 1970s, labour-intensive manufacturing began to move to the Mainland. At the same time, Hong Kong increased its position as a transport, logistic, financial, management, and business service centre for the Mainland and the Asian Region (Enright *et al.*, 1997; Faure & Lee, 2004; Tsang, 2004). By the late 1970s, Hong Kong has become an international financial centre and has achieved a fairly matured industrial base that supported domestic exports.

1980s: An Industrialised City on Transformation

This period is characterised by the transformation from a manufacturing economy to a service economy. On one hand, Hong Kong's economy has become increasingly intertwined with that in Southern China, particularly the Pearl River Delta region. On the other hand, Hong Kong also sought to transform itself into a service economy. Since 1983, Hong Kong's service economy has grown at a rate of 17 per cent per year in real terms, faster than any other economy in the world (Enright *et al.*, 1997, p. 14). In 1986, Hong Kong had successfully developed into a capital market for the local entrepreneurs as well as for the region as a whole, particularly for the fast growing economy of China.

1990s: Economic Re-adjustment

Stepping into the 1990s, the Hong Kong economic growth appeared to slow down. The relocation of labour-intensive production processes during the 1980s intensified the cost-cutting strategy of many Hong Kong's manufacturers. Many people in Hong Kong, in particular those who relied on the traditional lower-skilled, lower value-added economy model were at a disadvantage position. On July 1, 1997, Hong Kong returned to China. Under the Basic Law, the existing economic, legal and social systems will be maintained for at least 50 years. Unfortunately, Hong Kong saw its most severe economic downturn in the wake of the Asian financial crisis that swept through the region, just a few months after the handover.

Early 2000s: Towards a Knowledge-based Economy

Hong Kong continues the process of economic restructuring into a service economy at the dawn of the new millennium. In the early 2000s, unemployment has risen and output contracted. Many of Hong Kong's firms outsource low-value added activities out of Hong Kong and concentrate on the knowledge-intensive part of the production chain and high-value, technology-based markets. At the same time, there has been a rapid expansion in the services sector. Gradually, Hong Kong expands its role as a world-class services centre. In 2002, this sector generated 88 per cent of Hong Kong's Gross Domestic Product (GDP). By the end of 2003, the economy appeared to have rebounded, despite the attack of the SARS (Severe Acute Respiratory Syndrome) outbreak.

Achievements in Recent Years

Now, Hong Kong is one of the world's leading financial and services centres: 7th largest foreign exchange market in mid-2001; 10th largest exporter of services in 2003; 12th largest banking centre as at end of September 2003; and 8th largest stock market at end of February 2004. Hong Kong is a leading telecommunications hub for the Asia-Pacific region, the world's busiest container port, and also a popular venue for hosting regional headquarters or representative offices (HKSAR Government Information Centre, 2004, May).

In sum, Hong Kong has faced challenges in the past and has succeeded despite war and Japanese occupation, inflows of refugees, the United Nations' embargo, the "crisis of confidence" brought by the turmoil of the Cultural Revolution on the Mainland and the return to China, and changes in the local economic structure throughout its history (Enright *et al.*, 1997; Faure & Lee, 2004; Tsang, 2004). It is the Hong Kong's hardworking and adaptable workforce, along with the bold and fearless entrepreneurs, armed with the so-called "can-do" spirit that have thrived on these challenges, and "transformed the territory from a backwater trading port, into a manufacturing economy, and then into a service economy, and ... is marching into a knowledge economy" (Hong Kong General Chamber of Commerce, 2001, October).

2.3. The Hong Kong Education System

Hong Kong was a British colony until July 1, 1997. As might be expected, its education structure resembled the British system but with a much higher degree of screening and selectivity above the junior secondary level. The Hong Kong education system is characterised by the so-called 6-5-2 school system, i.e. 6-year primary course, 5-year secondary course leading to the Hong Kong Certificate of Education Examination (HKCEE), and 2-year sixth-form matriculation course leading to the Hong Kong Advanced Level Examination (HKALE). Figure 2.1 shows the Hong Kong education system as at September 2003.

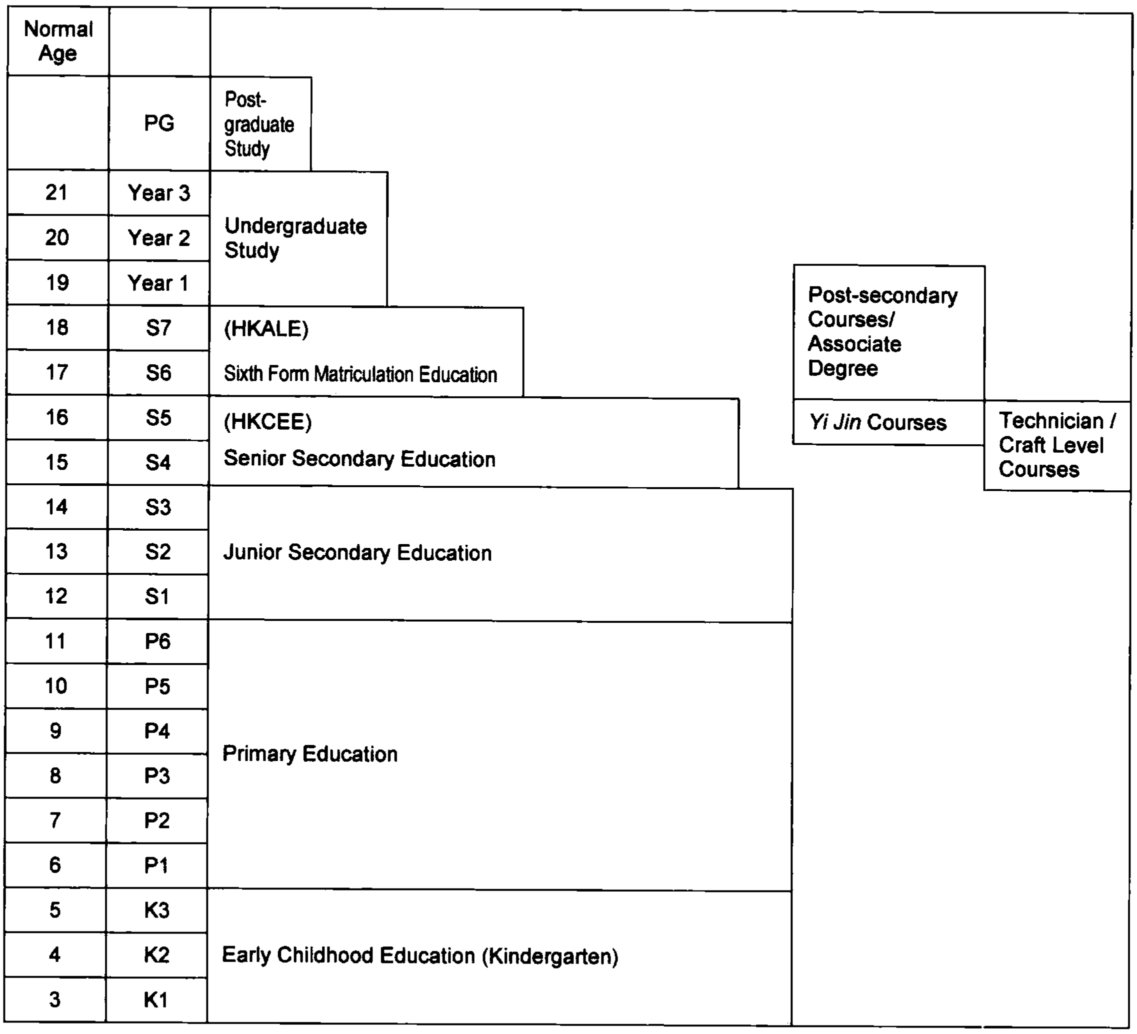

Figure 2.1 Overview of the Hong Kong Education System.

(Adapted from EMB, 2003, p. 2)

Currently, about one-third of the secondary school graduates entered into sixth form courses after passing the HKCEE, and about half of the sixth-form students passed the HKALE. In 2002, only about 18 per cent of students in the age group were admitted to the eight higher education institutions subvented by the University Grants Committee (UGC).[2]

There are three types of secondary schools in Hong Kong by curriculum: Grammar, secondary technical and prevocational schools. Grammar schools offer a broad range of academic, cultural and practical subjects; secondary technical schools lay emphasis on technical and commercial subjects; prevocational schools offer an alternative form of secondary education with a larger proportion of technical and practical content. In 2002, there were 405 government-aided secondary schools offering the grammar, technical or prevocational curriculum. The differences in the proportion of practical and technical content in the curriculum among the three types of schools are presented in Table 2.1 below.

Table 2.1

Proportion of Practical and Technical Content in the Curriculum of Grammar, Secondary Technical and Prevocational Schools

School Type	Level	Percentage of Practical and Technical Content in the Curriculum *	
		Pre-1997	Recommended by CDC
Secondary Grammar	Sec 1 to 3	15 - 20%	Not applicable
	Sec 4 and 5	Not specified	Not applicable
Secondary Technical	Sec 1 to 3	25 - 30%	Not specified
	Sec 4 and 5	Not specified	Not specified
Prevocational	Sec 1 to 3	40 ± 2% practical / technical content *	Business / technological content reduced to 30±4%
	Sec 4 and 5	30% practical / technical content *	30 - 35% of the curriculum should be on business / technological content

Remark: * Subjects considered practical and technical for this purpose are defined by the Director of Education.

(Source: CDC, 2000b, p.13)

2 Hong Kong has 11 degree-awarding higher education institutions, eight universities are under the UGC which oversees government-funded universities. The others are the Hong Kong Shue Yan College, the Open University of Hong Kong and the Hong Kong Academy for Performing Arts.

The Education and Manpower Bureau (EMB) introduced Direct Subsidy Scheme (DSS)[3] in September 1999, which was intended "to develop a strong private school sector by providing high quality schools so that parents have greater choice in finding suitable schools for their children" (EMB, 2004e). Under the scheme, non-profit-making schools are free to decide on their own curriculum and fees, choose the medium of instruction, and select their student intake. In September, 2003, there were 51 DSS schools, offering 4 per cent of the school places (HKSAR Government, 2004).

Ability Banding and Streaming (Tracking)

In Hong Kong, there is a firmly established practice of banding students across schools on their ability and to further stream (track) them within schools. Allocation of students to secondary schools is managed through a Secondary School Places Allocation Scheme (SSPA). At the end of primary schooling, Hong Kong students are segregated into three "bands"[4] of ability and allocated into secondary schools on that basis. Schools that received a high proportion of "Band 1" students are commonly known as "Band 1" schools. As McCelland (1994) observed, to a large extent the result of such kind of allocation exercise is that "popular schools attract the highest achievers and, through this, retain their reputations. Prevocational and private schools are usually the least popular" among parents and students (p. 111).

3 The DSS resembles the concept of charter school in the USA where greater flexibility is given to schools in personnel and financial management.

4 Prior to 2001, under the Academic Aptitude Test Scheme (AAT), students were divided into 5 "Allocation Bands", each consisting of 1/5 of the total number of primary students in the school net. Starting from 2001, the interim Secondary School Places Allocation System (SSPA) is put in place, which groups students into three, instead of five.

Inside the schools, it is quite often the case that the more academically able students are being allocated to the Science/Mathematics stream, and then the Arts/Humanity stream. Whereas the less academically able ones are usually assigned to Commerce/Technical streams taking (pre-) vocational or technical subjects. Consequently, the unimportant and non-academic perception of technical subjects is perpetuated (EOC, 1999; Volk *et al.*, 2002).

Alternative Routes

In recent years, fewer than 20 per cent of secondary students in Hong Kong go to tertiary education. Because of its uniform secondary curricula and the public examination system, in Hong Kong there are over 10,000 "zero-point"[5] (i.e., all subjects were failed) secondary school-leavers a year in the HKCEE (Ming Pao Daily News, 2004). This is hardly healthy and acceptable.

Starting from October 2000, the HKSAR Government introduced the Project *Yi Jin*[6] (formerly called the Project Springboard) to provide an alternative route for those students who have failed in the HKCEE to pursue further studies. Successful completion of the one-year full-time *Yi Jin* Certificate programme is considered by the Government as equivalent to five passes in the HKCEE (i.e. a full HKCEE) for employment purposes (EMB, 2004b). Yet, many Hong Kong parents still hold deep-rooted notions and are

5 In Hong Kong public examination results, the grades awarded are assigned numerical values (points). Five points allocated to an A grade, 4 points for a B, and 0-point for an F (fail) grade, etc. It is a common practice that the numerical values are added together to produce a score for use for entry to matriculation course or to a tertiary institution, or when an employer asks for five HKCEE subjects at grade E or above.

6 *Yi Jin* is a Chinese term meaning "advancement through perseverance", implying that with perseverance any student could advance significantly through the study programme (Wong & Yeung, 2004).

unwilling to concede that their children are unfit to stay in the mainstream. Whether the government will succeed to persuade parents to embrace such a new idea is in question.

Other than the Project *Yi Jin*, a number of programmes such as the Associate Degree (AD) have been launched by the Government in recent years to enhance youth employability or as a bridge to access higher education.

The Need for Education Reform

The above discussions have shown that the Hong Kong education system is predominately examination-driven, highly selective, elitist and academic with regard to curricular orientation, and highly competitive with regard to admissions and streaming. Obviously, the current Hong Kong education system is not adequate to prepare students for meeting the challenges of the knowledge-based society of the 21^{st} Century and the changing labour market. What employers need from the educational system are well rounded individuals who are open to change, innovative, self-reliant, can take decisions and have a commitment for lifelong learning. Dalin and Rust (1996) have made a lively description of the scenario of the 21^{st} Century workplace:

> The labour market of the [21^{st} Century] will likely become more flexible and whereas professional boundaries were once relatively strongly defined, the professional boundaries of the [21^{st} Century] will be less and less distinguishable. It will be more and more difficult to defend specific skills and competencies as something belong to this or that profession. Competence will be more broadly defined and adhere to less local and more internationally developed standards. (p.75)

Lillis (1998) also remarks:

> As society moves to the knowledge era, job requirements are moving from repetitive skills to knowing how to deal with surprises and exceptions, from

depending on memory and facts to being spontaneous and creative, from avoiding risk to taking risk, from focusing on policies and procedures to working flexibly and collaboratively with people. (p.12)

Changes in the workplace have posed new expectations on the Hong Kong education system. There are voices within and outside the education community urging the Government to reform its education system and to improve the competences and skills of young people in the labour market. Obviously, young people who lack the knowledge and skills required by the knowledge-based economy will be in a very disadvantaged position when seeking employment. Unemployment among young people has been quite a serious problem in Hong Kong in recent years. According to the labour force statistics released by the Census and Statistics Department (2000), the unemployment rate of youth aged 15-19 increased from 12.5 per cent in 1996 to 23.7 per cent in 2000. In the third quarter of 2001, the unemployment rate reached 25.1 per cent (Ip, 2002). K. M. Cheng (2002), the Chair Professor of Education and Pro-Vice-Chancellor at the University of Hong Kong, opined that: "The ever-growing serious structural unemployment was an early proof of the need of reform in education" (p. 165).

The Chief Executive of the HKSAR, Mr. C. W. Tung, also considered that "the education system of old can no longer meet the challenges of the new age. Embracing the knowledge-based new economy requires a large pool of talent equipped with the right skills and creativity" (HKSAR Government, 2000, para. 53). In many other occasions, Mr. Tung also stressed the importance of technology and education to support Hong Kong's economic growth and to improve its competitiveness in a knowledge-based economy. As Tung remarked in the speech delivered at the opening of the 6th Annual Conference of the Hong Kong Institution of Science in 1998:

> The 21st Century will be a knowledge-based world. In a knowledge-based global economy, innovation and technology are essential in adding value, increasing productivity and enhancing our overall competitiveness. Innovation and technology also [play] critical [roles] in enhancing our personal pursuits of excellence, advancing our industrial development and improving our quality of life in general. Hong Kong must strive to fully equip itself to seize new opportunities and to compete successfully in the global market as we enter this new era. I wish to point out that the world's most outstanding economic success stories of recent years have mostly involved the application of innovation and technology (Tung, 1998).

From the above discussions, it has become obvious that the current Hong Kong education system is not adequate to meet the challenges of the knowledge-based society of the 21st Century. The Hong Kong Government has initiated a number of major education reforms within a relatively short period of time before and after 1997 with an emphasis on the development of a "knowledgeable, progressive, and adaptable workforce" (HKSAR Government, 1999). In fact technical/technology education in Hong Kong has long been serving a utilitarian end contributing to human resources development in the territory.

2.4. Development of Technical/Technology Education in Hong Kong

This section reviews the background and developments of technology education in Hong Kong. By tracing the changes in the provisions of technical/technology education since the 1930s until the most recent technology education reform initiatives, this section also explores the impacts of socio-economic factors on the ever-changing technical/technology education curricula.

Technical/technology education has been introduced at different points of time in Hong Kong's history with varying emphases to cope with the social, economic and technological developments both locally and globally (Crawford, 1995;

ED, 1997a; Waters, 2002). Its history could be backtracked to the establishment of the Junior Technical Schools (JTS) in the 1930s, the development of secondary technical and modern schools in the early 1960s, the prevocational schools in the late 1960s, the introduction of the Design & Technology (D&T) subject in the late 1970s, the implementation of the New Technical Curriculum (NTC) in 1997, and the Technology Education Key Learning Area (TEKLA) in 2000.

1930 to 1945: Trade Schools in the Early Years

The beginning of formal technical/technology education in Hong Kong could be traced back to the year 1932 when the Junior Technical School (JTS) was set up and started running (Crawford, 1995; ED, 1997a; Waters, 2002). The JTS was a full-time secondary school maintained by the Government. The school offered a four-year pre-apprentice training course biased to engineering in pattern making, technical drawing and applied science (ED, 1954; Waters, 2002). In 1935, the Salesian Society, a missionary body, founded the Aberdeen Trade School and started to offer technical training courses for boys. The school provided the students with general education up to senior secondary level, together with apprenticeship training in trades such as mechanics, electricians and carpenters (Waters, 2002).

1950s: Technical Education in Mainstream Schools

In view of the rapid industrialisation during the 1950s, the Government attempted to develop technical and vocational education within the mainstream of secondary education, which was predominately academic in nature. In 1957, the Junior

Technical School (JTS) was relocated to Wan Chai and was re-named as Victoria Technical School (VTS). Since then the school started offering a standard secondary technical school curriculum for boys. In 1953, the Ho Tung Technical School for Girls was opened as a complement to VTS. The status of Victoria Technical School and Ho Tung Technical School for Girls was enhanced when both schools expanded to offer a five-year curriculum up to the school certificate level in a wide range of technical subjects in addition to general academic courses (ED, 1961). At the same time, in 1953, the Salesian Society opened Tang King Po School in Kowloon, which comprised a trade school with classes in printing, shoemaking and tailoring. The Aberdeen Trade School was also converted into a secondary technical school in the late 1950s (Waters, 2002).

1960s: The Rise and Fall of the Modern Schools

In the 1960s, Hong Kong launched one of the greatest economic booms of its history by the end of the decade. The rapid growth in the manufacturing industry brought about immeasurable economic benefits to the Hong Kong people. But on the other hand, it created many problems on the supply of technical personnel to meet existing and future needs. Under such circumstances, the Government had to take some positive steps to deal with the technical manpower issues in order to cope with the pace of growth in industry.

Consequently, at the turn of the 1960s, the Government established five secondary modern schools that offered three-year technical courses for the less academically-inclined students, as an alternative to the largely academic, grammar-school type of secondary education. In 1962, the Government built the Kowloon

Technical School for Boys. It was intended that students leaving the modern schools could enter the labour market at the level of skilled workmen or craftsman trainees. Those leaving the secondary technical schools could become technicians after an apprenticeship in industry or further studies in the Hong Kong Technical College.[7]

Modelled after its counterpart in the United Kingdom (UK), the secondary modern schools in Hong Kong were soon found unpopular among Hong Kong parents who considered that such schools were a refuge for failing students. And so in 1963, just about three years after the establishment of the modern schools, the Government started to convert these schools into secondary technical schools providing a five-year course. Within four years' time secondary modern schools disappeared totally in name from the Hong Kong education scene.

To supplement the insufficient provision for technical courses in Government schools, the Education Department continued to provide financial support to a small number of schools operated by missionary bodies, such as Aberdeen Technical School and Tang King Po School run by the Salesian Society. In mid-1960s, both schools offered five-year technical courses in metalwork and technical drawing up to the school certificate examination level.

By the end of the 1960s, there were insufficient Form 3 leavers available as recruits to the craftsman training programmes. The Education Department considered the establishment of a new type of post-primary "junior technical college" which would offer a three-year programme (half academic, and half practical) for the 11-15 age-group (Sweeting, 2004). This type of institution was later re-named as "prevocational schools".

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7 The Hong Kong Technical College was set up in 1955 with financial offering from the Chinese Manufacturer's Association to the Hong Kong Government. The college was the forerunner of the current Hong Kong Polytechnic University.

1970s: Rapid Expansion of Technical Education

The 1970s was a decade of remarkable development in technical education for Hong Kong. During this period, secondary technical and prevocational education received much more emphasis than before. This was "clearly related to their increasing importance within the economy" (Sweeting, 2004, p. 243). Both the 1973 Green Paper entitled *Report of the Board of Education on the Proposed Expansion of Secondary School Education in Hong Kong over the Next Decade* (Hong Kong Government, 1973) and the 1974 White Paper on *Secondary Education in Hong Kong over the Next Decade* (Hong Kong Government, 1974) supported the expansion of secondary technical and prevocational schools. The White Paper recommended that:

> In the junior secondary forms all pupils will follow a common curriculum, of which about 25% to 30% will be allocated to practical and technical subjects (para. 2.14); and
>
> To provide by 1979 sufficient subsidised places in Forms IV and V for 40% of the 15-16 age-group, and that within this provision, 40% of the of the places would be in secondary technical schools (para. 2.8).

Unfortunately, the major expansion of technical and prevocational education occurred at a time when the economy was already reducing its reliance on manufacturing industries and moving towards a greater reliance on tertiary production. Despite its rapid expansion in the mid-1970s, technical/prevocational education in Hong Kong has remained a relatively small sector in the overall education system. The vast majority of students still follow a general/academic secondary school curriculum. The expansion resulted only in the proportion of students in technical/prevocational education increasing from 4% in 1969 to 6.2% in

1979 and about 9% in 1989 (Sweeting, 1998, p. 21). Some of the above-mentioned policy documents turned out to be just "paper tigers" (Sweeting, 2004, p. 239). The policy for the expansion of technical and prevocational education in secondary schools was never fully implemented as the Government allowed schools which did not have enough space and physical facilities to make their own decisions about curriculum matters (Hong Kong Government, 1974).

1980s: Restructuring of Prevocational Schools

In the early 1980s, all prevocational schools were restructured to extend their three-year course into five-year and up to the HKCEE level, following a panel of visiting scholars' comment that technical and prevocational education was not sufficiently articulated with the academic streams to allow students to switch streams without excessive backtracking (Visiting Panel, 1982). This allowed a limited number of prevocational schools' more capable senior form students to enter technician-level courses in technical institutes, while most others were expected to enter craft-level courses or joined the craft apprenticeship schemes after the completion of the three-year course.

In August 1986, the Education Commission (EC)[8] released its second report (EC, 1986). The Commission recommended that the sixth form curriculum should be extended to all prevocational schools.

8 The main tasks of the Education Commission are to advise the Government on the overall educational objectives and policies of Hong Kong.

1990s: Becoming of the New Technical Curriculum

Before 1992, sixth form courses were offered in grammar schools and technical schools only. Starting from 1992, 17 new Advanced Supplementary Level (ASL) subjects were introduced into the sixth form curriculum along with the Advanced Level (AL) subjects, subsequent to the Education Commission's recommendations stated in its Report No.2 (EC, 1986). The main purpose of the ASL courses is to enable sixth form students to study a wider range of subjects through a combination of AL and ASL subjects rather than just 2 or 3 AL subjects as in the past. ASL Design and Technology was one of the subjects out of the 17 new ASL subjects available for examination in May 1994. The subject was designed for students in all types of secondary schools including grammar, secondary technical and prevocational schools (ED, 1997a).

During the mid-1990s, in the wake of the economic restructuring of Hong Kong into a service economy, there had been increasing concerns within and outside the education community that many of the practical/technical subjects in the school curriculum had failed to keep up with the pace of economic development and thus no longer suited the needs of students and society (ED, 1997a). In 1996, the Director of Education set up a working group to conduct a comprehensive review of practical/technical curriculum in schools in light of the changing needs of Hong Kong's socio-economic situation. The working group's report (ED, 1997a) recommended the introduction of a new technical curriculum which aimed to impart to students generic and transferable skills to prepare them for further studies and a changing workplace. Subsequently, a number of newly-designed or updated business and technological subjects were introduced. These included, at the junior secondary level, the three Fundamentals subject[9], eight Application subjects[10] for prevocational schools, and Design & Technology (Alternative Syllabus) for technical schools. At the senior secondary level, the new subjects introduced were Graphical Communication, Technological Studies, Information Technology, and Design & Technology (Alt. Syl.).

As regards the roles of secondary technical and prevocational schools, the Report (ED, 1997a) recommended that secondary technical schools should continue to provide technical education, and prevocational schools should offer an alternative type of secondary education to that offered by grammar schools (para. 3.6 & 3.18). However, it may seem odd that both the secondary technical and prevocational schools were given the option to remove the technical/prevocational reference from their names (para. 3.6 & 3.19).

To implement the New Technical Curriculum (NTC) in all the 27 prevocational and 19 secondary technical schools starting from the 2000/01 school year, a non-recurrent grant of HK$162.7 million was allocated to the Education Department. These included the costs for conversion of special rooms and workshops in the schools and upgrading their existing teaching facilities and equipment, commissioning outside bodies (such as tertiary institutions) to produce textbooks and instructional materials, and running teacher retraining courses in support of the new and updated business and technological subjects (EMB, 1997). The NTC was introduced in the wake of the handover to China with an unrealistic tight implementation schedule and inadequate funding. Lee and Bray (1995) call this the

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9 These Fundamentals subjects included: Business Fundamentals, Design Fundamentals and Technology Fundamentals.

10 The Application subjects included Fashion Design, Graphical Communication, Catering Services, Desktop Publishing, Automobile Technology, Electronics & Electricity, Interior Decoration and Retail Merchandising.

"deadline effects": The closer the year 1997 approaches, the deadline effects become stronger and more apparent.

Early 2000s: From Technical Education to Technology Education

While the implementation of the New Technical Curriculum was taking place in secondary technical and prevocational schools, two reviews were also conducted in parallel: A holistic review of the school curriculum (HORSC) conducted by the Curriculum Development Council (CDC) during 1999 and 2001 and a review of the education system by the Education Commission (EC) from 1998 to 2000.

According to Cheng (2002), this is an indication that each policy sub-sector maintains its own territory, with no commitment to submitting to a larger vision of Hong Kong's education. For Cheng, the fragmentation of policy-making reflects deficiency in the Government and related mechanisms in organising themselves which hinders the education development in the territory.

Technology Education Key Learning Area (TEKLA)

In 2000, the CDC published the *Learning to Learn: The Way Forward in Curriculum Development Consultation Document* (CDC, 2000a), and subsequently in 2001 the policy document entitled *Learning to Learn: Life-long Learning and Whole-person Development* (CDC, 2001a) to consolidate the HORSC recommendations. The CDC (2001a) recommends the development of a Curriculum Framework as the basic structure for learning and teaching throughout all stages of schooling. According to this framework, existing subjects in schools are grouped into eight Key Learning

Areas (KLAs).[11] Technology Education (TE) becomes one of the KLAs in the new curriculum framework. An important implication for this is that it endorsed the status of technology education as an essential knowledge domain of a "broad and balanced curriculum".

In 2000 and 2002, two other documents were also published, namely *Learning to Learn: Technology Education Key Learning Area Consultation Document* (CDC, 2000b) and *Technology Education Key Learning Area Curriculum Guide (Primary 1 – Secondary 3)* (CDC, 2002). The later document portrays the vision of Technology Education in Hong Kong to be pursued and promulgates the directions of its further development:

> TE will be moving from a curriculum that provides students with specialised knowledge and skills to one that emphasises the development of students' understanding of their own aptitudes, interests and abilities for their future studies and work. (CDC, 2002, para. 1.4.2)

The CDC (2002) recommends TE as the entitlement of every Hong Kong student (Section 1.3.1). It is also recommended that at the primary level, the emphasis of TE learning is on "Awareness and Exploration" (Section 2.5.1), and the content of TE is subsumed in the General Studies (GS) curriculum together with the related contents of the Personal, Social and Humanities Education (PSHE) and Science KLAs (Section 1.3.4). At the junior secondary level, the emphasis of TE learning is on "Exploration, Experiences and Familiarization" (Section 2.5.1), and that at the senior secondary level is on "Exploring Orientation for Life-long Learning and Specialization". The TE curricula for the junior and senior secondary levels are subject-based (Sections 2.5.1 and 2.5.2).

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11 Key Learning Areas are fundamental concepts of major knowledge domains within the school curriculum.

However, the CDC (2000b) observed that there are a number of issues in the existing Technology Education curriculum that have to be addressed. These include:

- New subjects to be introduced due to rapidly emerging new technologies and social expectations, which far outnumber outdated subjects to be phased out, resulting in an overlapping and overcrowded secondary TE curriculum;
- The lack of common focus and lateral coherence among existing TE subjects as they are introduced at different points of time with different emphases;
- The lack of coherence and focus of TE elements in the primary curriculum as they are scattered across different topics in the General Studies curriculum.

(CDC, 2000b, p. 5)

Technology Education Curriculum Framework

In view of the above-mentioned issues, a curriculum framework for TE was developed for organising learning and teaching for technological subjects (CDC, 2002). The framework, as shown in Figure 2.2, comprises a set of components including:

- Subject knowledge and skills, which are expressed in terms of learning targets under the strands of Knowledge Contexts in Technology, Process in Technology, and Impact of Technology;
- Generic Skills; and
- Values and Attitudes. (CDC, 2002, para. 2.2)

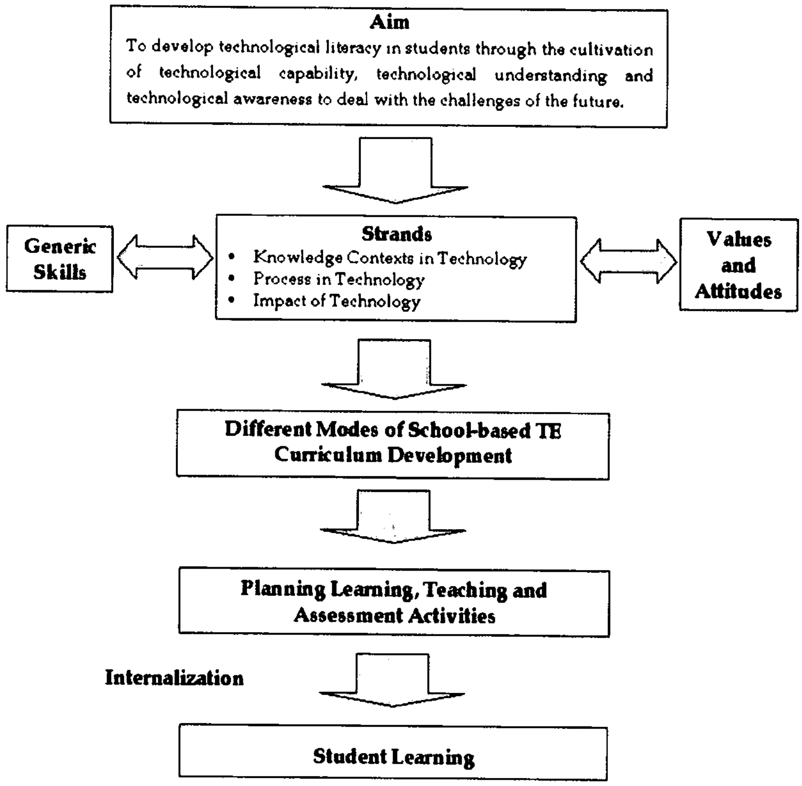

Figure 2.2 Technology Education Curriculum Framework.

(CDC, 2002, p. 17)

Knowledge Contexts. According to the CDC (2002), the Knowledge Contexts in Technology refer to a broad base of learning elements in TE. They provide the contexts for the development of technological capability, understanding and awareness in students. The knowledge contexts could be updated as necessary to keep students abreast of the emerging changes in technology. The CDC considers that in the current Hong Kong context, the following six knowledge contexts are essential for TE:

- Information and Communication Technology (ICT)
- Materials and Structures (M&S)
- Operations and Manufacturing (O&M)
- Strategies and Management (S&M)

- Systems and Control (S&C)
- Technology and Living (T&L)   (CDC, 2002, para. 2.2.1)

2.5. Status of Technical Subjects in Hong Kong

The status of a school subject has much to do with its "respectability". As noted by many writers (e.g., Jones, 1997; Layton, 1994), technology does not have a single well-established academic discipline in higher education but rather a multiplicity of technologies. In his book entitled *School Subjects and Curriculum Change*, Goodson (1993) traces the link between common factors discerned in the evolutionary profile of school subjects and the career imperatives of school teachers. He states that the evolving "career" of the school subject presents a changing range of opportunities for practitioners in the field. Tied up with academic status in school are departmental territories, teaching time, resources, and career prospects for subject teachers, together with the rights for the constituency of able students (Goodson, 1997).

Traditionally, the Chinese people put high values on education, academic achievement, and scholarship. In the Chinese society, the term "technical" often receives a low status because it is synonymous or associated with "industry", "craft" or "manual work". For many Chinese parents, "technical subjects" are craft subjects for the working class, which is low-status and non-scholarly. Tertiary status gives value to a subject (Goodson, 1985). In Hong Kong, subjects like Design & Technology are not generally offered at the senior secondary level and not being seen to provide the same opportunities as more academic subjects for university admission. In addition, there are no articulated studies in technology education in universities.

These unfavourable perceptions have discouraged many students from pursuing the study even if they are interested in or given the opportunity to opt for it. The steady but low HKCEE candidatures in technical subjects during the past years as shown in Table 2.2 below is a strong indication for this unfavourable situation.

Table 2.2.

Percentage of Subjects Sat in Technical Subjects in HKCEE (1991-2000) by School Candidates

Year	Total No. of Subjects Sat	Total No. of Subjects Sat in Technical Subjects	Percentage of Subjects Sat in Technical Subjects
1991	608,777	8,306	1.4
1992	599,931	8,631	1.4
1993	569,259	8,775	1.5
1994	575,015	8,343	1.5
1995	580,983	8,305	1.4
1996	525,740	8,650	1.6
1997	534,009	8,644	1.6
1998	560,658	8,522	1.5
1999	574,246	8,429	1.5
2000	579,713	8,593	1.5

(Source: HKEAA: Examination Reports, 1991-2000; ED, 2000)

The problem of competing and overlapping subject content among technical subjects and the declining rate of the HKCEE candidatures in technical subjects after the year 2000 illustrate further deterioration of this situation (Figure 2.3).

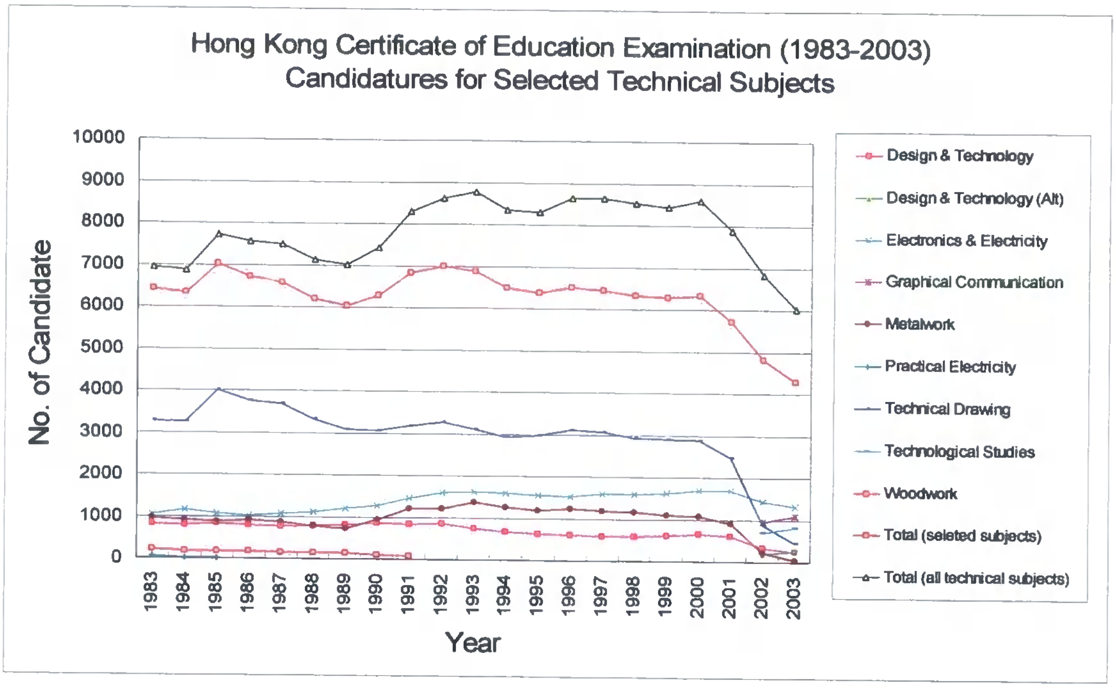

Figure 2.3 Hong Kong Certificate of Examination candidatures for selected Technical Subjects (1983-2003).

(Source: HKEAA: Examination Reports, 1983-2003)

Although ASL Design & Technology succeeded in getting a place within the sixth form curriculum since 1992, it has so far not being welcomed by school administrators, tertiary institutions, and students alike. This is reflected from the rather small number of candidates sat in the ASL Design & Technology through out the years (Table 2.3). Given the significant cost implications, the Hong Kong Examinations and Assessment Authority will stop running the examination of this subject along with other low-candidature ones in 2006 (HKEAA, 2003).

Table 2.3

Statistics of Candidates Sat in ASL Design & Technology Exam. (1996-2003)

Year	1996	1997	1998	1999	2000	2001	2002	2003
No. of Candidates	52	45	44	43	29	27	30	32

(Source: HKEAA: Examination Reports, 1996-2003)

Moreover, there is evidence that schools are inclined to develop other subjects with higher currency, such as Computer Studies and Putonghua (Mandarin), at the expense of cultural, practical and technical subjects (the so-called "marginal subjects"). To accommodate these new subjects, curriculum time is often taken away from those marginal subjects. With fewer and fewer students opting for technical/technological subjects at the senior secondary level, some schools eventually decide to eliminate these subjects from their senior curriculum altogether. Apart from reinforcing the low status of the subjects, such exclusion limits the development of technology education in schools, and more disappointedly, it hinders the career prospect of the subject teachers and their enthusiasms in teaching. As Goodson (1985) remarks:

> In secondary schools the self-interest of subject teachers is closely connected with the status of the subject in terms of its examinable knowledge. Academic subjects provide the teacher with a career structure characterised by better promotion prospects and pay than less academic subjects. (p.360)

Probably the most significant aspect of the change to technology education in Hong Kong is the concept that as a key learning area it contributes to all students' general education and thus should be taken by all students in the compulsory years of schooling. One thing that is still uncertain is whether such a move would eventually change the overall image of TE and the status of technological subjects.

2.6. Summary

The chapter briefly reviewed Hong Kong's socio-economic, political and educational context and had brought out a series of issues that support the need for this study. These included the uniqueness of the Hong Kong education system, policies pertaining to the development of technical/technology education in the territory, and the status of technical/technological subjects.

By tracing the evolution of technical/technology education in Hong Kong, it is interesting to note that, time after time, history is repeating itself. Recurrently, in various stages of its economic developments, Hong Kong needs "skilled workers" in various forms: Manual workers in the past and knowledge workers just recently. In all cases, the education system is called upon to meet the changing needs of society: The junior technical school in the 1930s, the secondary modern schools in the 1960s, the prevocational and technical schools in the 1970s and 1980s, and the New Technical Curriculum in the late 1990s. As commented by Sweeting (2004), the secondary modern schools could be seen as forerunners of the prevocational schools of the 1970s and the1980s.

From the above discussions, it is also evident that there are major discrepancies between what have been advocated by the Education Department (1997a) in its review report about the New Technical Curriculum (NTC) with that in the Curriculum Development Council's *Learning to Learn* policy paper (CDC, 2001b) and the TEKLA *Curriculum Guide* (CDC, 2002). The lack of role clarity among government agencies and ambiguity about expectations erode the likelihood of smooth and successful implementation (Fullan, 2001). All the way, frontline teachers and school administrators in Hong Kong are overburdened by educational reforms of all kinds, and have been receiving confusing signals about them. They are confused about what the main substances of the reforms are and are not. Indeed to them many of the distinctions made earlier have no meaning. All they experienced are "new" ideas, "new" requirements, coming from diverse directions, each added on top of their daily workload. Overall, few teachers have felt the benefits of the reform. As for parents, many decided that their children cannot afford to be guinea pigs and so have opted out of the education system by sending their children to local international or overseas schools (Sweeting, 2004).

However, it would be fair to say that recent reforms have created a lot of openings for schools to advance technology education in new directions, e.g., school-based curriculum development and more flexible ways of time-tabling to allow both girls and boys to study technological subjects (Volk & Yip, 1999; Volk *et al.*, 2002, 2003).

In sum, with regards to the relationship between Hong Kong's economy and education, it can be seen that the Hong Kong Government lacks forward planning capacity, and educational changes have followed rather than preceded major structural changes in the economy. As Sweeting (1998) comments:

> Post-war industrialisation was followed by the expansion of [primary] and then secondary education. The growth of a thriving tertiary sector since 1975 preceded by a decade the growth of the tertiary education sector. Further, throughout the period, technical and [pre]vocational education have constituted a very small sector of educational provision and the growth of this sector occurred during the period when the manufacturing sector declined in importance. Overall, schooling has concentrated on providing a highly academic curriculum which reflects the traditional range of academic disciplines. Therefore, the idea that the process of education directly results in economic growth is problematic. (p. 40)

CHAPTER 3

TECHNOLOGY AND TECHNOLOGY EDUCATION

3.1. Introduction

Teaching and learning about technology at all levels of education can only be done properly when those involved have a clear idea about what technology is. In other words, they should be able to give a decent answer to the question: "What is technology?" This chapter reports on the review of literature on technology and technology education that provides the substance for the thesis.

3.2. Nature of Technology

The word "technology" is probably one of the most misunderstood and misused terms today (Wright *et al.*, 2003). The difficulty of defining technology is intensified by the popularity of its use in daily life. Phases like "high tech" are commonplace but have very different meanings to different people. Technology is often used in a generic way as to encompass all the technologies that human beings developed and used for daily living needs. Some believe that technology is synonymous with recently developed artefacts such as computers, the Internet and high-tech devices. Others equate technology with value-laden words such as "advanced", "sophisticated", and "high" technology (Fleer, 1998). Many scholars have devised their own definition of technology. For Mitcham (1994), technology is object (tools, machines), process (design and transformation of materials), knowledge (know-how, techniques), and volition (aims, intentions, and choices that link the other three).

Satchwell and Dugger (1996) also make a distinction between "hard" technologies (e.g., tools, equipment, etc.) and "soft" technologies (e.g., management systems, software, Internet, etc.).

The International Technology Education Association (ITEA, 2000a) explains that:

> People who are unfamiliar with technology tend to think of it purely in terms of [artefacts]: Computers, cars, televisions, toasters, pesticides, flu shots, solar cells, genetically engineered tomatoes and all the rest. But to its practitioners and to the people who study it, technology is more accurately thought of in terms of the knowledge and the processes that create these products. (p. 9)

In fact, technology is as old as humankind; it is the product of human volition (Mitcham, 1994), has evolved alongside human beings, and has played a dominant role in the shaping of our civilisation. As ITEA (2000a) asserts:

> Humans have been called the animals that make things, and at no time in history has that been so apparent as the present. ... Technology has been going on since humans first formed a blade from a piece of flint, harnessed fire or dragged a sharp stick across the ground to create a furrow for planting seeds, but today it exists to a degree unprecedented in history. (p. 1)

Arnold Pacey (1983, cited in Ginner, 1995), in his work *The Culture of Technology*, examined various viewpoints of how technology is developed and used by people. According to Pacey, technology has three dimensions, namely technical, cultural and organisational aspects (Figure 3.1). Technology can be perceived from a narrower (restricted) and a broader (general) perspectives. A "restricted" view of technology refers primarily to its technical aspects (knowledge, skills and techniques, tools, machines and resources), and an all embracing "general" view of technology also incorporates the cultural aspects (goals, values, ethics, and behavioural codes), as well as the organisational aspects (economic and industrial activities, professional commitments, users' and consumers' concerns). For Pacey, technical changes can produce cultural and organisational adjustments in the same way as organisational innovations can lead to technical and cultural changes. In other words, technological practice takes place within, and is influenced by, cultural and social contexts.

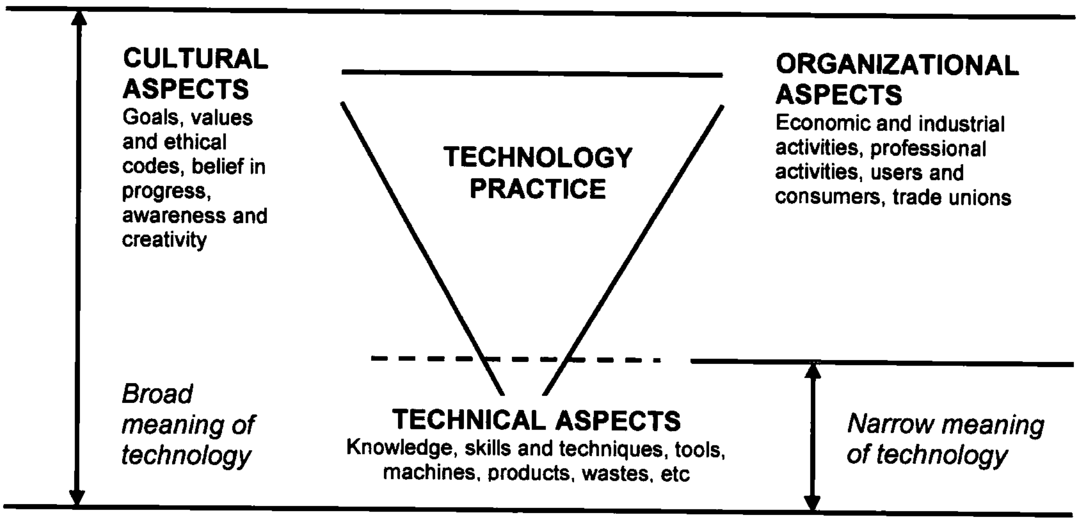

Figure 3.1 Narrow and broad views of technology.

(Pacey, 1983, cited in Ginner, 1995, p. 34)

The United Nations Education, Social and Cultural Organisation (UNESCO) defines technology as:

> The know-how and creative processes that may assist people to utilise tools, resources and systems to solve problems and to enhance control over the natural and made environment in an endeavour to improve the human condition. (UNESCO, 1986)

The UNESCO's definition of technology has shaped technology education in a number of nations, e.g., in the National Curriculum of the UK, students are required to apply knowledge and skills to solve practical problems. The International Technology Education Association (ITEA)'s latest definition of technology, stated in its recent publication, *Standards for Technological Literacy: Content for the Study of*

Technology (STL), is "the modification of the natural environment in order to satisfy perceived human needs and wants" (ITEA, 2000a, p. 7).

In Hong Kong, the Curriculum Development Council, in its recently published *Technology Education Key Learning Area Curriculum Guide (Primary 1 – Secondary 3)*, defines technology as "the purposeful application of knowledge, skills and experience in using resources to create products or systems to meet human needs" (CDC, 2002, p. 4).

The above definitions of technology reinforce each other. These definitions of technology incorporate the knowledge, tools, materials, techniques, processes, problem solving nature of technology and how it impacts every part of the man-made and the natural worlds. Most markedly common among these definitions is the concept that technology is a consequence of human innovation.

3.3. Technological Literacy

Technology has become a powerful force in everyday life. In today's global economy, it is imperative that each nation develops a technologically literate work force in order to compete and succeed in the world marketplace. The National Academy of Engineering in the USA, in its report *Technically Speaking: Why All Americans Need to Know More about Technology* (Pearson & Young, 2002), asserts that "Technological literacy, a broad understanding of the human-designed world and our place in it, is an essential quality for all people who live in the increasingly technology-driven 21st Century."

The International Technology Education Association (ITEA) defines technological literacy as "the ability to use, manage, assess, and understand technology" (ITEA, 2000a, p. 7). According to ITEA, technological literacy in its most generic sense is what every person needs to know and be able to do with respect to technology. This implies that a technologically literate person understands, in increasingly sophisticated ways that evolve over time, what technology is, how it is created, how it shapes society; and how technology, in turn, is shaped by society. ITEA maintains that technological literacy can be achieved through technology education (ITEA, 2000a).

In 2001 and 2004, ITEA commissioned the Gallup Organisation to conduct two similar polls on how the US public viewed technological literacy. The major conclusions reached were:

- The public understands the importance of technology in their everyday lives and supports the need for maximising technological literacy.
- There is a definitional difference in which the public thinks first of computers when technology is mentioned, while experts in the TE field assign the word a meaning that encompasses almost everything people do in their everyday lives.
- The public wants and expects the development of technological literacy to be a priority for K-12 schools.
- The public in general agrees on the importance of being able to understand and use technology and on the need to include technological literacy as part of the schools' curriculum. (Rose & Dugger, 2002; Rose *et al.*, 2004)

In Hong Kong, the Curriculum Development Council (2000b) states that, in order for the Hong Kong students to have the ability and responsibility to use technology to create an even better future, they must be educated to be technologically aware, literate, and capable. These three interrelated levels of technological literacy are briefly described below:

Technological Awareness

- Be aware of the cultural and contextual dependence of technological developments. Respect cultural differences and the rights of others as well as developing a sense of social responsibility in performing technological activities;
- Be aware that the well-being of oneself, one's family, society and the natural environment depends upon decisions on how to use technological artefacts and systems appropriately;
- Appraise the impact of technology on society and the environment.

Technological Understanding

- Understand the interdisciplinary nature of technological activities;
- Understand the underlying concepts and principles of technological artefacts, systems and environments;
- Understand and apply the knowledge of processes and resources used in designing, making and evaluating products, systems and solutions.

Technological Capability

- Identify needs, problems and opportunities, their respective constraints, and preferences;
- Develop, communicate, implement and evaluate solutions creatively;

- Make informed decisions in creating, using and modifying artefacts, systems and environments. (CDC, 2000b, pp. 11-12)

3.4. Technology Education in Schools

Technology Education is the study of technology and its impact on society. The arrival of technology as a component of general education and on a national basis is a rather recent event (Kimbell, 1993; Marsh, 1997b; Owers, 2001). Layton (1993) points out that technology education would be an important context for the general education curriculum: A way to connect it with the human-made world. During the 1980s and the 1990s, there were concerns about the economy and about a lack of competitiveness and enterprise in many developed and developing countries. There were also continuing pressures from the private sector and government to "vocationalise" the secondary curriculum in order to meet future economic needs (Marsh, 1997b). Subsequently, many countries have shifted their emphases in technology education towards economic development and competition (Petrina, 2000). More recently, a strong argument for the inclusion of technology as a school subject has been associated with the perceived need that, in a rapidly changing technological society, a major priority is to educate people to become technologically literate so that they are not technologically disadvantaged because of the limitations in their schooling experiences (ITEA, 2000a; Marsh, 1997b).

Another justification for technology education is that the study of technology converges with several contemporary educational emphases: Critical thinking, problem solving, authentic and cooperative learning, accommodation of diverse learning styles, theory/practice, abstract/applied knowledge, interdisciplinary approaches, integration of academic and vocational education, multicultural awareness, and ethics, responsibility, and values. In brief, technology education (i.e., the study *about* and *through* technology) is an important component of education that aims to prepare students for life and for work.

Technology as a school subject carries a variety of names. For example, *Technology* (UK), *Craft, Design and Technology* (UK), *Design and Technology* (UK; Hong Kong), *Technology and Design* (Northern Ireland), *Technology Education* (USA), *Design and Applied Technology* (New Jersey, USA; Hong Kong), *Technological and Applied Studies* (NSW, Australia), *Technology and Enterprise* (Western Australia), and *Living Technology* (Taiwan) have all been used, and each signifies a different rationale. The differences are often associated with struggles between competing interests to exert their influences on the school curriculum (Black, 1998).

3.5. Models of Implementing Technology Education in Schools

According to Williams (2002), there appears to be at least three different concepts of implementing technology education in the school curriculum. The first concept sees technology as a stand-alone or discrete subject having its own body of knowledge and methodologies, separated from other learning areas. This model is prevalent at the secondary education level. Another rationale for the development of technology as a distinct learning area is related to the technological nature of society. It is argued that in a technological society, all students need to be provided with the opportunities to experience and critique a range of technologies as part of their general education. This conception of technology as a distinct learning area is becoming popular among developed countries like the UK (the renewed National Curriculum Orders, 1999), the USA (Standards for Technological Literacy, 2000), and Australia (Technology Key Learning Area, 1994).

The second concept is having technology as part of an integrated study, for example, as a study integrating unit or module taught by teachers from a range of disciplines. This is in accord with Wright (1992), who asserts that technology is not an isolated body of knowledge and it has strong connections with all other areas of knowledge:

> Science explains the natural's laws that are applied by technology. Mathematics and mathematical models explain the operation of technological systems. Language and art can be used to describe technology and its impacts. The social studies can describe how technology has, is, and may well impact and be impacted by people and society. (p. 64)

A new subject, Integrated Science & Technology, as proposed by the CDC (2000b) for non-science students at the senior secondary level in Hong Kong, is an example based on this concept. The subject aims to provide the students with additional learning experiences in regard to modern scientific and technological developments.

The third concept is of technology providing the basis for integrated activities, where students will learn about, for example, mathematical concepts and language through engaging in meaningful technological learning activities, which require knowledge from a range of learning areas in addition to technology. This concept is similar to the second one except that the activity or project is preliminary technological, and the mathematical concepts and language development emanate from this technological activity.

3.6. Technology Education in Other Countries

The following sections trace the emergence and struggle for survival of technology education and related subjects in the United Kingdom (UK) and United States of America (USA), with particular attention to changes in socio-economic conditions. Reasons for selecting these two countries for in-depth analysis are given below.

The UK (England and Wales) is the first country to have (design and) technology as a compulsory component in the national curriculum since 1990, and it has been used as an inspiration by many other countries (Barlex, 2003; Kimbell & Perry, 2001). The foundation for technology education in the USA was laid over a century ago by the industrial movements in the UK, Western Europe, and Russia. More recently, technology educators in the USA have developed *Standards for Technological Literacy* (ITEA, 2000a) and established technology as a new basic in American education. As such, the USA serves as a microcosm that reflects the diversity of approaches to teaching technology on the international stage, ranging from traditional industrial arts to established design and technology emphases.

United Kingdom (England and Wales)

According to Kimbell (1993), (design and) technology has a relatively short history in the British curriculum "though its antecedents are numerous and ancient" (p. 2). Since the 1960s, it has taken thirty years for design and technology to move "from being a side-show intended only for the less able, to being at the heart of the new

National Curriculum (NC)[12], a compulsory study for all children from 5 to 16 years of age" (p. 2).

Technical/technology education in the UK has its roots in crafts, art and design, and was associated with manual work and low status occupations (Young, 1998). The historical evolution of design and technology as a school subject in the UK and its inclusion as a foundation subject in the National Curriculum could be seen in four major stages (Kimbell, 1993; Wright, 1993).

(1) *Craftwork* was introduced into British schools as a response to the country's economic decline after the Second World War. This type of programme included a series of separate studies in woodworking, metalworking, and technical drawing. Teachers were highly skilled craftsmen who took students through a sequence of practical projects that introduced them to using woodworking and metalworking hand and machine tools.

(2) In the 1970s, *Craftwork* was replaced by a new subject *Craft, Design and Technology* (CDT) with "design" added to the making emphasis of existing programmes. The CDT programme sought to portray the process of designing in ways that appeal to students who would formerly have been restricted to the basic crafts of woodworking and metalworking.

(3) During the 1980s, there was a growth in technology-related examination courses which focused on teaching elements of applied science (i.e., a loose definition of technology) with a strong industrial and vocational flavour. These new ingredients included electronics, pneumatics, structures, and the like. A broad

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12 For the purpose of our discussion in this thesis, the British National Curriculum refers to the educational programme that is for England and Wales only, and not for Scotland and Northern Ireland which have their own curriculum with a uniquely different type of technology education.

review was carried out to rationalise these courses and came up with a set of National Criteria which were adopted by the Secondary Examinations Council and all examinations in the technological area had to meet these criteria.

(4) In 1988 the British Education Act included technology as a compulsory national curriculum subject to be studied throughout England and Wales. Subsequently, the National Curriculum was implemented in 1990. The National Curriculum was a mandatory programme for all state primary and secondary schools. It included Technology as a foundation subject "which required pupils to apply knowledge to solve practical problems" (National Curriculum Council, 1990).

Technology in the National Curriculum. The National Curriculum Technology subject integrated a number of school subjects (Craft, Design and Technology, Home Economics, Business Studies, and Information Technology) under a single learning area. Design was at the heart of this "broadened" Technology subject. The subject was organised under four attainment targets (ATs) for all pupils aged 5-16: AT1 Identifying needs and opportunities, AT2 Generating a design, AT3 Planning and making, and AT4 Evaluating. The scheme was found to be very complex and not easily understood by teachers (Barlex, 2003). The lack of clear communication within and outside the field resulted in an urgent review of the Technology subject (Wright, 1993). Following a series of reviews, a new statutory order was published in 1995, with changes being made on the mission statement and the number of attainment targets reduced. The new mission statement is, "Pupils should be taught to develop their Designing and Making skills with knowledge and understanding in order to design and make products" (School Curriculum and

Assessment Authority, 1995, p. 5). In the revised version, only two attainment targets remained: AT1 Designing, and AT2 Making.

Technology in the National Curriculum is a process-based programme that makes use of the design process as the vehicle to organise its content with the intent of leading students to a knowledge of technology (McCormick, 1999; Morley, 2002; Wright, 1993). Wright (1993) comments that the success of this approach is determined by the design problems used and the expectations teachers have for their students. One weakness of using the design process as curriculum organiser, as pointed out by Wright, is that it does not provide clear definition for the area of study. Besides, turning from being a "designing and making" subject into generalised problem-solving without a specific knowledge base can lead to a loss of focus. Kimbell, Stables, and Green (1996) and Morley (2002) also comment that to have designing as an essential component of design and technology education, the degree of openness of design problems and the learning situations remain one of the most difficult curriculum challenges for design and technology teachers.

For David Hargreaves (cited in Kimbell & Perry, 2001), design and technology is moving to the heart of the school curriculum and is becoming a model of the combination of skills needed in the knowledge-based economy. For others, design and technology is more than just a subject that makes distinctive contribution to the school curriculum: "It is a learning experience which is unbounded by fixed bodies of traditional knowledge, and transcends the academic/practical divide" (Engineering Council, cited in Kimbell & Perry, 2001, foreword).

However, the role of design and technology in UK schools is changing. The UK Government's Green Paper *14-19: Extending Opportunities, Raising Standards* (DfES, 2002) proposes that education and training of 14 to 16-year-olds should be delivered by a more flexible curriculum with a broader range of options. Starting from September 2004, the study of design and technology (D&T) is no longer compulsory at Key Stage 4 (i.e., age 14-16), yet schools still have to make D&T available to all students who wish to pursuit in this curriculum area (QCA, 2003). It is anticipated that such a statutory change will have considerable impacts on D&T provisions in schools in the UK.

United States of America

The evolution of technology education in the USA has also gone through four developmental phases consisting of (1) manual training, (2) manual arts, (3) industrial arts, and (4) technology education (Virginia Tech Technology Education, 2002).

(1) *Manual Training* was basically a subject centred on manipulative skill development and the completion of specific exercises. It was also a programme to "keep boys in school" and "develop leisure-time interests" (Gerbracht & Babcock, cited in Foster, 1997).

(2) *Manual Arts* stressed project making for creativity and design of useful items (Virginia Tech Technology Education, 2002; Wicklein, 1990). It evolved from manual training around the late 1890s when the US educators were concerned that students were focusing on using tools at the expense of design and problem solving skills.

(3) *Industrial Arts* became a common component in the US school curriculum from the 1920s to the 1980s. It brought elements and requirements of industries into the school curriculum. Traditional shop courses were primarily

focused on developing skills in industry related areas such as woodworking, metalworking and drafting. In 1947, William Warner presented Industrial Arts as a general and fundamental school subject and identified five curricular components of communications, construction, power, transportation, and manufacturing (Virginia Tech Technology Education, 2002).

(4) *Technology Education* is an evolution of industrial arts. The name change to Technology Education came about on February 20, 1985, when the American Industrial Arts Association (AIAA) changed its name to the International Technology Education Association (ITEA). Since then, many other state associations in the USA and local programmes have changed their names to reflect an emphasis on technology (Bussey *et al.*, 2000).

Volk (1996) reviews industrial arts and technology education programmes and compares industrial arts to technology education on a number of contemporary issues including academic integration, definitions of the subject, and classroom activities. He observes that overlaps are found between the subject matter of industrial arts and technology education: "These overlaps reflect the tools, materials, processes, objectives, definitions, and activities common to both programs" (p. 28).

Todd (1990) also notices that in the past both industrial arts and technology education in the USA had more emphasis on the technical content aspect of the curriculum (e.g., elements, structures, functions, systems of technology) and had neglected the process aspect of technology (e.g., design problem solving, research & development, exploring, developing, improving, optimising, assessing and controlling technology). However, it is noted that the recent trend has been generally and gradually shifted from an emphasis on technical skill development towards a broader conceptual and process-based approach to the study of technology.

As observed by Todd, despite the US's educational tradition of local control, many states' technology education curriculum have been developed along this line, and there is considerable evidence that more commonalities exists than is apparent at a glance.

Standards for Technological Literacy. Over the past two decades, a number of initiatives have been launched in the USA that have had a major impact on the scope, direction, and focus of technology education in the country. The International Technology Education Association (ITEA), with funding from the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA), developed *Standards for Technological Literacy: Content for the Study of Technology* (STL) (ITEA, 2000a). The twenty Standards are grouped into 5 topic areas: (a) The nature of technology; (b) the relation between technology and society; (c) understanding the design process; (d) applying the design process and assessing, using and maintaining technology; and (e) understanding of medical, bio-related, energy and power, information and communication, transportation, manufacturing and construction technologies. The Standards lay emphasis on understanding and abilities of "doing" technology. These Standards are designed to provide a comprehensive conceptual framework and vision for technological literacy and contain benchmarks for what students should know and be able to do with technology K-12.

Sanders (2001) investigated the current programmes and practice of technology education in the USA. He reported that there was a distinct shift from the industrial arts emphasis on skill development to the development of problem solving, and this has been further delineated along with a strong emphasis on design in the STL.

In the past, much of the technology education curriculum in the USA has been organised around technical systems, (e.g., communication, transportation, construction, production, etc.). The *Standards for Technological Literacy* defines and broadens the content base of the technology field and also places increased emphasis on engineering and design. It represents the most comprehensive conceptual framework for technology education in the USA to date. However, as noted by Custer (2003), the substantial broadening of contexts in the STL to include agriculture, and medical technologies, as well as the distinct shift away from technical systems towards design and problem solving induced major challenges to practitioners in the country. Custer (2003) further comments that the Standards are still too general to be implemented into the classroom and have yet to be developed in sufficient details for student learning and assessment purposes.

Moreover, technology education in the USA faces several significant challenges related to identity. As a field of study that has evolved over a century ago from manual training, technology education in the USA is just beginning to establish a new identity that people outside the field recognise and understand. As ITEA (2000a) has pointed out, there is still widespread confusion about the differences between technology education and educational technology. For ITEA, educational technology is not concerned with studying technology as a discipline, but rather is concerned with the use of various technologies to enhance the teaching and learning process in all subjects, including technology education. The most serious challenge for practitioners in the technology education field is the persistent and growing association of technology with computers and other high tech electronics (Rose & Dugger, 2002; Rose *et al.*, 2004).

In brief, technology education in the USA has its historical roots in vocational education (Wicklein, 1993), and is an emerging discipline that has changed through the years. In recent years, however, there are major changes that adjusted the direction of technology education which attempts to adapt to and reflect a fast moving, highly sophisticated, technological society. These include:

- Teachers are focusing more on a technological base rather than on an industrial base;
- Trade-oriented subjects (woodworking, metalworking, and drafting) are being replaced with courses focusing on concepts, processes and systems of technology (information and communication, transportation, manufacturing, construction, and agricultural and bio-related technologies);
- Vocational education orientation is being replaced with general education;
- The name of the subject area has changed from industrial arts to technology education.
- An emphasis on technical skill development towards a broader conceptual and process-based approach (designing) to the study of technology.

3.7. Summary

Based on the above reviews, it can be seen that there are diverse perceptions of the nature and scope of technology education in the school curriculum, including but not limited to the following:

- A learning area seen by many as predominantly manual training that catered for low achieving students and others not motivated by "more academic" subjects;
- A learning area in which students develop knowledge and skills that prepare them to live, to work, and to further study in a technological society;
- A learning area in which students learn to understand and use emerging technologies; and
- A vehicle for the integration of learning undertaken in other discipline areas in the school curriculum. (Williams, 2001)

The rationales for the development of technology as a distinct learning area are in general related to the technological nature of society and equity of opportunity for students. The concept of technology education as a learning area that contributes to all students' general education is the most significant justification that it should be taken by all students in the compulsory years of schooling.

It has also been argued that a solid conceptual framework for technology is critical to the development of the subject (Marsh, 1997b; Owers, 2001; Wicklein, 1993). As Wicklein (1993, p. 79) asserts, "In the absence of a solid conceptual structure, there is a serious risk of technology education classes slipping into an incoherent series of activities selected primarily on the basis of student- or teacher-appeal." The curriculum contents for technology education subjects in the UK and the USA, as compared with that of Hong Kong, are summarised in Table 3.1 below.

Table 3.1

Comparison of Curriculum Content Areas in TE Subjects: HK, the UK, and the USA

Hong Kong Technological Subjects as proposed by (CDC, 2000b)	
Orientation	Content-oriented + Process-oriented
Curriculum Content Area	***1. Knowledge Contexts*** • Information & communication technology • Materials & structures • Operations & manufacturing • Strategies & management • Systems & control • Technology & living ***2. Technological Problems Solving Processes (The Design Cycle)*** • Identifying needs • Developing solutions • Evaluating solutions • Making informed decisions ***3. Impacts of Technology*** • On human, society and the environment • Social values and culture influence on technological development. ***Other Areas:*** • Values & Attitudes • Generic Skills
United Kingdom D&T National Curriculum (QCA, 1999)	
Orientation	Process-oriented
Curriculum Content Area	***Knowledge, Skills & Understanding on*** 1. Developing, planning & communicating Ideas 2. Working with tools, equipment, materials and components to produce quality products 3. Evaluating processes and products 4. Knowledge and understanding of materials and components 5. Knowledge and understanding of systems and control 6. Knowledge and understanding of structures ***Other Areas:*** • Key Skills • Health and Safety

Table 3.1 (Continued)

United States of America Technology Content Standards (ITEA, 2000a)	
Orientation	Content-oriented → Process-oriented
Curriculum Content Area	***1. Nature of Technology*** • Characteristics and scope of technology • Core concepts of technology • Relationships among technologies and connections between technology and other fields ***2. Technology and Society*** • Cultural, social, economic, and political effects of technology • Effects of technology on the environments • Role of society in the development and use of technology • Influence of technology on history ***3. Design*** • Attributes of design • Engineering design • Role of research and development, and experimentation in problem solving ***4. Technological World*** • Apply the design process • Use, maintain and assess the impact of technological products and systems ***5. Designed World*** • Medical technologies • Agricultural and related biotechnologies • Energy and power technologies • Information and communication technologies • Transportation technologies • Manufacturing technologies • Construction technologies

The above discussions reveal that there are radical changes and broadening of the technology education curriculum content areas in both Hong Kong and the USA. In a sense, the curricula are not incrementally evolved from existing subjects in schools; they are revolutionary in both knowledge and associated pedagogy. As will be discussed later in Chapter 4 of this thesis, teachers' lack of a shared understanding of technology education would be a major barrier to its implementation in schools. Besides, teachers' lack of confidence in their knowledge and skills in teaching technology-related subjects would also hinder the ongoing development of this emerging learning area.

CHAPTER 4

CURRICULUM CHANGE AND RELATED ISSUES

4.1. Introduction

This chapter begins with an outline of the concepts of curriculum and curriculum change. This provides a conceptual framework for discussions on technology education curriculum change in this thesis. It then discusses the crucial factors for successful implementation of technology education curriculum reform in schools.

4.2. Meaning of Curriculum

"Curriculum is not pre-given but rather a social construct." According to Herbert Spencer (cited in Franklin, 1999), the curriculum is consciously constructed by society to reflect its prevailing values and beliefs, particularly those things that it cherishes and wishes to pass on to succeeding generations. Curriculum also has a regulative role. For Spencer, the role of the curriculum is an instrument of social control for allowing society to achieve its array of political, economic and social goals.

In similar vein, Goodson (1997) argues that curriculum is a social construct which is constructed, negotiated, and reproduced in a variety of arenas and at a variety of levels. Morris and Lo (2000) further elaborate that curriculum could be seen as both an extension of a society's culture and a forum in which a variety of interest groups within the society compete to promote their conception of valid knowledge. As such, school knowledge very often carries the dominant values and ideologies of the society (Apple, 1990).

A number of curriculum experts and writers (Goodlad, 1979; Lawton, 1983; Morris, 1995a; Stenhouse, 1975) distinguished curriculum into different levels of decision-making or categories, e.g., intended curriculum, formal curriculum, perceived curriculum, implemented curriculum, attained curriculum, and hidden curriculum.

(1) *Intended* or *manifest curriculum* refers to the curriculum set down by the education system on what students are expected to learn.

(2) *Formal curriculum* is that which gain official approval and adoption by an institution (e.g., school) and/or teachers.

(3) *Perceived curriculum* refers to curriculum within people's mind. Teachers' perceived curricula in mind are most significant, given their important role as change agents in curriculum reform (Fullan & Stiegelbauer, 1991).

(4) *Implemented curriculum* is what actually goes on in school and is the basis for student learning.

(5) *Attained curriculum* is what students actually achieve through their learning experiences (Robitaille & Maxwell, 1996).

(6) *Hidden curriculum* conveyed through educational practice is not part of any plan. The values and attitudes (e.g., sex role differentiation and ability grouping) which student "learn" from the hidden curriculum are potentially very powerful and should not be underestimated (Morris, 1995a).

Here, the differences among the various categories of curriculum have to be stressed. This is because what actually goes on in schools is often not consistent with the intentions of the official or intended curriculum. A distinction also needs to be made between the adoption of a curriculum innovation and its implementation. According to Morris (1995a), the decision made by a school to accept an innovation does not imply that the school would implement the innovation in the intended way. In other cases, a curriculum innovation might not be implemented in certain schools either because teachers and/or the schools are not willing to adopt it, or because they want to adopt it but are unable to implement it as intended.

4.3. The Nature of Curriculum Change

According to Fullan (1991), education reform refers to changes in education initiated from the top, usually by the central government, while curriculum reform is a type of educational reform which focuses on changes to the content and organisation of what is being taught. For Fullan (2001), educational change involves two main aspects: The content of change (i.e. what changes to implement); and the process of change (i.e. how to implement them). These two aspects are inseparable because they interact with and shape each other.

The content of educational change in practice may involve: (1) the use of new or revised materials; (2) the use of new skills and behaviour, e.g. changes in teaching practice; and (3) changes in beliefs and understanding or pedagogical assumption and theories (Fullan, 1986). According to Fullan, changes of process (e.g., changes in teaching practices and in underlying beliefs) is more difficult to achieve than changes of content (e.g., using new materials) because they are to do with changes in people's "doing" and "thinking" respectively. Fullan stresses that it is not easy for people to change their behaviour and thinking significantly, even if they are willing to do so.

Many researchers and writers identified three broad phases to the change process, namely (1) Adoption, (2) Implementation, and (3) Substantiation. Adoption (or initiation) is the process leading up to and including the decision to proceed with implementation. Implementation is the process of putting into practice an idea or programme, or sets of activities and structures new to the people attempting or expected to change. Substantiation (or continuation) is an extension of the implementation phase in that the new initiative is sustained beyond the first or second year or whatever time frame is chosen (Fullan, 2001). According to Hargreaves & Fink (2000), sustainability in educational change does not simply mean whether a particular initiative can last. "It addresses how [the initiative] can be developed without compromising the development of others in the surrounding environment, now and in the future" (p. 32).

Based on his study on the social histories of educational change, Goodson (2001) identified three different segments in educational change processes: The external, the internal and the personal. According to Goodson, external change is mandated in a top-down manner, as with the introduction of the National Curriculum guidelines in the UK; internal change agents (i.e., teachers and educationalists) work within the school setting play central roles in initiating and promoting change within an external framework of support; and personal perspective of change refers to the personal beliefs and missions that individuals bring to the change process. Goodson (2001) asserts that:

> New models of educational change need to reinstate the balance between the internal affairs, the external relations and the personal perspectives of change. The capacity of internal agents to refract externally mandated change is substantial and, with low staff morale and low staff investment, change can remain more symbolic than substantive. (p. 54)

4.4. The Conceptual Framework

Fullan (2001) suggests that the implementation of an educational reform is basically a process of learning new skills, behaviour and concepts. It takes place over time, incrementally and developmentally involving ongoing assistance and psychological support and depends on a new school culture organised to encourage support and require interaction and collaboration among teachers. Fullan groups the factors affecting implementation of educational change into three main categories, namely (1) characteristics of the change itself, (2) local factors, and (3) external factors. Figure 4.1 illustrates Fullan's education reform model which incorporates these three interactive factors that affect implementation.

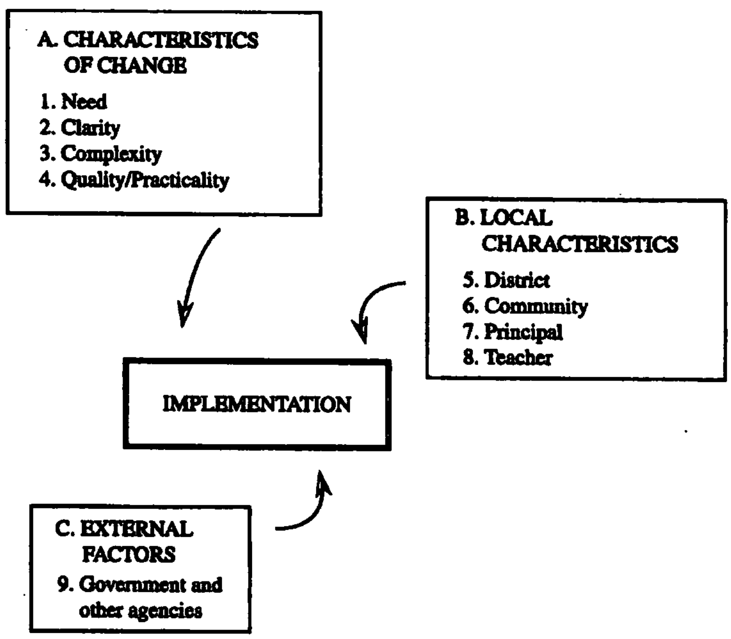

Figure 4.1 Interactive factors affecting implementation of education reform.

(Fullan, 2001, p.72)

The present study drew and expanded on the above factors to highlight the role of each when assessing the technology curriculum reform in the Hong Kong context. The framework portrayed in Figure 4.2 is an attempt to capture the complex "system of variables" (Fullan, 2001, p. 71) that is at the heart of the adoption and implementation processes of technology education curriculum change in Hong Kong.

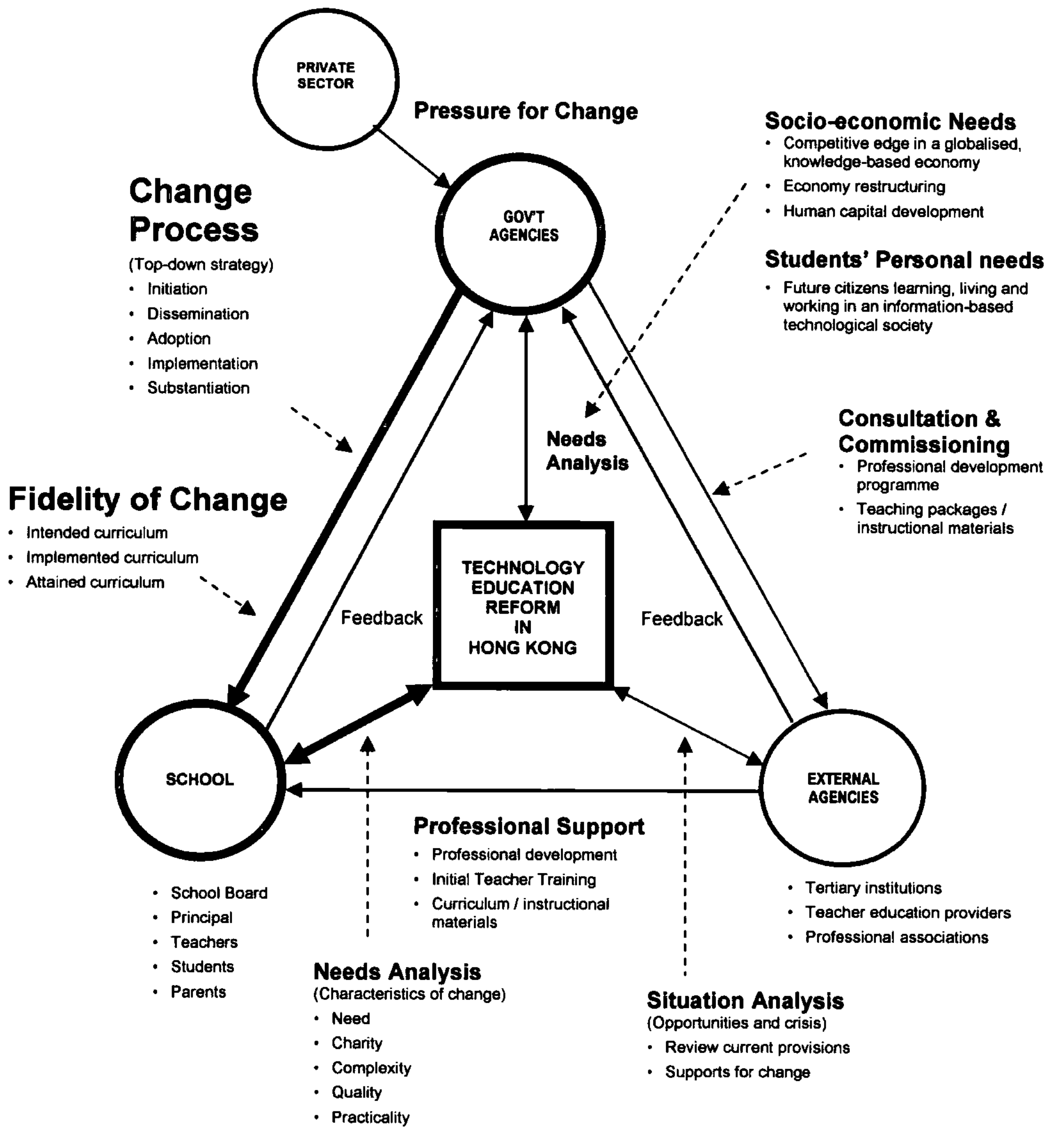

Figure 4.2 Conceptual framework for the research study.

(After Fullan, 2001)

Characteristics of the Change Itself

Fullan (2001) suggests that the intrinsic characteristics of a curriculum innovation have important implications on its success or failure. These characteristics include: The need and the perceived relevance of the innovation; its clarity, complexity, quality, and practicality (i.e., can it be easily used in the classroom?).

Need and relevance of the change. Teachers often do not see the need for externally imposed changes. Even though the importance of the perceived or felt need is obvious, schools still might not adopt and implement the change because they are faced with overloaded reform agendas. This implies that top-down educational innovations should take good account of schools' and teachers' priority needs.

Clarity. Clarity about goals and means is a perennial problem in the change process. Unclear and unspecified change could have the side effect of causing great anxiety and frustration to those sincerely try to implement the change. However, as Fullan (2001) argues, any significant change would involve a certain amount of ambiguity, ambivalence and uncertainty that requires individual implementers to work out their own meaning. For Fullan, effective implementation is a process of clarification which is likely to come in large part through reflective practice.

Complexity. Complexity refers to the difficulty and extent of the change required of the individuals responsible for implementation. This implies that educational change can be examined with regard to difficulty level, skills required, extent of changes in beliefs, teaching strategies, and use of materials.

Quality of the change program. The importance of the quality of the change program itself is self-evident. This implies that large-scale top-down curriculum change requires attention to high-quality instructional materials. In addition, appropriate and quality resources to support implementation and professional development are critical.

Practicality. As far as individual teachers are concerned, practicality of a curriculum change has something to do with their personal costs and benefits. According to Fullan & Stiegelbauer (1991, p. 129), "personal costs in time, energy, and threat to sense of adequacy, with no evidence of benefit in return, seem to be the major costs of change in education over the past years." On the other hand, when the change project involves benefits such as "a sense of mastery, excitement, and accomplishment, the incentive for trying new practices are powerful" (Huberman & Miles, cited in Fullan & Stiegelbauer, 1991, p. 129).

Local Factors

Local factors relate to the social conditions of change and the context (organisation or setting) in which change is taking place. These include characteristics of teachers, principals, school community, and the community at large.

Schools are social organisations, each of which would have its own culture or climate that might be conducive or unfavourable to change. Apparently, a school with a relative open climate where the teachers collaborate with each other and where the school administration is supportive of teachers is more likely to successfully implement a change.

School management board and school community characteristics. Fullan (2001) cautions that both the school management board and school community should not be underestimated when introducing innovations. The community and school management boards would take a conflicting or cooperative mode depending on their own position and circumstances. For instance, a school management board can indirectly affect implementation by hiring (or firing) reform-oriented school principal or teachers.

The principal. Fullan (2001) stresses that the school principal can be one of the main agents or blockers of change. The principal's actions serve to demonstrate whether or not a change is to be seriously put into action and can support teachers' efforts to change both psychologically and with resources.

The teachers. Individual teacher's characteristics play roles in determining adoption and implementation of change. According to Fullan & Stiegelbauer (1991), some teachers are more change-oriented and self-actualised, and have a greater sense of efficacy which leads them to action and persistence in the effort required to bring about successful implementation. Collective efforts also count. The quality of working relationships among teachers is strongly related to effective implementation. These include collegiality among teachers, open communication, trust, sharing, support and help.

Parents and the community at large. The support of parents and the community at large is likely to affect implementation as well (Fullan, 2001). Parents and the community's demand for reform, their readiness for it, and their initial and ongoing support for it will have important consequences for implementation.

External Factors

External factors concern the roles of the government, the private sector, and professional organisations relating to the innovation. The social, economic and political climates in which the innovation is taking place should also be well taken into account.

Government and external agencies. Whether implementation of an educational innovation occurs or not will depend on the congruence between the intentions of the reform, societal and school needs, and how the change is introduced and followed through. Very often, in Hong Kong, the government agencies have been preoccupied with policy and programme initiation and underestimated the problems and processes of implementation. As noted by Fullan (2001), the lack of role clarity among government agencies, ambiguity about expectations, absence of regular interpersonal forums of communications, ambivalence between authority and support roles of external agencies combine to erode the likelihood of successful implementation.

Social, economic and political climates. The general public, the private sector and professional organisations might all be sources of reform. Educational policies and change proposals arising from public concerns or with social, economic and politic supports, are more likely to be adopted by schools (Fullan, 2001).

4.5. Curriculum Change Strategies Adopted in Hong Kong

Changes in schools may be driven by a number of forces at different levels, including government policy initiatives, demands from the school management, and attempts by individual teachers to meet the changing needs of their students.

Hong Kong in general adopts a highly centralised, top-down strategy of curriculum innovation and development that stresses the power and authority of the central agency (Choi, 2003; Morris & Scott, 2003; Sweeting, 1993). It has often been said that the success of any curriculum innovation or change relies heavily on the acceptance and support of frontline teachers. Yet, there is a low level of implementation or a resistance to adoption in Hong Kong because teachers often do not have the sense of ownership of the change and have no intrinsic motivation to adopt it.

Each school has its unique characteristics of teachers, students and ecological context, which requires differing processes of change. Recognising that the concept of "one-size fits all" does not work, more recently, the CDC (2000b) recommends schools to adapt the central curriculum and develop their own school-based curriculum to cater for the needs of their students and to help them achieve the set learning targets.

4.6. Resistance to Change

Many writers (e.g., Fullan, 2001; Morris, 1998a; Olson *et al.*, 1999) argue that an education innovation without considering teachers' needs or concerns usually resulted in resistance to change. The cause of this problem is partly due to a lack of attention to the attitude, perceptions, and concerns that teachers would form towards the innovation. Pershing, An, and Lee (2000) suggest that such concerns have important implications for the innovation process itself as well as in the inherent quality of the proposed change.

Olson, James, and Lang (1999) also stress that teachers are an integral part of the overall change process. Teachers' understanding and perceptions of a school subject have considerable impacts on their interpretation, and subsequent implementation of that curriculum. Further, teaching unfamiliar subject matter create role insecurities for teachers, as do new approaches to teaching, which are perhaps still more challenging (Goodson, 1985).

Both Hargreaves (1994) and Sikes (1992) maintain that teacher cultures are crucial in any consideration of educational change because it is through these cultures that change is mediated, interpreted and realised. According to Sikes, the neglect of teacher culture has led curriculum innovators to underestimate its significance as a medium through which many innovations and reforms must pass. Given that teachers are at the frontline of most educational innovations, it is obvious that their attitudes towards curriculum reforms (adoption, reinvention or rejection) should be well taken into account.

Fullan (2001) states that a large part of the problem of educational change may be less a question of strict resistance and more a question of the difficulties relating to planning and coordinating a multi-level social process involving many people.

The above discussions indicate that the sources of resistance to educational change usually come from affected parties' perceived loss of status and control, fear of the unknown, and threats to expertise and established skills. The early involvement of schools and teachers in the decision making process and extensive communication with them can facilitate genuine acceptance and commitment to educational change (Morrison, 1998). This implies that for the central agencies and curriculum developers, they need to listen to frontline teachers who are the ones actually implementing changes in the classroom. This will require working with teachers and trying to address the problems they face, rather than just providing them with ready made solutions. If these potential obstacles are ignored, the experience with implementation can be more harmful than if nothing had been done (Fullan, 2001).

4.7. Implementing Change in Technology Education

Chinien, Oaks, and Boutin (1995) conducted a study in the Canadian context to investigate the transition from industrial arts to technology education in all Canadian provinces and territories. Based on the result of the study, they concluded that facility planning, equipment, teacher training, and research are critical factors for successful programme implementation and required the allocation of adequate resources. This study confirmed that teachers are the major change agents in the transition to technology education. They need opportunities to participate in continuing professional development activities. Given the relatively low status of technology education in most school reform efforts, it was suggested that all technology education professionals need to be more politically involved to form a strong united front for the advancement of technology education.

Bussey, Dormody, and VanLeeuwen (2000) conducted research to investigate the factors relating to the adoption of technology education in public schools in New

Mexico, the USA. It was reported that:

(1) The five most frequently cited barriers to teachers adopting technology education in New Mexico were: Inadequate budget, inadequate facilities, inadequate resources, inadequate educational programmes about technology education, and fear of change.

(2) The five most frequently cited promoters for adopting technology education in New Mexico were: Personal interest, workshops, visiting technology education programmes, available grant funding, and school-to-work initiatives.

(3) The five most frequently cited suggestions for strengthening technology education in New Mexico were: Increase funding for technology education, develop financial incentives, increase state level support, increase industry support and improve pre-service education programmes for technology education.

More importantly, in Bussey and associates' (2000) study, it was found that the strongest predictor of the level of adoption of technology education was the perception of the teacher towards technology education.

Hacker (1999, 2000) also carried out an investigation on the transition of industrial arts to technology education in schools in New York State, USA. He identified a number of implementation issues which can be useful references for the present study on the transition of technology education in Hong Kong:

(1) *Technology is not well understood.* Sometimes people refer technology to "technical means", "artefacts" (aspirin, chairs) or to "sets of procedures". A

common misconception is that technology is synonymous with computer hardware and software (Hacker, 1999).

(2) *Technology Education is tainted by its traditions.* Precursors to Technology Education in the USA were manual training, manual arts, and industrial arts. In the schools, these were commonly known as shop programmes (Hacker, 1999).

(3) *There is limited support for Technology Education programmes.* Technology Education is a discipline with only a recent history in the USA. There is a lack of support from school administrators for the introduction of yet another school subject into the curriculum. Technology is normally an elective subject, competing for time in the school day with required subjects with longstanding disciplinary traditions (Hacker, 1999, 2000).

(4) *Lack of articulation.* There is no coordinated instructional delivery system, K-12, which provides articulated study in technology. At secondary school levels (particularly in the high schools), technology is normally an elective, studied only by a small proportion of students (Hacker, 1999).

(5) *Mismatch of teacher capabilities and student needs.* Many Technology Teachers in the USA have been traditionally trained as Industrial Arts teachers and lack mathematics, science, computer science, and engineering knowledge and skills. Many of these traditionally trained technology teachers are still teaching in their "comfort zone" which is on the crafts end of the crafts to engineering continuum. In order to meet students' needs in the new millennium, Hacker (2000) argues for re-conceptualising pre-service and in-service education for all technology teachers in particular for those traditionally trained industrial arts teachers.

4.8. Summary

This chapter described the theoretical framework that underpinned the analyses of the implementation of curriculum change. The chapter also discussed the crucial factors for successful implementation of Technology Education curriculum reform in schools, which are summarised as follows:

- Consistency in policy;
- Collaboration among staff in school;
- Subject and school principal leadership;
- Teachers' recognition of their role in the curriculum innovation;
- Parental and public recognition of the value of technology education;
- On-going psychological and physical supports and resources for teachers;
- Professional development for school leaders and teachers; and
- Appropriated and adequate funding.

In this chapter, it has also been argued that educational change should consider the roles of a variety of stakeholders. Further, change strategies arising from external top-down reforms should take into account the fact that all schools are different. At the school level, the centrality of the school principal and the teachers' role cannot be underestimated. These change agents are crucial to the success of any reform initiatives within the school setting. The focus of change needs to include school management arrangements, curricular and pedagogical issues, parents, community and cultural values. Resources to support implementation and professional development for school leaders and teachers are also critical. Last but not least, supports from parents and the wider community are vital.

CHAPTER 5

TECHNOLOGY TEACHER COMPETENCES AND TEACHER EDUCATION

5.1. Introduction

Since the 1990s, there have been criticisms within and outside the education community that Hong Kong school education is not doing a good job of developing workplace skills for the economic system, and so must be transformed to meet the needs of an emerging information-based society. Policy-makers and the general public have also called for high standards for what Hong Kong children should know and be able to do. The quality of the teaching profession in Hong Kong has also been the subject of increasing attention and central to the Government's policy agendas. According to Mrs. Fanny Law, the Permanent Secretary for Education and Manpower, attaining this goal will require teachers who meet professional standards (Law, 2000). In a speech delivered at the Seminar on Teacher Development and Education Reforms in Hong Kong, Mrs. Law (2000) stresses that:

> What matters most for students' learning are the commitment and capabilities of their teachers. The challenges from the new era of lifelong learning call for an updated repertoire in teaching, and collaborative learning on the part of teachers, researchers and other education workers. Indeed, teacher development is the critical success factor for the education reform.

By referring to the National Board for Professional Teaching Standards' (NBPTS) five core propositions that underpin the National Board's certification requirements in the USA, Mrs. Law elaborates on the qualities expected of an accomplished teacher for education reforms in Hong Kong. As Mrs. Law (2000) asserts:

- Teachers are committed to students and their learning;

- Teachers know the subjects they teach and how to teach those subjects to students;
- Teachers are responsible for managing and monitoring student learning;
- Teachers think systematically about their practice and learn from experience;
- Teachers are members of learning communities.

In developed countries like the UK and the USA, interest in teacher competence is a response to the concern expressed by both government and the community about falling standards and the so-called "crisis in education" (Ballantyne *et al.*, 1998). The following sections aimed to analyse the major issues affecting initial teacher education and attempted resolutions in the UK and the USA. These two countries are selected because they allow comparison with Hong Kong across antecedents.

5.2. Technology Teacher Education in Hong Kong

1970s to Mid-1990s

As mentioned earlier, Hong Kong experienced rapid expansion in technical education in the early 1970s as a result of the booming manufacturing economy. In order to provide adequate supply of trained technical teachers for secondary schools, the newly established Morrison Hill Technical Institute located at Wan Chai started to offer Technical Teachers' Training Courses (2-year full-time, 1-year full-time, and 2-year part-time) (Grossman *et al.*, 2002; Sweeting, 2004).

In 1973, a Green Paper entitled *Report of the Board of Education on the Proposed Expansion of Secondary School Education in Hong Kong over the Next Decade* was published (Hong Kong Government, 1973). One major recommendation put forward by the Green Paper was the setting up of a Technical Teacher Training Board under the auspices of the Board of Education. The main roles of the Training Board were to set up the standards in technical teacher training and to plan programmes and facilities relevant to the changing needs of industry in Hong Kong (ED, 1975).

In February 1974, in order to attract mature students with industrial experience and technical qualifications to enter the teaching profession, the Government introduced an "enhanced inducement allowance" while they were receiving a one-year full-time course of technical teacher training. Later in September of the year, the Hong Kong Technical Teachers' College (TTC) was established with the Department of Technical Teacher and Workshop Instructor Training of the Morrison Hill Technical Institute as its core (Hong Kong Government, 1978). Starting from September 1980, a three-year course was offered to Form 5 graduates who would teach technical subjects in schools upon completion of the course. Practical experience of industrial applications of technical subjects were provided as an integral part of the training programme (Hong Kong Government, 1978). During the early 1980s, pre-service training was available for every type of teacher, however, a significant proportion of the secondary school teaching force was without professional training, including technical teachers (Visiting Panel, 1982).

Before 1986, most teachers teaching practical, technical and cultural subjects were non-graduate teachers. The Education Commission, in its Report No.2 (EC, 1986), recommended that:

> Degree courses for non-graduate teachers of practical, technical and cultural subjects: Part-time in-service courses leading to Bachelor of Education qualifications in Design and Technology, Art and Design, Home Economics and Physical Education should be developed in local tertiary institutions. (para. VII.6.8)

Further,

> Secondary schools in the public sector which offer any of the specified practical, technical or cultural subjects at the senior secondary level should be allowed to employ a teacher who has successfully completed the local degree course (or equivalent) as the teacher-in-charge of the subject and to appoint him or her as a Graduate Master or Mistress outside the normal quota of graduate posts, subject to a maximum of four such appointments in each standardised school. (para. VII.6.10)

Mid-1990s to 2003

More recently, there are multiple routes available for those wishing to become a technological subject teacher in Hong Kong. Before the establishment of the Hong Kong Institute of Education (HKIEd) in 1994, non-graduate technological subject teachers were mostly trained through the three-year Teacher's Certificate Course at the Hong Kong Technical Teachers' College (TTC). In April 1994, the HKIEd was established, formed by uniting the former four colleges of education[13] and the Institute of Language in Education administered by the Education Department into one single entity. A purposely-designed campus located in Tai Po, in the northern

[13] These included the Northcote College of Education, the Grantham College of Education, the Sir Robert Black College of education, and the Hong Kong Technical Teachers' College.

New Territories, was built and opened in 1997. Until recently, in 2000, secondary school graduates could take a two-year Certificate of Education (CE) programme at the HKIEd to obtain a professional qualification to teach. Technical subjects provided in the CE programme included Design and Technology and Technical Drawing. Professional studies in the programme included among others, teaching methodology, general educational theories, teaching practicum, and an industrial attachment (Hong Kong Technical Teachers' College, 1993). For holders of a higher diploma or first degree in engineering, design or related studies without any professional teacher training, they could still be employed by a school as "permitted teachers" but have to complete a part-time in-service programme within a specific period of time.

In 1997, the HKSAR Government (1997) decided to make teaching an all-trained, all-graduate profession. Accordingly, starting in 1999, the HKIEd begin to phase out the CE programmes. Given the Government's recent commitment to upgrade all teachers to degree level, a Postgraduate Diploma of Education (Secondary) (PGDE[S]) programme and a Bachelor of Education (Secondary) (BEd[S]) programme for Design & Technology were developed for teachers of technological subjects. The two-year part-time PGDE programme admitted its first cohort in the 1999/2000 academic year, and the four-year full-time BEd programme just one year after.

Postgraduate Diploma of Education programme in D&T. The PGDE(S) is an initial teacher education programme that leads to the award of Qualified Teacher Status recognised by the HKSAR Government. It is a 36 credit-point modular programme, of which 8 credit points involve Field Experience. The programme offers Curriculum and Methods for the D&T Major and Professional Studies comprising Educational Foundations, Information Technology, Language in the Classroom, Elective Studies, and Field Experience. Table 5.1 below shows the modules offered in the PGDE(S) Design & Technology Major and their credit values.

Table 5.1

Modules Offered in the PGDE(S) Design & Technology Major

Domain	Module	cp
Academic Studies (Major)	Design & Technology in the Curriculum and Classroom	3
	Advanced Methods of Teaching Design & Technology	2
	Curriculum and Methods Project	3

Bachelor of Education programme in D&T. The four-year BEd(S) in Design & Technology programme is modular in structure. The BEd(S) programme has 120 credit points (cps) in total, plus 20 cps for field experience. The basic curriculum framework for the programme consists of Academic Studies (Major) (43 cps) and Minor (15 cps), General Education (17 cps), Professional Studies (39 cps), Elective options (6 cps), and Field Experience (20 cps). It can be seen that nearly 60 cps or approximately 42 per cent of the programme is allocated for pedagogy and the practice of teaching.

Table 5.2 below shows the modules offered in the BEd(S) Design & Technology Major as well as their credit points. It can be seen that the D&T programme is biased towards the technical content with the inclusion of both "hard" technologies (i.e., tools, equipment, etc.) and "soft" technologies (i.e., social aspects of technology, software, Internet, etc.).

Table 5.2

Modules Offered in the BEd(S) Design & Technology Major

Domain	Module	cp
Academic Studies (Major) (Core)	Graphic Communication, 3-D Design, Technology Systems, Electricity & Electronics, Design Technology & Society, Manufacturing Processes, Structures & Mechanisms, Computer-Aided Design, Control Technology, Information Technology in D&T, Product Design & Development, Computer-Aided Manufacturing, Design & Making, Academic Project in D & T	43
Academic Studies (Optional)	Digital Electronics / Industrial Attachment	3
Professional Studies (Curriculum & Methods)	D & T in the Secondary Curriculum & Classroom, Advanced Secondary Methods of Teaching D & T	4

Teaching practicum is an integrated part of BEd and PGDE programmes in Hong Kong. However, within the last couple of years, there are practical problems of finding an adequate number of schools and places for practicum placement of technology teacher trainees. One reason is due to closing down of technological subjects in many schools; the other is that many teachers find their job already too demanding in terms of time and energy, and thus do not have the spare capacity for taking care of teacher trainees.

BEd vs. PGDE. More recently, in Hong Kong, there are heated discussions on the relative strengths of BEd and PGDE routes into teaching. These can be found in government policy papers and reports, research literature, and even newspaper columns. Arguments put forward by government officials that favour the PGDE are often based on concerns with the flexibilities in controlling teacher supply or perceived financial savings. As regards the preparation of teachers of technological subjects, in general it is considered that an integrated BEd programme would be more appropriate as these subjects often require an extended period of study during which student teachers can acquire and practise their teaching and technological skills. In addition, the four-year BEd programme is considered particularly suited to the preparation of multidisciplinary and interdisciplinary teaching and learning. This is seen as an advantage as university graduates in Hong Kong usually major in one or two subjects. University graduates with a relatively narrow discipline focus are considered inadequate for the broad subject matter knowledge required in teaching interdisciplinary subjects such as the new Integrated Science and Technology subject in the senior secondary curriculum.

An all-trained, all-graduate profession? Although the Government has put forward the idea of making teaching an all-trained, all-graduate profession in 1997, until this happens, the school administration still has the final say when recruiting teachers. School principals can employ staff with irrelevant bachelor's degrees or even without any professional teacher training. This might in part due to the emigration wave (commonly called "brain drain") that led to a shortage of teachers before the change of sovereignty in 1997. A large number of professionals left Hong Kong to obtain foreign nationality in such countries as Canada, the USA, Australia, New Zealand, and Singapore as a form of "insurance" against a worst-case scenario regarding the change of sovereignty over Hong Kong. Following the signing of the Sino-British Joint Declaration in 1984, it was estimated that about 24% of those emigrated from Hong Kong were from the education sector (Hong Kong Legislative Council, 1989). Employers frequently disregard the initial teaching training requirement when looking for teachers to fill the vacancies (Sweeting, 2004). Until then, as spelled out in Section 42 of the Education Ordinance, "permitted teachers" (non-registered) are allowed to teach in Hong Kong schools (EMB, 2004c). The minimum academic qualification required of a permitted teacher teaching in a school providing primary/secondary or post-secondary education is an associate degree, a higher diploma or equivalent; whilst a "registered teacher" must possess an approved teaching qualification and/or approved teaching experience (EMB, 2004d). Figure 5.1 presents statistics of a teacher survey on technology-related subjects in the academic years 1997-2001.

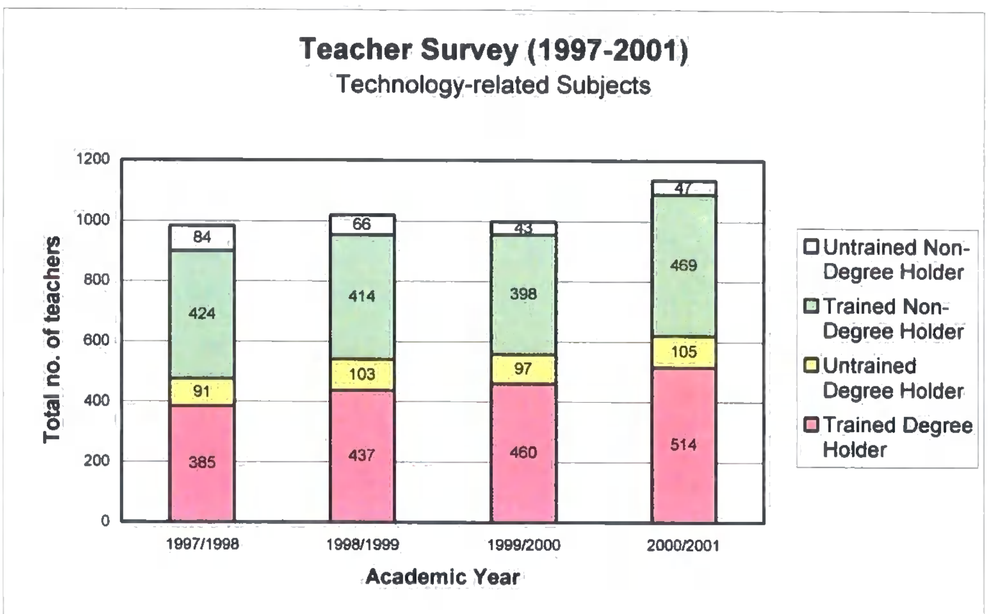

Figure 5.1 Teacher survey (technology-related subjects).

(Source: ED, 1997-2001)

5.3. Technology Teacher Education in Other Countries

Nowadays, beginning technology teachers in Hong Kong and elsewhere confront a situation quite different from their more experienced colleagues when they first entered the teaching profession many years ago. Newly qualified teachers are generally required to possess a significantly broader knowledge based as a result of considerable curriculum revisions and expansion. Moreover, in countries like the USA, the emphasis is now moving towards a process (design) focus rather than the traditional materials or technology systems focus. The philosophical basis underpinning the teaching *about* and *through* technology also requires "new" knowledge associated with appropriate pedagogical skills. Barlow (2002) opined that the technological and pedagogical knowledge base of technology teachers entering the secondary school sector has expanded and continues to expand dramatically. Thus, contemporary secondary technology education models may no longer effectively produce a fully prepared technology teacher with an adequate knowledge base.

According to Custer and Wright (2002), the preparation of technology education teachers involves three primary dimensions: Knowledge, doing, and valuing. As noted by Custer and Wright, in the past, the profession has in various ways concentrated on all three aspects but with a primary emphasis on the "doing" component. They argue that technology teacher education must continue to concentrate on the knowing, doing, and valuing aspects of technology, but at the mean time should maintain a balance among the three. In view of the importance given to multidisciplinary connections, integrated content, and transfer of learning in recent education reforms, Custer and Wright suggest that technology education teachers should actively pursue opportunities on interdisciplinary collaboration.

The following section gives a brief review of the courses for training teachers of technology education in the UK and the USA.

United Kingdom (England and Wales)

In the UK (England and Wales), initial teacher training (ITT) in design and technology has gone through considerable changes in recent years. The first government document highlighting future changes was concerned with the accreditation of ITT courses (Department for Education and Employment, 1998). This was followed by the Department for Education and Employment's *Circulars 9/92* (England), *35/92* (Wales) and *10/97*, which introduced the first National Curriculum for ITT. Aspects of the general professional development are specified within the DfEE *Standards for the Award of Qualified Teacher Status* (QTS). To successfully complete a course of ITT and be eligible for QTS, a teacher trainee will be assessed against the set of Standards (Burton & Bartlett, 2002).

The changes begun in the early 1990s have led to a new pattern of initial teacher training. Before 1990, the most common route for design and technology teachers was through a four-year Bachelor of Education (BEd) course, combining a specialist degree with QTS. In recent years the trend has been to complete a first degree followed by a Postgraduate Certificate in Education (PGCE) (Rutland, 2001).

Multiple routes. The latest framework includes training through a 3 and 4 year BEd or a one-year PGCE. In addition, there are also a small number of BA and BSc courses which may lead to the award of QTS. Currently, the majority of entrants to the profession are trained through the PGCE route (Rutland, 2001). More recently, additional routes are available through School-Centred Initial Teacher Training (SCITT) schemes where schools rather than higher education institutions are taking a more leading role, and the Graduate Teacher Programme (GTP) which offers salaried school-based initial teacher training for mature students (DfEE, 2001; Sutherland, 1997). Obviously, the diversity of routes into the profession and the establishment of a National Curriculum for ITT would to a certain extent weaken higher education institution's contribution to teacher education (Sutherland, 1997).

Content for secondary D&T initial teacher training programmes. According to DATA (2004c), secondary D&T initial teacher training programmes in the UK usually cover the following subject specific content:

- The historical and current rationales for D&T education within the curriculum across primary and secondary phases, highlighting links with other subjects, e.g. Art & Design, Mathematics and Science;
- The core competences of designing, product analysis and developing a design brief and specification;
- The use of research techniques, creative learning strategies and critical and creative thinking;
- Awareness of industrial methods and approaches, including techniques, processes and procedures to manufacture products and systems;
- Health and safety training;
- Values in D&T and links to citizenship;
- The contribution D&T makes to the development of pupils' numeracy, literacy and language development;
- The critical use of ICT to enhance teaching and learning in D&T, using modern technologies such as interactive white boards, scanners, digital cameras, and specialist ICT resources such as CAD/CAM and subject specific software.

Induction. Statutory induction arrangements were also introduced in 1999 for all teachers in their first year after the award of QTS (DfEE, 1999). In its document *The Induction of Newly Qualified Teachers*, the Department for Education and Employment (1999) has established clearly the expectations of newly qualified teachers during their induction year. According to the document, schools employing newly qualified teachers (NQTs) must provide them with an induction tutor, an appropriate training programme and a reduced teaching load. Induction is essential for the NQTs as it is "a bridge from initial teacher training to effective professional practice" (DfEE, 1999, para. 1). It is also vital for beginning teachers in design and technology, as they need to acquire a rich and varied knowledge base and that new technologies are emerging rapidly at all times. By making induction statutory, it would make the first year of teaching for beginning teachers easier but also carries the threat of being barred from teaching if standards are not meet. Burton and Bartlett (2002) comment that to itemise discrete teaching skills through QTS and NQT (Induction) Standards provides "an impoverished and partial model of the teacher and that the whole is greater than the sum of the parts" (p. 248).

United States of America

In the USA, education is in the hands of individual states. The authority to license teachers lies with the 50 individual states and the District of Columbia. In general, technology education teachers in the USA are prepared through the traditional pathways of undergraduate study approved by individual states (Ritz & Copeland, 2002; Volk, 1997). Licensure requirements vary widely from state to state, and even among institutions offering programmes of similar subjects within the same state (Litowitz & Sanders, 1999).

Content for technology teacher education programmes. As Welty (2003) observed, technology teacher education programmes in the USA in general provide students a relatively flat collection of technical programmes with a fairly comprehensive treatment of technology. Most of these programmes tend to provide their students with a number of courses in the study of materials and processes, design, manufacturing, communication, construction, transportation, and energy utilisation. Welty comments that due to the compartmentalisation of knowledge across discrete areas, these courses lack the scaffolding needed to construct profound understandings about technology. Welty suggests that in order to better prepare student teachers and to address the standards for the study of technology, teacher education programmes need to include more courses that are designed specifically to empower aspiring teachers to teach a wide range of generalisable concepts and skills.

Custer and Wright (2002) support the idea of delivering technical courses in technology teacher education programmes. The reason for that is to provide student teachers with basic experience and knowledge with the types of equipment and processes that are commonly used in workshops and laboratories in schools.

Given the rather broad content areas stated in the *Standards for Technological Literacy* (STL) (ITEA, 2000a), Custer and Wright (2002) maintain that a technology teacher should have a comprehensive knowledge of the "content knowledge base"[14] for the study of technology as well as "fundamental processes"[15]

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[14] These include the nature of technology, technology and society, and design and problem solving.

[15] These include designing, producing, using and assessing activities.

for doing technology. They further suggest that "Being an effective technology teacher requires more than knowing technological information and processing capabilities. Technology teachers must be able to teach others about technology" (p. 112).

In contrast, Welty (2003) suggests that instead of trying to cover all the content areas they have to offer, teacher preparation programmes should focus their energy and resources on teaching the essential concepts and skills that will enable the next generation of technology teachers to provide their students with a sound intellectual foundation for life-long learning.

Alternative routes. During the last decade, many universities in the USA were unable to recruit sufficient numbers of students into their traditional teacher preparation programmes. The resultant severe shortage of technology teacher has imposed great pressure on programmes to consider alternative paths to teacher licensure (Litowitz & Sanders, 1999; Ritz & Copeland, 2002; Welty, 2003). School systems are being forced to employ under-qualified (i.e., people with industrial or "life experiences" but without professional training) individuals as teachers. Teacher preparation institutions and state agencies for education have great concern on how they can meet the demand for qualified technology teachers. Some universities have created alternative programmes to reduce the problem, e.g., the interdisciplinary model adopted by Texas A&M University. This model provides candidates with technical content preparation from engineering and other technical departments outside the professional education unit (Ritz & Copeland, 2002).

While technology teacher education has much in common with other education disciplines, there are a number of specific characteristics that need to be addressed. The unique differences being faced by technology teacher education providers are highlighted below:

- Abilities related to using practical based resources in teaching technology in a workshop or laboratory setting (Burke, 1999).
- Changes in pedagogy that will affect lesson organisation through the use of a process (design or problem solving) approach. This may necessitate a shift in the teacher's role from a provider of knowledge to a facilitator of learning (Chester, 2002).
- The necessity of technology teachers to be receptive to change given the rapidly emerging changes in technology during the last two decades (Wash *et al.*, 1999).
- Difficulties in preparing a new generation of technology teachers who have to master a knowledge base that is expanding at an exponential rate (Welty, 1999).
- The expectations of school administrators and practising teachers that newly qualified technology teachers will not only be innovative but also have the ability to provide immediate curriculum leadership.

5.4. Teacher Knowledge

Shulman (1987) argues that all good teachers need three kinds of knowledge: Content knowledge, pedagogical knowledge, and pedagogical content knowledge. According to Shulman, *content knowledge* refers to knowledge of a subject discipline, which is generally described as subject content. *Pedagogical knowledge* refers to the general abilities that teachers possess. These include the ability to motivate students, the ability to plan lessons and the ability to establish and maintain an appropriate level of discipline in class. Shulman defines *pedagogical content knowledge* as the professional blending of the content and pedagogy that enables teachers to organise and adapt teaching topics to diverse student populations. As for Shulman, pedagogical content knowledge develops over years of teaching experience. "If beginning teachers are to be successful, they must wrestle simultaneously with issues of pedagogical content (or knowledge) as well as general pedagogy (or generic teaching principles)" (Grossman, cited in Ornstein *et al.*, 2000, p. 508).

At present, there is general agreement that teachers should be experts in subject matter content, and potential teachers should be required to demonstrate mastery of their subject before they are allowed to teach it (National Council on Teacher Quality, 2004; Weiss *et al.*, 2002). Darling-Hammond and Ball (cited in Fullan, 2001, p. 244) found that teacher's subject matter knowledge is one of the important elements of teacher effectiveness, and that teachers who are fully prepared and certified in both their subject discipline and in teaching are more highly rated and more successful with students than are teachers without preparation. Some people even contend that subject matter knowledge is the only thing necessary to be a good teacher (Wise & Leibbrand, 2000). A related issue faced by many teacher educators all over the world, including Hong Kong, is how to keep a balance among educational theories, subject matter knowledge, pedagogical knowledge, and pedagogical content knowledge in teacher education programmes.

As regards design and technology, Banks (1996) states that it is a very broad subject so teachers need to have a good understanding of a substantive part of it in order to serve their students properly. Custer and Wright (2002) further elaborate that an effective technology teacher should be able to:

- Develop a contemporary philosophy based on an understanding of the role of technology education in meeting the needs of students and society; and use this philosophy to develop educational goals for technology education programmes.
- Identify the knowledge base and processes of technology in order to determine content for technology education programmes;
- Present technology to students using appropriate teaching methods (ranging from content-centred to process-centred, and teacher-led to student-directed) in an interesting and exciting way;
- Identify strengths and weaknesses of the programmes and assess student progress using various methods, including examinations, and portfolios.

(pp. 112-113)

The Design and Technology Association (DATA, 1995, 2003) and Roden (2000) summarise neatly subject and pedagogical knowledge required for teachers in design and technology:

- Distinctive aspects of the subject, beliefs and values associated with the subject and its role in modern society;
- Knowledge about the management of learning, organisation of the learning environment and working with each other;
- Substantive content knowledge or aspects of the subject, such as products and applications, quality and technical vocabulary, mechanisms and structures, and health and safety;

- Pedagogical content knowledge or aspects of the subject relating directly to learners;
- Process knowledge or the method of inquiry in the subject, including the process of designing, making, communicating and evaluating.

Given that one of the major objectives of the present research was to develop a set of competences for newly qualified technological subject teachers for Hong Kong. The above discussions on teacher knowledge, in particular those associated with design and technology, will be very valuable in this regard.

5.5. Domains of Technology Teacher Knowledge

Chester (2002) suggests that the first priority of initial teacher education is to create a framework of practice within which newly qualified technology teachers are able to operate. This framework includes components such as subject matter knowledge about technology, pedagogical knowledge and school subject knowledge about how to teach specific content (e.g., understand and make ethical decisions about technological systems, and the ability to use practical based resources).

The following sections summarise previous discussions on teacher knowledge. Figure 5.2 provides a model that represents domains of teacher knowledge for technology education. The model differs from Pamela Grossman's (1990) general model of teacher knowledge in several ways. First to *subject matter knowledge*, an explicit reference to the nature of technology was added, necessary given the changing curricular goals as proposed in recent major initiatives like the Technology Education Key Learning Area (TEKLA) (CDC, 2000b).

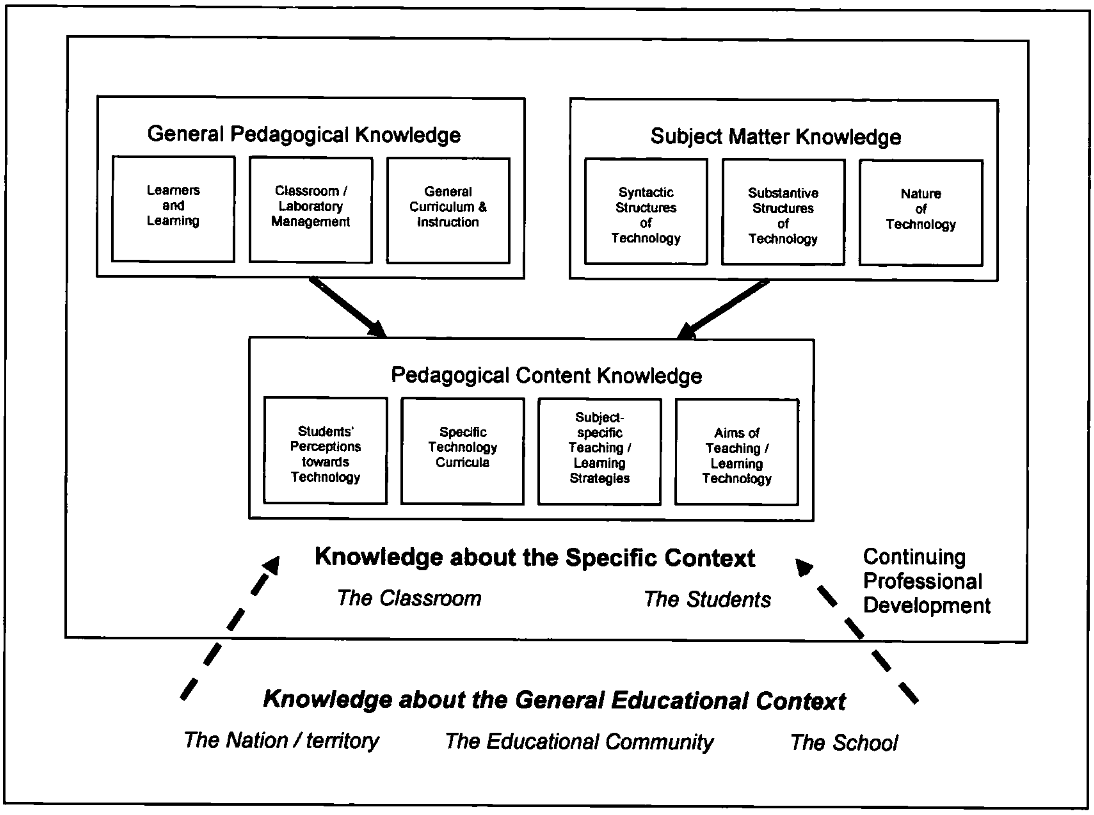

Figure 5.2 Domains of technology teacher knowledge.

(Adopted from Carlsen, 1999)

Second, Schwab's useful conceptions of substantive and syntactic structures were retained. If technology teachers are to teach the new (broad-based) technology curricula successfully, their subject matter knowledge should include the structures of design, technology, engineering, science, and mathematics. This appears a big challenge; after all, a well-prepared technology teacher for the 21st Century would be expected to be familiar with designing and at least three to four technological areas such as Computer-Aided Design and Manufacture.

Third, within *pedagogical content knowledge*, "students' perceptions towards technology" and "topic-specific teaching and learning strategies" were included, both categories with special significance in technology education. Within the later category, it would include much of the knowledge that technology teachers draw upon in selecting and using technological equipment, orchestrating substantive classroom discourse, and managing laboratory and other technological learning environments and activities.

Fourth, given that knowledge structures are not static and technology teachers have to constantly reshape their knowledge, the importance of context and its unique relationship to the various knowledge domains were highlighted in this diagram. These are in line with the contemporary thinking that teachers should be committed to continuous learning and engage in professional discourse about subject matter knowledge and student learning of the discipline.

The above framework provides a way of opening up dialogue on the strengths of technology teachers and identifying their professional development needs. Besides, a shared understanding of the different aspects of the professional knowledge of a technology teacher helps to provide a common ground for discussions between different parties, including teacher trainees, teacher educators, employers, and policy-makers.

5.6. Teacher Competences and Standards

Competence and Competency

The terms competence and competency are often used interchangeably in the literature. In its general sense, competence can be defined as the ability to do a particular activity to a prescribed standard effectively (Davies & Ellison, 1997). Competence also refers to a state of being well qualified to perform an activity, task or job function. Thus, “competence attempts to capture the richness and complex nature of the best professional practice from a holistic or integrated view that cannot be observed directly" (Thompson, 1998, p. 16). As pointed out by Hager (1993), the professional competence of teachers can only be inferred from their performance.

Competency is narrower in meaning (Hager & Beckett, 1995; Thompson, 1998). A competency refers to "a definable knowledge/skill/attitude made explicit in work (action) and attained in social contexts to a defined standard through practice, study and personal interactions" (Bartlett, 1992). This implies that competency is a fluid concept, meaning that it can change over time, and can be enhanced and improved through coaching and professional development opportunities. In similar vein, Hager (1993) further elaborates that professional competencies for teachers can be considered as the knowledge, abilities, and attitudes/beliefs that teachers possess and bring to the actual teaching environment in performing the teaching act.

During the last decade or so, there are recurring debates about the place of competency standards in teaching and teacher preparation (Hager, 1993; Marsh, 1997a). Opponents of competency standards criticise that a narrow, mechanistic conception of competency which sees competency standards as lists of particular, discrete vocational tasks is undesirable. It is considered that an integrated conception of competence in terms of knowledge, abilities, skills and attitudes would capture the holistic richness of professional practice and avoid the problem of atomisation.

Teacher Competences

It is generally agreed that teachers must perform to a satisfactory level of competency to implement the curriculum. This means demonstrating a sufficient level of knowledge, skill and motivation to meet the demands and requirements of the teaching job satisfactorily. As for newly qualified or beginning teachers, the school principal, colleagues and even students would have sets of expectations on their performance. For Capel, Leask, and Turner (1997), the first and foremost is an expectation that they can do the job: Can teach (their specialist subject); able to take charge of classes, behave in a professional manner; able to learn and benefit from experience; and take a full part in the life of the school. Ballantyne, Thompson, and Taylor (1998) carried out a study to investigate Australian high-school principals' conceptions of beginning-teachers' competences. It was perceived that a competent beginning teacher should: (1) have a particular type of personality, (2) be a subject expert, (3) be a skilled manager, (4) have a professional approach, and (5) have control of the class.

Professional Standards for Teachers

It seems that the development of professional standards for teachers has become a major focus in the field of education in many countries around the world (Ball, 1992; Marsh, 1997a; Western Australia Department of Education, 2001). The main purposes for developing professional teacher standards are: (1) as a means of improving the quality of learning and teaching, and (2) enhancing the status of teaching as a profession. It is asserted that the development of national professional competency standards could:

- Assist teachers to improve their workplace performance by encouraging them to reflect critically on their own practice, individually and collaboratively;
- Inform professional development so as to support improvements to teaching;
- Raise teachers' self-esteem and their commitment to teaching;

- Underpin a national approach to improving teacher education programmes, including curriculum and pedagogy;
- Underpin a national approach to improving induction programmes in schools and systems;
- Possibly form the basis for a nationally consistent approach to registration and probation; and
- Provide a platform for discussions and consensus-building about the nature of teachers' work and the quality of teaching and learning among teacher education providers, the profession and external bodies. (Marsh, 1997a, p. 93)

Reynolds (cited in MCEETYA, 2003) has made a distinction between standards and competences. According to Reynolds, the concept of standards is a broader concept than competencies as it includes a range of factors such as values and attitudes. Further, standards refocus issues of teachers' processes, purposes and efforts rather than outcomes alone. Marsh (1997a) further explains that standards are usually defined in terms of "minimum standards" and this involves establishing certain "criteria" (p. 90).

United Kingdom (England and Wales)

The issue of standards for teachers has been a focus of policy development in the UK for most of the last decade. According to the Department for Education and the Welsh Office (DFE &WO, 1992), teacher competence refers to attainment at a level appropriate to newly qualified teachers (NQTs). For practicing teachers, these might imply "minimum standards". The DFE &WO also identified a set of five broad areas of competence for the NQTs. The competences included:

- Subject knowledge. These competences include knowledge of the subject, and knowledge about the subject – both as a discipline in itself and its place in the curriculum;
- Subject application;
- Class management;
- Assessment and recording of pupils' progress; and
- Further professional development.

In 1998, the Teacher Training Agency published the National Standards for Qualified Teacher Status document to replace the more general competences set out in *DFE Circulars 9/92* and the *14/93*. The standards are set out under the following headings:

- Knowledge and understanding;
- Planning, teaching and class management;
- Monitoring, assessment, recording, reporting and accountability; and
- Other professional requirements.

The standards are stated in specific, explicit and assessable terms, which provide a basis for the award of Qualified Teacher Status (QTS). For those to be awarded QTS for secondary teaching must demonstrate that they "have a secure knowledge and understanding of the concepts and skills in their specialist subject(s), at a standard equivalent to degree level to enable them to teach it (them) confidently and accurately" (Teacher Training Agency, 1998, p. 3).

More recently, in England and Wales, the DfES/TTA publication *Qualifying to Teach* (DfES/TTA, 2002) delineates requirements for all courses of initial teacher training. There are requirements of standards for knowledge and understanding of various subject areas within the primary and secondary school curricula: Planning, teaching, and class management; monitoring, assessment, recording, reporting, and accountability; and other professional requirements including professional values and expectations. The award of qualified teacher status is entirely dependent upon teacher trainees reaching these nationally prescribed standards.

Based on the above discussion, it is apparent that recent changes in the requirements for the qualification of teachers in England and Wales have underpinned subject-specific deepening of teacher knowledge. All teacher trainees in England and Wales now have to comply with certain specified standards regarding background knowledge in subject areas if they are to gain qualified teacher status. It is interesting to note that the National Curriculum specifications for children's learning have been reduced but those for teachers are just the reverse (Parkinson, 2001).

According to DATA (2003), the minimum competences for design and technology teachers are made up of a core (which includes generic subject competences, subject application and subject-specific knowledge) and four specialist fields [16] of knowledge. For example, teacher competences for the Materials Technology specialist field include the ability and skills to:

- Sketch and accurately draw construction details using formal drawing techniques;
- Make use of modelling techniques using basic modelling materials;

16 The four specialist fields are Electronics and Communication Technologies, Food Technology, Materials Technology, and Textiles Technology.

- Use computer solid modelling techniques to develop and test design ideas and generate working drawings;
- Use ICT to access design data and create spreadsheets related to the costs of materials;
- Investigate, disassemble and evaluate a range of manufactured products identifying the production processes and technologies used and the visual and other sensory qualities employed in design;
- Recognise that there is an environmental consequence when using resistant materials and show awareness of different cultures and evaluate the impact on society of a range of products;
- Use the properties of wood, metal and plastics to meet design requirements and accurately mark out, cut and waste, deform, form, and fabricate by hand and using basic machines; and
- Make use of CAM prototyping techniques to synthesise and develop design ideas while considering visual and other sensory qualities of materials.

(DATA, 2003)

United States of America

The USA has just recently developed content standards for technology education teachers. In October 2003, the new *Standards for Technology Education Program Review* (ITEA, 2003) developed by the International Technology Education Association was approved by the National Council for Accreditation of Teacher Education's (NCATE) Specialty Area Studies Board. There are ten standards which are subdivided into two sets as shown below:

Subject Matter Standards for Technology Education

Standard 1 – The Nature of Technology

Standard 2 – Technology and Society

Standard 3 – Design

Standard 4 – Abilities for a Technological World

Standard 5 – The Designed World

Effective Teaching Standards for Technology Education

Standard 6 – Curriculum

Standard 7 – Instructional Strategies

Standard 8 – Learning Environment

Standard 9 – Students

Standard 10 – Professional Growth

Standards 1-5 of the *Standards for Technology Education Program Review* document specifically focus on the subject matter of technology.[17] Standards 6-10 identify the knowledge necessary for effective teaching of technology in technology teacher education programmes.[18]

Furthermore, in order to provide technology teacher education candidates with comprehensive learning opportunities, there are knowledge, performance and disposition indicators included with each standard:

- *Knowledge Indicators* that focus on cognitive information such as concepts, theories, ideas, formulae, definitions, identifications and analyses about the standard.

[17] For more detailed descriptions of Standards 1-5, please refer to the *Standards for Technological Literacy: Content for the Study of Technology* (ITEA, 2000a).

[18] For more detailed descriptions of Standards 6-10, please refer to the *Professional Development Standards* (ITEA, 2002b).

- *Performance Indicators* that focus on physical outcomes, applications of learning, and the ability to use content concerning the standard.
- *Disposition Indicators* that concentrate on attitudes, values, ethics, beliefs, and affective behaviours about the standard.

5.7. Competences and Standards for Technology Teachers in Hong Kong

Recently, recognising that frontline teachers are the key players in implementing the education reforms, the HKSAR Government has implemented a series of measures to enhance the quality and professionalism of the teaching force, through providing training and support as well as formulating appropriate professional standards for teachers. These measures included:

- A draft Teacher Competencies Framework (TCF) was endorsed by the Advisory Committee on Teacher Education and Qualifications (ACTEQ) in March 2003 to promote teachers' professional development. The ACTEQ stresses that the competencies elaborated in the framework are not standards, but rather as indicators from which teachers and schools can determine their strengths and weaknesses, and subsequently develop appropriate and relevant staff professional development programmes to satisfy their own particular needs.
- A Task Force was also set up under ACTEQ to review initial teacher education. The Task Force has completed a preliminary review on the content and processes of initial teacher education. The ACTEQ and major teacher education providers have also started work on developing a

relevant framework which adopts an integrated approach rather than separate or discrete competencies.

The ACTEQ's (2003) generic teacher competencies framework (TCF) includes four domains which cover the major responsibilities typical of a classroom teacher. The framework also outlines different stages of a teacher's professional development in each of these domains. Each of the four domains has four dimensions, each of which highlights an important aspect of teachers' work. The four core domains and dimensions are:

- *Teaching & Learning Domain*: Subject Matter Knowledge, Curriculum and Pedagogical Content Knowledge, Teaching Strategies and Skills, Use of Language and Multi-media, and Assessment and Evaluation;
- *Student Development Domain*: Students' Diverse Needs in School, Rapport with Students, Pastoral Care for Students, and Students' Different Learning Experiences;
- *School Development Domain*: School's Vision and Mission, Culture and Ethos, Policies, Procedures and Practices, Home School Collaboration, and Responsiveness to Societal Values and Changes; and
- *Professional Relationships and Service*: Collaborative Relationships within the School, Teachers' Professional Development, Involvement in Policies Related to Education, Education-related Community, and Services and Voluntary Work. (ACTEQ, 2003, p. 24)

According to the ACTEQ, the TCF does not constitute a set of mandatory requirements on teachers and schools but serves as a reference tool for practising teachers to review the direction of their professional development. Competency descriptors of selected domains and dimensions which are considered most relevant to the present study are presented in Tables 5.3 to 5.5 below.

Table 5.3

Competency Descriptors in the Teaching and Leaning Domain

Dimension	Competency Descriptors at the Threshold Level
Subject Matter Knowledge	• Displays a basic command of content knowledge of the subjects assigned to teach, but may not be aware of gaps and misconceptions n the basic subject content. • Has sporadic and infrequent updating of subject knowledge.
Curriculum and Pedagogical Content Knowledge	• Displays basic knowledge of the current curriculum objectives, pedagogy and subject content; able to impart basic, core subject matter to students, but may not be able to anticipate student misconceptions. • Makes sporadic attempts to strengthen or update own knowledge base for teaching and to share pedagogical content knowledge with colleagues.
Teaching Strategies and Skills, Use of Language and Multi-media	• Employs a limited range of teaching strategies and skills in delivering lessons to students, adhering mainly to the original lesson plan. • Displays an acceptable command of language(s); aware of the importance of appropriate use of language as a medium of instruction. • Makes sporadic attempts to update him- / herself with current research in teaching and learning with a view to improving own teaching methods.
Assessment and Evaluation	• Able to follow the statutory assessment and reporting requirements and knows how to prepare and present informative reports to students; recognises the level at which a pupil is achieving and assesses pupils against attainment targets, where applicable with guidance from an experienced teacher.

(ACTEQ, 2003, pp. 25-29)

Table 5.4

Competency Descriptors in the Student Development Domain

Dimension	Competency Descriptors at the Threshold Level
Students' Diverse Needs in School	• Has basic understanding of students' characteristics at different developmental stages, students' different learning styles and intelligences, family backgrounds and interests. • Shows awareness of the impact of students' diverse backgrounds on their learning processes.

(ACTEQ, 2003, p. 30)

Table 5.5

Competency Descriptors in the Professional Relationships and Service Domain

Dimension	Competency Descriptors at the Threshold Level
Teachers' Professional Development	• Prepared to share knowledge and good practices with colleagues when invited to do so. • Participates in school-based staff development activities / other professional development activities when assigned to.
Involvement in Policies Related to Education	• Has a basic grasp of current education policies and pays attention to the possible implications of these new initiatives on own teaching work. • Has a basic grasp of current education policies and pays attention to the possible implications of these new initiatives on own teaching work.

(ACTEQ, 2003, pp. 39-40)

The ACTEQ (2003) also proposes that in order to meet the complex demands of education reforms, "all teachers, irrespective of their rank and capacity, should engage in CPD (Continuing Professional Development) activities of not less than 150 hours in a three-year cycle" (p.13). Major modes of teachers' CPD activities as identified and recommended by the ACTEQ include:

- *Local and overseas conferences, symposia, workshops, and courses*: E.g., workshops on current education reform, and courses on mentoring organised by the EMB or tertiary institutions;
- *Offshore (non-local) study visits:* E.g., structured study visits to the mainland, and overseas study tour organised by the school;
- *Higher academic study*: E.g., attending Master or Bachelor degree programmes offered by accredited local or overseas tertiary institutions; and
- *Job enrichment activities*: E.g., sharing of good practices, and visits to other schools or institutions for professional exchange. (pp. 42 - 43)

The above discussions on teacher knowledge and teacher competences form the bases for the development of "minimum competences" for technological subject teachers entering the profession. In the context of the present study, "minimum competences" refer to the subject knowledge, skills and understanding that a school or future employer would rightly expect in a beginning or newly qualified technological subject teacher.

Other than the aspects discussed above, three other areas which are unique to the present Hong Kong context are reviewed and presented below. These areas include: Teachers' language proficiency, IT competency, and health and safety requirements.

Language Proficiency of Technological Subject Teachers

The language proficiency of teachers has been one of the major concerns of the educational community in Hong Kong. In October 1993, the Education Commission set up a Working Group to study problems pertaining to teachers' language proficiency. The Education Commission, in its Report No. 6 entitled *Enhancing Language Proficiency: A Comprehensive Strategy* (EC, 1996), criticised the language proficiency of teachers. The EC recommends that:

- Minimum language proficiency standards should be specified, which all teachers (not just teachers of language subjects) should meet before they obtain their initial professional qualification. The standards should be designed to ensure that new teachers are competent to teach through the chosen medium of instruction. (para. C2)
- Teacher education institutions to give more attention to language awareness

and language skills issues ... in initial training programmes for all teachers. (para. C3)

In late 1997, the Education Department (1997b) issued the *Guidance on Medium of Instruction to Secondary Schools*. The *Guidance* required most of the schools to switch their medium of instruction (MOI) from English to Chinese, the mother tongue. Minimum proficiency standards are being established for both English and Chinese subject teachers, and they are required to pass benchmark tests. As for religious studies, cultural, commercial and technical subjects, however, individual schools (or perhaps subject teachers) may choose the MOI which they think best meeting their circumstances.

Just recently, on February 3, 2005, the Working Group on Review of Medium of Instruction for Secondary Schools of the Education Commission (EC) launched a three-month public consultation to seek views for mapping out the future of this important education issue (EC, 2005). The Working Group considers that "to be able to communicate subject contents effectively, teachers must possess, in addition to subject and pedagogical knowledge, sufficient proficiency in language" (EC, 2005, para. 3.12). It is proposed that in order to be eligible to teach in English Medium Instruction (EMI) schools, subject teachers should have obtained a Grade C or above in English Language (Syllabus B) in the HKCEE or equivalent (e.g., a Grade D or above in Use of English in HKALE) (EC, 2005, para. 3.12). In view of the importance of teachers' language proficiency on teaching and student learning, the present study also investigates school administrators' and teachers' views on language proficiency for newly qualified teachers of technological subjects in Hong Kong.

Information Technology Competency of Technological Subject Teachers

The HKSAR Government launched its Information Technology (IT) in Education Policy in 1998 and introduced IT competency levels to enhance the use of IT in learning and teaching in all schools (EMB, 1998). According to this policy, Hong Kong teachers are required to reach different levels of IT Competency in Education during the period 1998/99 to 2002/03; and to adopt IT-supported instruction as one of the essential instructional strategies in future.

At the "Basic Level", a teacher should be able use IT as productivity tools and integrate IT selectively and critically in learning and teaching environments. At the "Intermediate Level", a teacher should be able to utilise a wider range of IT tools in education and integrate the use of these into the educational experiences of their own students. At the "Upper Intermediate Level", a teacher should be able to explore the range of possibilities for use of IT across the curriculum and place IT in a meaningful educational context (Au *et al.*, 1999).

Consequently, teacher education institutions in Hong Kong are required to integrate in their pre-service programmes IT competency elements such as producing courseware, applying the skills of computer-assisted instruction, and using electronic networks for peer support and collaborative learning (Au *et al.*, 1999). The attainment of the IT Competency in Education Levels is now a graduation requirement for all pre-service and in-service students in the Hong Kong Institute of Education (HKIEd). All subject majors and teaching methods areas will require students to use IT effectively and critically in teaching their own subjects. The students must attain the Upper Intermediate Level as a requirement for graduation and entry into the teaching profession (HKIEd, 2003).

In the context of design and technology (D&T), Information Technology (known as Information and Communication Technology, ICT, in the UK) refers to the use of computers and peripheral equipment to aid learning, designing, modelling and the presentation of ideas; control devices; manufacture products or components of quality; and communication (DATA, 2004d; NAAIDT, 1995). In the UK, the latest National Curriculum document for design and technology highlights the compulsory nature of Computer-Aided Design and Manufacture (CAD/CAM) in secondary schools as an integral part of designing and making (QCA, 1999). Similarly, design and technology teacher trainees are required to be competent in using modern information communication technologies specific to their subject such as Computer-Aided Design (CAD) software and computer-controlled equipment in design and technology (DATA, 2004d).

Technological subject teachers in Hong Kong, like their counterparts in the UK, are expected to be competent to use IT to enhance teaching and learning and to make special contributions to students' IT capability. The Quality Assurance Division (QAD) of the Education and Manpower Bureau (EMB) states that as a matter of priority, "technology-related subject teachers in Hong Kong are required to apply, where appropriate, IT in design, communication and production to enrich students' learning experience, and to enhance the learning and teaching of technology-related subjects" (QAD, 2002, p. 108).

Health and Safety Requirements

Health and safety is another major recurring concern for the teaching of technology-related subjects in Hong Kong. The Quality Assurance Division (QAD) of the Education and Manpower Bureau (EMB), in its school inspection annual reports repeatedly commented on the health and safety issues observed in schools. Some of the comments were focused on workshop safety and environment, for example, "some schools needed to take remedial action to store tools and materials properly and to clear the workshop of unnecessary items" (QAD, 2000, para. 3.31); and other comments were on student misbehaviours, for example, "some of the students were not conscious enough of safety issues during workshop practices and did not observe safety regulations" (QAD, 2002, p. 107).

In the UK, other than setting minimum competence standards for the NQTs of design and technology, the importance of subject-specific health and safety training is also addressed. The *DfEE Circular 4/98* (cited in DATA, 1998, p. 8) set out the standard that teachers should be "familiar with subject-specific health and safety requirements, where relevant, and plan their lessons to avoid potential hazards." Subsequently, the Design and Technology Association (DATA, 1998), in its publication entitled *Exemplication of Standards for Health and Safety Training in Design and Technology* exemplifies the standards set out in the *DfEE Circular 4/98.* As DATA (1998) suggested:

> All teachers on gaining QTS in secondary design and technology, or having design and technology training in primary education, must be able to carry out their teaching commitments in a safe manner. (p. 5)

And that:

> All teachers have a need to update themselves on health and safety requirements and guidance. Those with certificates will need to renew their certificates every 5 years. (p. 5)

DATA (2004b) further elaborates that design and technology teachers and trainees should demonstrate both personal and professional competences in health and safety. They should be capable of undertaking risk assessment and ensuring that the environment is not a health and safety hazard. They should also demonstrate that they can adopt appropriate teaching strategies to ensure safety within design and technology activities and have secure knowledge and understanding of equipment, processes, tools, materials and components before using them.

Documents Relating to Standards and Competences for Technology Teachers

The Advisory Committee on Teacher Education and Qualification's (ACTEQ) generic Teacher Competences Framework (TEF) offers a sound platform upon which to build a framework for teacher development. Other than local sources of references, the following documents relating to standards and competences for technology teachers in other countries were being reviewed and referred to when compiling the research instruments for the present study:

- *Minimum Competences for Students to Teach Design and Technology in Secondary Schools*, England and Wales, UK (DATA, 1995).
- *Guidance for Primary Phase Initial Teacher Training and Continuing Professional Development in Design & Technology: Competences for Newly Qualified and Practising Teachers*, England and Wales, UK (DATA, 1996).

- *Exempliication of Standards for Health and Safety Training in Design and Technology*, England and Wales, UK (DATA, 1998).
- *Minimum Competences for Trainees to Teach Design and Technology in Secondary Schools* (Revised), England and Wales, UK (DATA, 2003).
- *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards*, USA (ITEA, 2000b).
- *ITEA/CTTE/NCATE Curriculum Standards: Initial Programs in Technology Teacher Education*, USA (ITEA, 2003).

5.8. Mode of Technology Teacher Education Programmes

With Hong Kong moving towards a graduate teaching profession, an issue facing policy-makers is whether technology teacher education should continue to take place in a mono-purpose institution like the HKIEd or whether it should be done at the faculty or school of education within a comprehensive university. A related issue is whether technology teacher education should be conducted through an integrated teacher education programme (also known as "concurrent" mode, e.g., BEd) or a general first degree followed by a postgraduate teacher education programme (i.e., "end-on" mode, e.g., Postgraduate Diploma in Education [PGDE]).

The later issue touches upon the relative advantages of the two modes of teacher education and about how a technology teacher is best prepared. A "first degree + PGDE" structure claims to provide a solid foundation in subject matter, and more importantly it gives students a chance to make the decision of becoming a teacher when they are more mature. In contrast, other may argue that an integrated teacher programme does not preclude a solid foundation in subject matter being laid for its students. A four-year BEd degree programme may actually help teacher-trainees to blend their subject matter knowledge better with the educational theories that they concurrently learn (Leung, 2003). The present study also considered the views of school administrators and teachers on the appropriateness of the BEd and PGDE modes of teacher education for training future technological subject teachers in Hong Kong.

5.9. Summary

This chapter provided a brief account on the history and development of technology teacher education in Hong Kong, the UK, and the USA. This was followed by discussions on teacher knowledge, teacher competences and competencies in general, and for technology education in particular. A model on domains of teacher knowledge for technology education was also presented. In the latter part of the chapter, the necessity and means for developing competences and standards for technology teachers in Hong Kong were explored.

CHAPTER 6

A SURVEY ON SCHOOL PRINCIPALS' AND TECHNOLOGY TEACHERS' PERCEPTIONS TOWARDS TECHNOLOGY EDUCATION [19]

6.1. Introduction

Discussions in previous chapters on the development of technology education in the Hong Kong context and the review of relevant literature on curriculum change, and teacher knowledge and competences set the stage for the present research study. The study aimed to investigate what and how technology education could contribute to the personal needs of Hong Kong students and that of Hong Kong's society in the new millennium. The study also aimed to study recent technology education curriculum reforms in Hong Kong and their implications for technology teacher education.

As outlined in Chapter 1 of this thesis, the research questions are:

(1) What direction and goals should technology education pursue in Hong Kong secondary schools in order to cater for students' personal needs and that of Hong Kong's economy in a knowledge-based society?

(2) What are the perceived major factors that would facilitate or impede the implementation of technology education reforms in Hong Kong secondary schools?

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[19] This survey, entitled "An Assessment of School Principals' and Technology Teachers' Perceptions and Expectations on Technology Education for Hong Kong: Implications for Recent Curriculum Reforms and Technology Teacher Education", was funded by the Internal Research Grant of the Hong Kong Institute of Education (RG12/2000-2001).

(3) What are the desirable competences for newly qualified teachers of technological subjects which are conducive to recent technology education curriculum reforms?

(4) What are the implications of these changes for technology teacher education programmes?

There are at present few research studies directly related to stakeholders' attitudes and perceptions towards technology education, in particular during the transition from a craft-oriented technical curriculum to broad-based technology education, and the development and implementation of technology education as a key learning area in the school curriculum. A good example of this type of studies is that reported by Hill, Wicklein and Daugherty (1996). Hill and his associates conducted research in the USA to study technology teachers, school principals, and guidance counsellors' agreement about selected characteristics of various aspects of technology education. They asserted that this kind of research study is necessary, as some efforts to integrate technology education into the school curriculum had met with resistance or failed because administrators, teachers, or guidance counsellors did not adequately understand the purpose and new role of technology education. They argued that this problem is critical to the field, whether or not leaders within the teaching profession hold a common vision and understanding. The results of their study revealed that, among other things, there was considerable agreement among technology teachers, principals, and guidance counsellors that technology education should be available for all students, a perception long desired by technology educators as they sought to correct the stereotyped image of industrial arts as a dumping ground and worked to become a programme that attracts the mainstream population of the school.

The present survey aimed at investigating Hong Kong school administrators' and technological subject teachers' attitudes and perceptions towards technology education. In Hong Kong, despite a growing emphasis on technology education in schools, minimal research exists with respect to the attitudes of practitioners in the field and other key stakeholders about technology education curricular change. A significant gap is evident between the goals of technology education perceived by curriculum developers and those perceived by practitioners in the field. It was considered that such a status study would be required to understand what people think and to determine the degree of acceptance of technology education by various key stakeholders. In this regard, the research study was timely and significant in that it served to bridge this gap.

6.2. Methodology

The procedures used in conducting this survey study were divided into four main parts in this chapter:

(1) Instrumentation

(2) Identification of the population and sampling

(3) Data collection procedures

(4) Data analysis

Both quantitative and qualitative methods were used for the study. These included:

(1) Questionnaire survey on secondary school administrators and technological subject teachers; and

(2) Semi-structured interviews for selected individuals from the above stakeholder groups.

This is in accord with Cronbach (cited in Hoepfl, 1997, p. 48) who claims that statistical research alone is not able to take full account of the many interaction effects that take place in social settings because it ignores effects that may be important, but that are not statistically significant. For Cronbach, qualitative inquiry accepts the complex and dynamic quality of the social world.

The sample size of secondary school administrators and technological subject teachers involved in this study was based on the number and type of secondary schools in Hong Kong. According to statistics figures provided by the Education Department (2000b), in 1999/2000, there were 480 secondary schools in Hong Kong (excluding English Schools Foundation [ESF] Schools and International Schools), within which 433 were Grammar Schools, 20 were Secondary Technical Schools, and 27 were Prevocational Schools. From this population, a stratified random sample would be selected for each group. It was estimated that the number of subjects to be involved in the questionnaire survey would be around 600, and the number of individuals to be interviewed around 20.

The advantages of administering a mail-out questionnaire survey as compared with an interview are that questionnaire survey is less expensive in terms of money and time, reduced interviewer-induced bias, and enhance respondent privacy (anonymity) (Bryman & Cramer, 2005; Rea & Parker, 1997). The use of a questionnaire also eliminates any bias introduced by the feelings of the respondents towards the interviewer. Besides, the actual data gathering is performed in a relatively short period of time obtaining a "snapshot" of the population. The primary disadvantages of the questionnaire are non-returns, misinterpretation, and validity problems (Oppenheim, 1992). These issues will be addressed and discussed later in this chapter.

6.3. Instrumentation

In a forum conducted at the closing of the Design & Technology Summer Camp held at the Hong Kong Institute of Education in July 2001, where current issues and problems associated with technology education in Hong Kong were debated and discussed openly and constructively, the present researcher collected preliminary information useful for developing questionnaires items for this study. This is in accord with Rea and Parker (1997), who noted that group discussion that contributes significantly to an understanding of the key substantive issues is a useful way of securing information for informing the development of the survey questionnaire prior to its implementation. Further, official documents, reports, articles, and research studies were reviewed that provided relevant questionnaire items. New items which served the unique purposes of the study were also developed.

In order to address the research questions and to obtain the desired information needed to accomplish the purpose of this study, two sets of survey questionnaire were developed for School Administrators[20] and Technological Subject Teachers.[21] Both sets of questionnaire were in Chinese and had seven sections. Section A differed on questionnaires sent to administrators and teachers, whilst the others sections were identical. (Appendices I and II)

Section A. Demographic Data

Section B. Perceptions on Technology Education (26 items)

Section C. Curriculum Content of Technology Education Programme (21 items)

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[20] In this survey, Administrator refers to School Principal and Vice Principal.

[21] In this survey, Technological Subject Teacher refers to Subject Teacher and Panel Chairperson.

Section D. Facilitating Factors for Implementing Technology Education in Hong Kong Secondary Schools (21 items)

Section E. Impeding Factors for Implementing Technology Education in Hong Kong Secondary Schools (26 items)

Section F. Desirable Competences for Newly Qualified Teachers of Technological Subjects:

- General Pedagogical Knowledge Competences (9 items)
- Subject Matter Knowledge Competences (16 items)
- Pedagogical Content Knowledge Competences (22 items)
- Continuing Professional Development Competences (9 items)

Section G. Teacher Education Programme for Technological Subject Teachers (10 items)

In general, a Likert-type scale was used for most items in the questionnaire. It allowed the respondent to choose one of several (usually five) degrees or intensity of feeling about a statement from strong approval to strong disapproval. The items were randomly arranged to prevent the respondent from getting into a pattern of answering or response set.

Subsequently, the research questions were further broken down into a number of guiding questions as the following:

(1) What are the self perceptions of technological subject teachers in Hong Kong on their preparedness towards recent Technology Education reforms? (Item A10 in Section A of the questionnaire for teachers)

(2) What are the perceived attitudes of secondary school administrators and technological subject teachers towards Technology Education? (Section B of the questionnaire)

(3) What are the perceived attitudes of secondary school administrators and technological subject teachers towards Technology Education Curriculum Content? (Section C of the questionnaire)

(4) What are the facilitating factors for implementing technology education in Hong Kong secondary schools as perceived by secondary school administrators and technological subject teachers? (Section D of the questionnaire)

(5) What are the impeding factors for implementing technology education in Hong Kong secondary schools as perceived by secondary school administrators and technological subject teachers? (Section E of the questionnaire)

(6) What are the desirable competences for beginning technology teachers as perceived by secondary school administrators and technological subject teachers? (Section F of the questionnaire)

(7) What are the perceptions of secondary school administrators and technological subject teachers towards technology teacher education programme in Hong Kong? (Section G of the questionnaire)

Further, the study sought to examine whether there were significant differences between the administrators' and teachers' responses regarding selected items or areas in the questionnaire, where appropriate.

A careful review of the literature resulted in a list of characteristics of Technology Education (Section B) and facilitating factors and impeding factors for implementing Technology Education in Hong Kong secondary schools (Sections D and E) to be included in the survey instrument. Questionnaire items relating to technology curriculum content (Section C) were derived from the list of "Content Elements" stated in the Curriculum Development Council's (2000b) *Learning to Learn: Key Learning Area - Technology Education Consultation Document.* Items relating to competences for newly qualified teachers of technological subjects (Section F) were mainly derived from DATA's (1995) categories of teacher competences for design and technology teachers. For example, "Newly qualified technological subject teachers should be able to select and use a range of technological materials and processes properly and safely for making artefacts" (Item F34).

6.4. Pilot Study

The first draft of the instruments was written in English and later translated into Chinese. Given that Chinese is the mother tongue of all the respondents, it was considered that using Chinese could avoid bias because of comprehension difficulties. In an effort to determine the appropriate language and wording of the survey questionnaires, the first draft of the questionnaires was administrated to two groups of 20 participants attending the Advanced Certificate of Teacher Education (ACTE) programme and the Mixed-mode Bachelor of Education (Secondary) (MMBEd) programme in the HKIEd in December 2001. The participants in these programmes were in-service teachers with teaching experience ranging from one to 15 years.

Some of them were subject panel chairpersons. They were being selected to participate in the pilot study because they possessed characteristics similar to the targeted population of the research study. The participants completed the questionnaire and provided written feedback regarding the clarity and validity of the instruments. Based on these evaluations, some minor changes were made to the wordings of the instrument items.

In brief, the main purposes of pilot testing on the survey questionnaire were to evaluate:

- The sensitivity of each item to discrimination;
- Validity of each item;
- Freedom from redundancy;
- Absence of response set;
- Length and convenience of administration; and
- Acceptability to the respondent.

6.5. Validity

A panel of local experts in Technology Education was consulted during the formulation of the survey questionnaires. The revised questionnaires were being reviewed for readability and face validity[22] by the panel. The panel comprised two secondary school principals, a design & technology subject teacher, two officials in the Technology Education Section of the Curriculum Development Institute (CDI)

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22 Here, face validity simply means the validity at face value. It is used to determine if a measure appears (on the face of it) to measure what it is supposed to measure. In this study, the experts were asked to make judgements which were based on logical or conceptual grounds.

and the Hong Kong Examinations and Assessment Authority (HKEAA), a technology education professional, and a technology teacher educator. (See Table 6.1 below) All panel members were actively involved in and knowledgeable about recent technology education reforms. They represented both technical expertise and substantive knowledge of recent reforms, and cultural environment associated with the study. Based on their comments and suggestions, the survey instruments were refined into their final form.

One of the panel members did not want his name disclosed in whatever way. An inhibiting factor would be due to the reserved personality of most Chinese people when they are being interviewed. Some would feel that there could be a risk that their "voices" on certain sensitive issues or topics might embarrass other persons. To maintain privacy and confidentiality, the identities of all panel members were protected through the use of pseudonyms.

Table 6.1

The Panel of Experts in Technology Education for this Study

	Background					
Panel Members	Principal	Teacher	Teacher Educator (FT, PT)	Academic in Tertiary Institution	Official in CDI and HKEAA	Council Member of Prof. Association
A	✓		✓			
B	✓		✓			✓
C		✓				✓
D			✓		✓	
E			✓		✓	
F			✓	✓		✓
G			✓			✓

6.6. Population and Sample

The data base for secondary schools in Hong Kong was established using two sources. The first was the (then) Education Department's list on the Internet from which to copy addresses. The second was a search in the Hong Kong Education City Website[23] for verifying technology-related subject offered in the targeted schools and the name of the school principals. Two hundred and ninety (290) secondary schools were being identified and were categorised into three groups according to their curriculum type, namely Secondary Technical (16), Prevocational (27), and Grammar Schools (247). Given that the total number of schools involved was relatively small and manageable; a census sampling was being taken for the entire population.

6.7. Data Collection Procedures

Questionnaire Survey

In April 2002, the survey questionnaire and a cover letter were mailed to targeted schools for distribution to administrators and individual technological subject teachers for completion. A summary of the research findings was promised, as well as institutional and personal anonymity. Each targeted Secondary Technical and Prevocational School would receive one copy of the "Administrator Questionnaire" and 12 copies of the "Teacher Questionnaire" with the request that the questionnaires were to be completed by technological subject teachers or panel chairpersons. Only

23 http://www.hkedcity.net/school/secondary.

one copy of the "Administrator Questionnaire" and 6 copies of the "Teacher Questionnaire" were sent to Grammar Schools involved because in general these schools had less technological subject teachers. Schools could call back for extra copies if required. The return envelopes were coded in some unobtrusive ways so that which school had returned and which had not yet responded could be identified. In order to minimise the number of non-returns and to increase the return rate, follow-up letters were sent to individual schools after two weeks to remind them to fill out and return the questionnaires. The content of this letter was similar to that of the previous cover letter. If necessary, fresh copies of the survey would be provided.

Quantitative Data Analysis

All quantitative data generated by the instrument were entered in a data base and analysed by the SPSS (Statistical Package for the Social Sciences) for Windows Release 11. The statistical procedures applied included the following:

(1) Descriptive statistics, namely frequencies, means and standard deviations. Even though the Likert-type questionnaire provided ordinal data, it was considered that the large sampling allowed for this type of analysis (Siegel & Castellan, 1988).

(2) Reliability coefficients for items in all sections, except those in Section A on the respondents' demographic data.

(3) Spearman's *Rho* tests for correlations were used where appropriate to determine the relationships between two or more variables in ranked order.

(4) *t*-tests to compare the mean scores of the Administrator and Teacher respondent groups.

(5) Analysis of Variance (ANOVA) to identify whether there were any significant differences between three or more sample means.

Follow-up Interviews

In addition to the main mailed questionnaire survey, a number of follow-up interviews were carried out for selected school principals and teachers who had returned the proforma showing their interest to be interviewed. This part of the study relied on qualitative methods in an effort to capture the respondents' perceptions of technology education and technology teacher education in Hong Kong. School principals were also interviewed because they are usually key decision-makers in the hiring of new teachers and they have the first opportunity to observe and evaluate new technological subject teachers' ability to transfer the skills and knowledge acquired through institutional training programmes. The principal also tends to be a clearinghouse for feedback from students, parents, other teachers and education professionals regarding a beginning teacher's overall performance.

It was considered that such follow-up interviews would provide opportunity for data triangulation of various kinds, giving the researcher confidence in data interpretation and explanations. For example, confirmations of the same event by different people, or testing out preliminary findings against other groups of teachers to see if the findings were in any way typical or representative of what was going on in their schools.

A "schedule" (interview guide) was developed which contained a list of questions to be explored during the interviews that used similar topics as those for the questionnaires. The schedule ensured good use of limited interview time; it makes interviewing multiple subjects more systematic and comprehensive; and it helps to keep interactions focused (Hoepfl, 1997). The schedule was modified from time to time to focus attention on areas of particular importance, and to exclude questions the present researcher had found to be unproductive for the goals of the research.

The schedule was designed with a common set of semi-structured interview questions that could be used for both the administrators and teachers. A sample is presented in Appendix III which covered the following main areas:

- School background;
- Knowledge about recent education and curricula reforms;
- Personal views on grouping the four existing subject areas (i.e., Business Studies, Computer Education, Home Economics, and Technological Subjects) under the Technology Education Key Learning Area within the new School Curriculum Framework;
- Future direction of technology education for Hong Kong in the 21st Century;
- Facilitating and impeding factors for implementing technology education in Hong Kong secondary schools;
- Knowledge, skills and competences required for technological subject teachers to meet the challenges of recent education and curriculum reforms.
- Mode of initial teacher education programme for technological subject teachers.

Sampling Design for the Interviews

The sampling design for the interviews was based on "expected reasonable coverage of the phenomenon given the purpose of the study and stakeholder interests... as fieldwork unfolds ... one may change the sample size if information emerges that indicates the value of a change" (Patton, 2002, p. 246). As regards the number of individuals to be interviewed, Patton (2002) remarks that "there are no rules for sample size in qualitative inquiry. Sample size depends on what [the researcher wants] to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can be done with available time and resources" (p.244). He also asserts that "the validity, meaningfulness, and insights generated from qualitative inquiry have more to do with the information richness of the cases selected and the observational/analytical capabilities of the researcher than with sample size" (p.245).

Lincoln and Guba (1985, p. 201) recommend sample selection to the "point of redundancy". According to Lincoln & Guba, the size of the sample could not be predetermined for this type of interview: "In purposive sampling the size of the sample is determined by informational considerations. If the purpose is to maximise information, the sampling is terminated when no new information is forthcoming from new sampled units." In brief, the aim of purposive sampling is not to generalise. Rather, it is to provide as much range and variation of data as possible.

The views given by Lincoln & Guba (1985) and Patton (2002) about the flexible and emergent nature of qualitative inquiry were well taken when selecting interviewees and considering the number of interviews to be conducted for this study. At first, three school principals, three panel chairpersons and six teachers were selected for interview according to the purposive sampling procedures suggested by Lincoln & Guba (1985, p. 201). The interviewees were selected according to their background to provide the maximum variation among their views. Other than those in the first batch, two more teachers were interviewed. Sampling stopped at the "point of redundancy" when the data obtained from previous respondents was replicated and repeated by additional interviewees. In this study, 14 school principals, subject panel chairpersons and teachers were interviewed.

Gaining Access

Once the potential respondents had been identified, the next question was to gain access to them. Lofland and Lofland (cited in Hoepfl, 1997) believe that researchers are more likely to gain successful access to situations if they make use of contacts that can help remove barriers to entrance; if they avoid wasting respondents' time; and if they treat respondents with courtesy. It is also important to provide respondents with a straightforward description of the goals of the research. All these points were well taken when designing the interviewing procedures. Further, in order to increase the chance of gaining access, the researcher promised to offer the interviewees a copy of the research report as part of a research "bargain" (Blaxter *et al.*, 1996).

Interviewing Procedures

The purposive sampling strategy was adopted for selecting interviewees for the study as the main objective was to seek information-rich cases which could be studied in depth (Patton, 2002). At the outset of each interview, the following issues were addressed and consent was obtained from the interviewee:

(1) The purpose of the inquiry;

(2) The protection of respondents through the use of pseudonyms; and

(3) Deciding who has the final say over the study's content.

All interviews were conducted in Cantonese (a Chinese dialect) to allow the interviewees to express themselves freely in their mother tongue. Probes were used to encourage the interviewees to describe their perceptions and experiences in detail and to seek clarification constantly of their words. Each interview lasted for about 45 minutes to an hour. In order to minimise the impact on interviewees' working in schools and make possible a professional dialogue about curriculum change and implementation, they were either interviewed at times that were most convenient to them, and in a room at their own school or workplace, or at the Tai Po Campus of the HKIEd if they so wished.

An analysis took place after the first interview; this analysis was then used to inform the second interview and so on. The initial batch of recorded interviews was transcribed in full to allow easy searching of their contents within a range of categories. The researcher then made notes of any emergent themes or patterns in the data. The purpose of making such notes was to begin identifying regularities in the form of patterns in the responses (Miles & Huberman, 1994).

Subsequent recoded interviews were not transcribed in full. In view of the great amount of time involved in transcribing, for later interviews only notes were made, rather than full transcripts. The researcher would go back to the mini-disk recordings for particular quotations whenever necessary. Throughout the fieldwork the present researcher tried to be sensitive to the routine of schools and the school year. Busy examinations periods and holidays were not used for conducting questionnaire surveys and interviews.

6.8. Ethical Issues

Regarding ethical considerations in this study, the survey questionnaire returns were anonymous. Furthermore, all interviews were recorded on mini-disks with the consent of the interviewees, and the anonymity of the interviewees was guaranteed. Interview transcripts were sent back to the interviewees before finalisation. All the completed questionnaires, recordings on mini-disks and transcripts were kept "strictly confidential" in a secure place and accessible only to the researcher. To avoid identifying the participants in the questionnaire survey and the interviews, sequential identification numbers were used. All the completed questionnaires will be destroyed and the mini-disk recordings erased at the end of the study.

6.9. Limitations of the Study

Several limitations of this survey study must be taken into considerations when interpreting the results. The sample of administrators and teachers analysed here consisted of only those who were willing to participate in the study. Administrators and teachers who did not complete and return the survey might have views different from those who did complete the survey. Thus when interpreting the findings in this study, it is important to note the unique features of the population of schools, administrators and teachers that have studied. Besides, it must be assumed that the respondents responded honestly to the items and that the instrument adequately and reliably assessed their perceptions towards technology education and technology teacher education.

CHAPTER 7

QUANTATIVE DATA ANALYSIS, FINDINGS AND DISCUSSIONS

7.1. Introduction

This chapter presents and discusses the quantitative data analysis of the survey study. The study investigates the perceptions of secondary school administrators and technological subject teachers in Hong Kong regarding (a) the nature of technology and technology education, (b) the curriculum content elements of technology education programmes, (c) and (d) the major factors that would facilitate or impede the implementation of technology education in schools, (e) desirable competences of newly qualified teachers of technological subjects, and (f) technology teacher education programmes. The respondents surveyed were school administrators, subject teachers and panel chairpersons of technological subjects.

Quantitative data generated by the instrument were entered into a data base and analysed by the SPSS for Windows Release 11 statistical package. To ensure accuracy of data entry, a 5% sample of the original questionnaires were randomly selected and cross-checked item by item with the information in the data base. Entry errors found were rectified immediately. The statistical procedures applied included the following:

(1) Descriptive statistics, including means as measures of central tendency, and standard deviations as an indicator of the extent of agreement among the respondents in the group.

(2) Reliability coefficients for items in all sections, except Section A which was related to the respondents' demographic data.

(3) Spearman's *Rho* tests for correlations were used where appropriate to determine the relationships between two or more variables in ranked order.

(4) *t*-tests to compare the mean scores of the two respondents groups.

(5) Analysis of Variance (ANOVA) to identify whether there were any significant differences between three or more independent group means.

7.2. Questionnaire Return Rate

The survey questionnaire and a cover sheet were mailed to targeted schools for distribution to administrators and individual technological subject teachers for completion in April 2002. Follow-up letters were sent to individual schools after two weeks to remind them to fill out and return the questionnaires. A total of 728 questionnaires were returned. Seven hundred twenty four (724, 99.5%) of the returned questionnaires were usable for data analysis purposes. In terms of school return rate, a total of 170 schools (59%) had returned the questionnaires: Sixteen (16, 100%) from Secondary Technical Schools, 20 (74%) from Prevocational Schools; and 134 (54%) from Grammar Schools (see Table A-1, Appendix IV). Figures 7.1 to 7.3 below show the distributions of the respondents according to their school curriculum type. (See also Table A-2, Appendix IV)

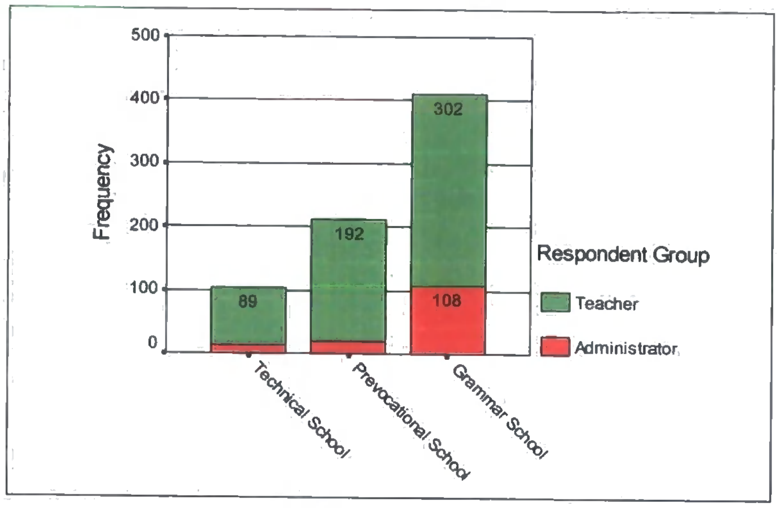


Figure 7.1 Distribution of the respondents by school type (curriculum).

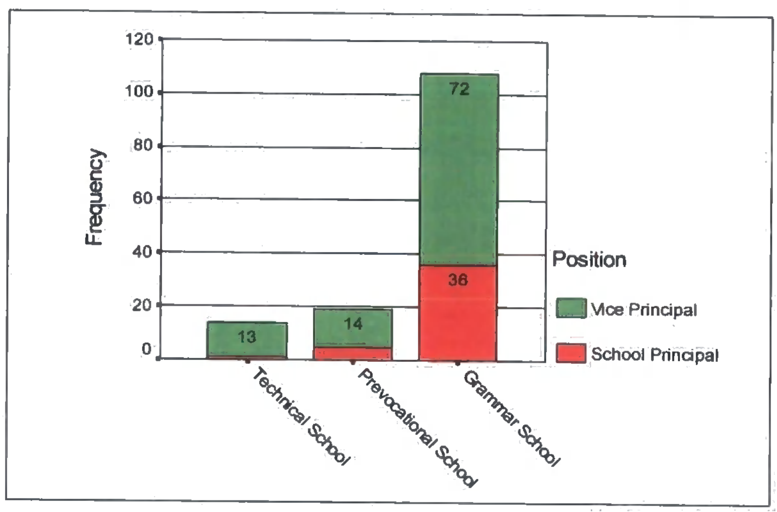


Figure 7.2 Distribution of the administrator respondents by school type (curriculum).

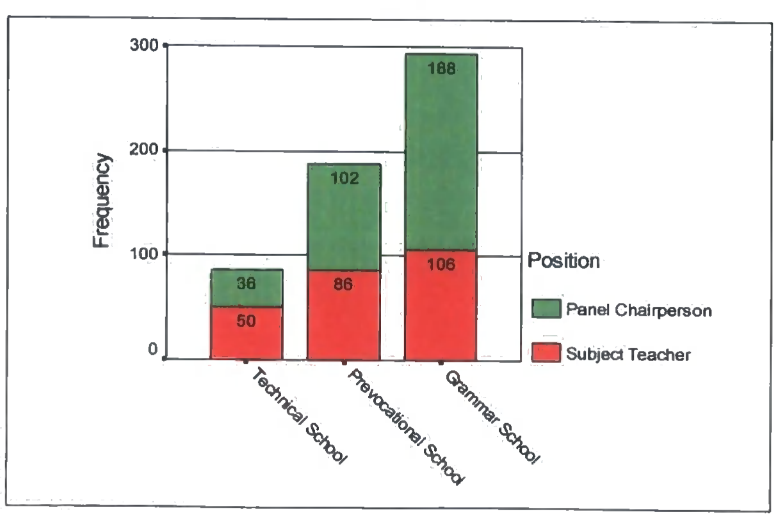


Figure 7.3 Distribution of the teacher respondents by school type (curriculum).

The high level of return rate, in particular from secondary technical and prevocational schools, was perceived as symptomatic of the concerns held by teachers and administrators, and indeed many of them commented on the need for this research in the blank spaces provided on the questionnaire. However, the imbalanced and unexpected high level of responses make it impossible to achieve the random distribution necessary for the purpose of generalisation as planned.

7.3. Reliability

In order to evaluate the reliability of individual sections (scales) in the questionnaire, the internal consistencies of reliability of the scales using coefficient alpha (Cronbach's alpha) were examined (Bryman & Cramer, 2005; George & Mallery, 2003; Shannon & Davenport, 2001). The SPSS software was used to perform the reliability analysis. First, the relationships among individual items and between items, and total scale scores were explored. Relationships among items (inter-item correlations) were used to describe the extent to which the respondents respond to different item on the scales in a similar manner. According to Shannon & Davenport (2001), high and positive inter-item correlations and item-total correlations offer support for internal consistency.

The reliability analysis on Section B is presented in detail below for illustration purpose. Data analysis reveals that all the item-total correlations from Section B (the Perceptions on Technology Education Scale) were all positive, except 3 items (i.e., Items B1, B2, and B24). It is also found that item-total correlations in Section B ranged from a low of -.01 (Item B1) to a high of .64 (Item B21). (See

Table 7.1 below) These results were not unexpected given the diversity of the views embedded in the perception statements. And so, all these statements were retained.

Table 7.1

Reliability Analysis of Scale B (Item-total Statistics)

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Item-total correction	Squared Multiple Correction	Alpha if Item Deleted
B1	90.59	90.45	-.01	.22	.85
B2	91.11	91.81	-.09	.32	.85
B21	88.81	82.27	.64	.54	.83
B24	91.00	94.85	-.26	.32	.86

Remarks: Only selected items were shown in this table.
The overall alpha value for Section B = .84.

The overall alpha value for Section B was .84, which suggested that the scale scores were reasonably reliable for respondents like those in the study. According to George & Mallery (2003), the closer the alpha is to 1.00, the greater the internal consistency of the items in the instrument being assessed (p. 231), and as a rule of thumb, an alpha value above .70 is considered acceptable, and above .80 indicate a high degree of reliability (p.231). The SPSS output for alpha values for individual scales are shown in Table 7.2 below. The alpha reliability for each scale, ranged from .78 to .96, suggested that the instrument was a valid instrument for use in the context of this study.

Table 7.2

Reliability Analysis of Scales (All except Section A)

Scale	Scale Alpha
B. Perceptions on Technology Education	.84
C. Technology Education Curriculum Content	.89
D. Facilitating Factors for Curriculum Change	.96
E. Impeding Factors for Curriculum Change	.96
F. Competences for Newly Qualified Technological Subject Teacher	.96
G. Technology Teacher Education Programme	.78

7.4. Background of Respondents and Participating Schools

In Section A (Items A1-A8) of the questionnaire survey, respondents were requested to supply information about their school and demographic data such as gender, age range, education level, subject taught, and years teaching in the present school.

Demographic Data of the Administrator Respondents

Administrator respondents' position and gender. Figure 7.4 below shows the distribution of the Administrator respondents' Position and Gender. One hundred and forty (140) School Administrators (42 School Principals and 98 Vice Principals) participated in the questionnaire survey. The majority of them (79.4%) were male, less than one-fifth (17.0%) of them were female, and some (3.5%) did not report their gender.

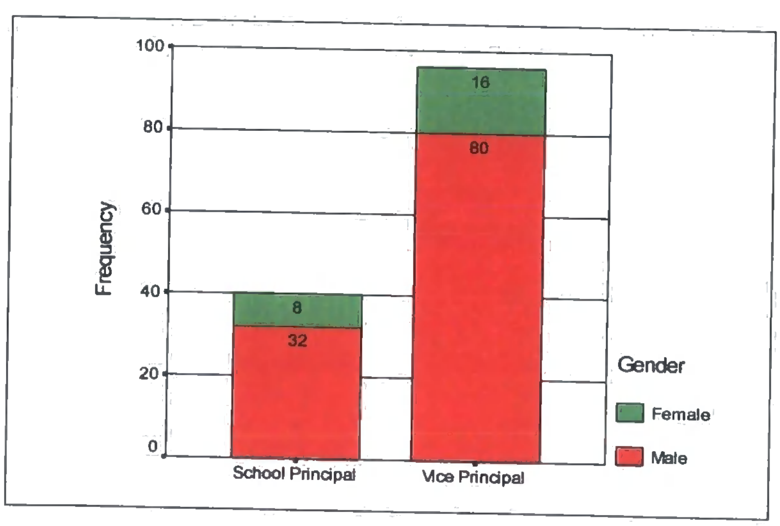


Figure 7.4 Administrator respondents' position and gender.

Administrator respondents' education level. Figures 7.5 and 7.6 below show the Administrators' educational level and number of years in the present position. Table A-3 (Appendix IV) reveals that half (50.0%) of the Administrator respondents held a Master's degree, and almost half (47.1%) of them held a Bachelor degree. Three of them held a Doctoral degree, and one (Vice Principal) simply held a teacher's certificate.

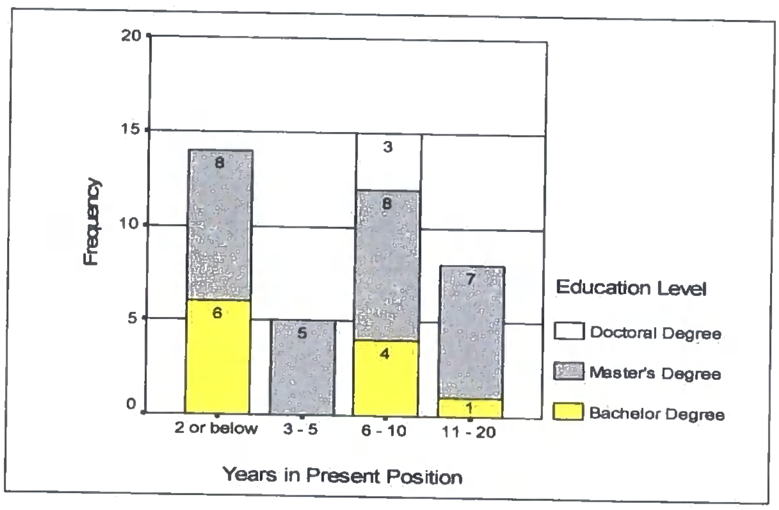


Figure 7.5 School principals' education level and years in present position.

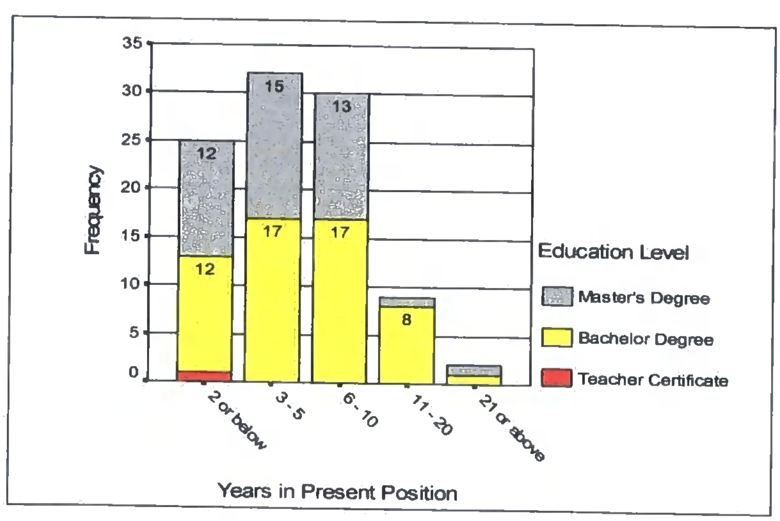


Figure 7.6 Vice principals' educational level and years in present position.

Administrator respondents' year in present job. It is noteworthy that more than half (54.3%) of the Administrator respondents (both School Principals and Vice Principals) were appointed to the present position within the last five years (Figures 7.5 and 7.6). The large turnover of School Principals and Vice Principals within this particular period of time might be partly due to the "brain drain" relating to the 1997 handover. Given that school principals are managers and key change agents at the school level, the major concern would be on whether they have sound preparation, including knowledge, attitudes and skills, to cope with massive educational reforms at a time of unprecedented political change before and after 1997.

Administrator respondents' subject major. Figure 7.7 below shows that most of the Administrator respondents had a Science/Mathematics or Arts/Humanity background. A small number of them were in the Technology/Engineering or Other disciplines (Educational Policy & Administration and Accounting). (See also Table A-4, Appendix IV)

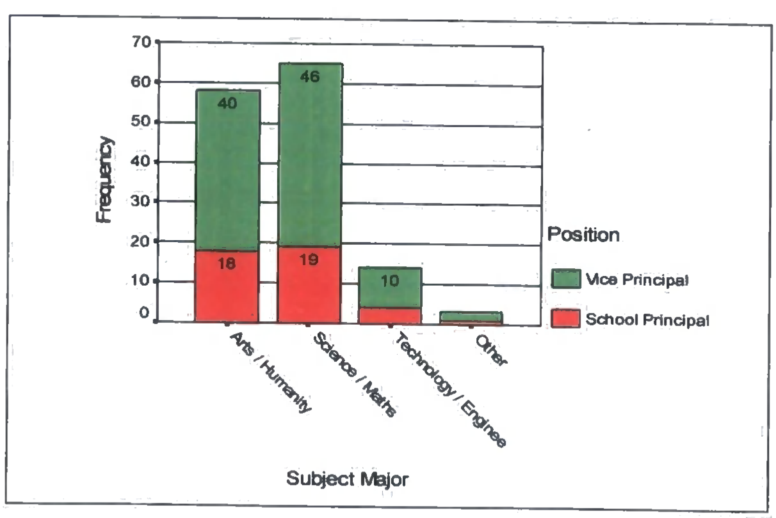


Figure 7.7 Administrator respondents' subject major.

Demographic Data of the Teacher Respondents

Teacher respondents' position and gender. Figure 7.8 below depicts the distribution of the Teacher respondents' Position and Gender. It can be seen that more than half of the Teacher respondents were Subject Panel Chairpersons and the rest were Subject Teachers. The diagram also shows a very uneven distribution of male and female technology teachers in Hong Kong, as compared with the Education Department's (2000a) statistics that in 1999 about 60 to 70 per cent of secondary teachers were women.

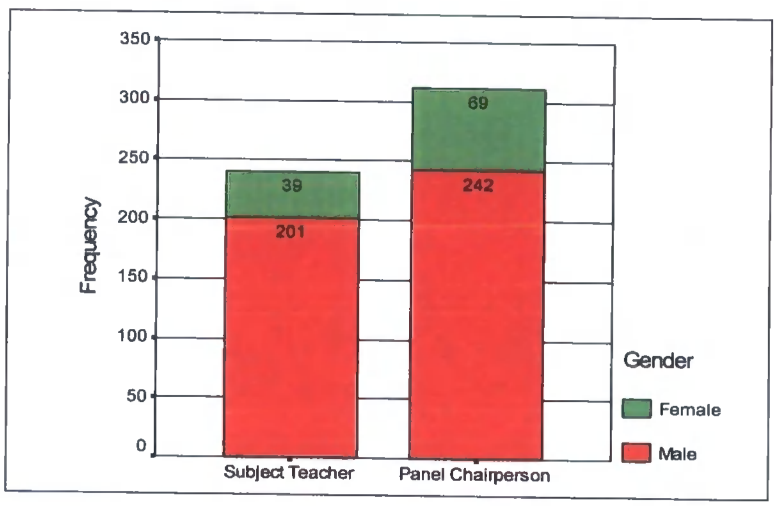


Figure 7.8 Teacher respondents' position and gender.

Teacher respondents' educational level and years in present job. Table A-5, Appendix IV) shows that slightly more than one-third (37.1%) of the Teacher respondents' were non-graduate teachers with either a Teacher's Certificate or a Higher Diploma. Among those Teacher respondents who were graduated, the majority (47.4%) of them held a Bachelor degree, 79 (14.4%) of them held a Master's degree, and six (1.1%) held a Doctoral degree. These figures have not included those 20 people who did not report their educational level. Figures 7.9 and

7.10 below show the Teacher respondents' education level with respect to their position and years in the present job.

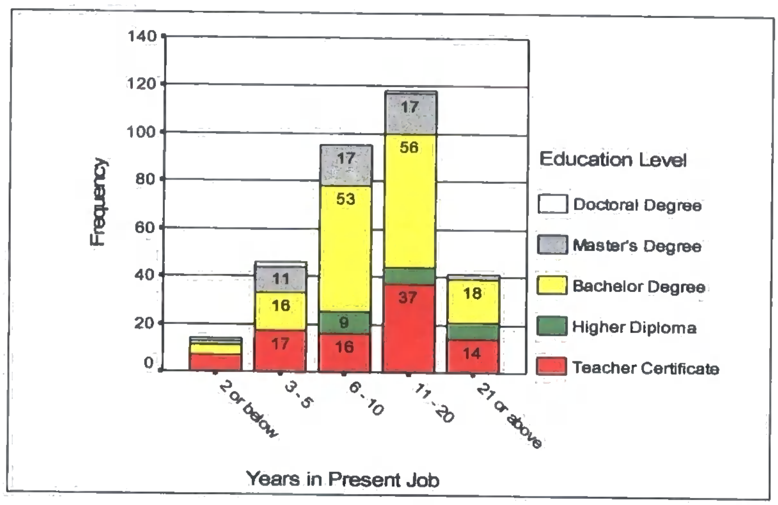


Figure 7.9 Subject panel chairpersons' education level and years in present job.

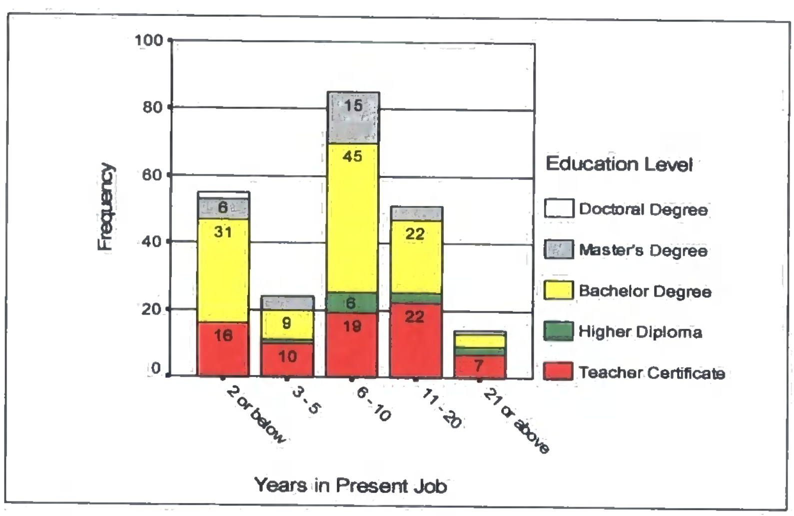


Figure 7.10 Subject teachers' education level and years in present job.

Teacher respondents' age range. From Figures 7.11 and 7.12 below, it can be seen that the technology teaching workforce in Hong Kong is well-experienced but aging. About two-thirds of the Teacher respondents were over 40, and quite a number of them were near their retiring age.[24]

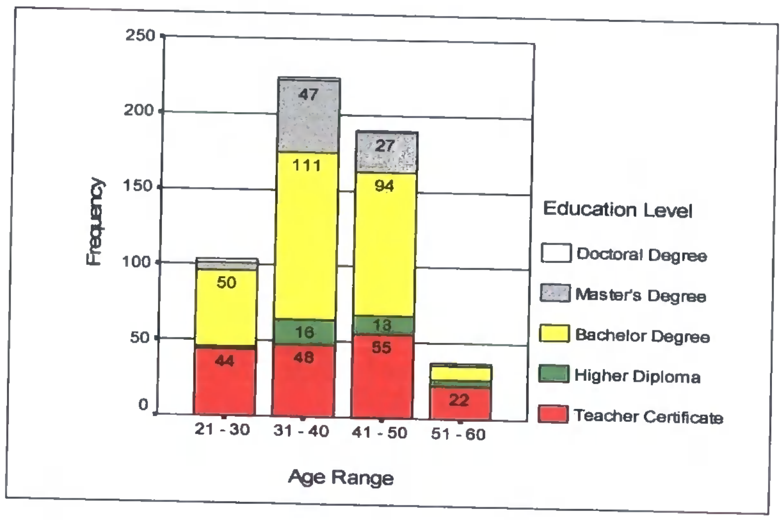


Figure 7.11 Teacher respondents' educational level and age range.

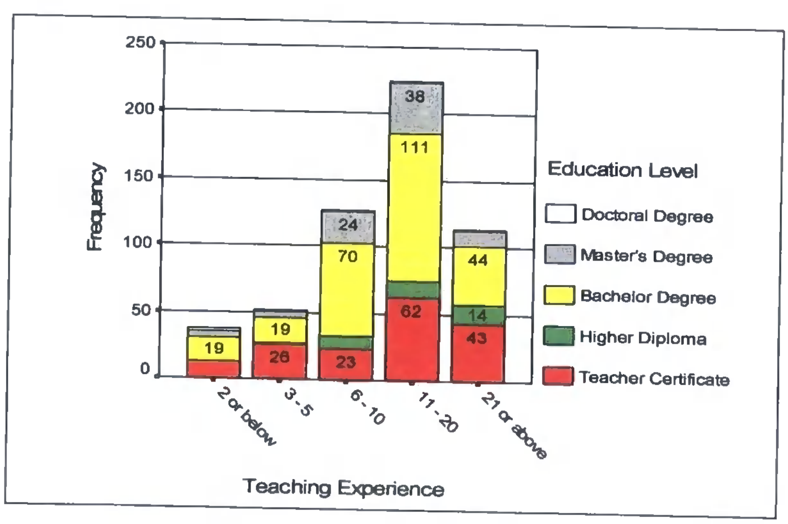


Figure 7.12 Teacher respondents' educational level and teaching experience.

[24] In general, the retiring age for Hong Kong teachers is 60, but in recent years teachers in Government Schools can opt for early retirement at the age of 52 or even earlier.

Teacher respondents' years in present job. Figure 7.13 below shows that within the last five years, a large number of teachers had changed job very frequently. This can be explained by the fact that many schools only offered short term contracts to technological subject teachers at a time of educational and curriculum changes to give themselves with more flexibility in teacher re-deployment. This unfavourable circumstance provides new teachers entering schools with no clear career prospects, and their genuine supports for recent education reforms are in question.

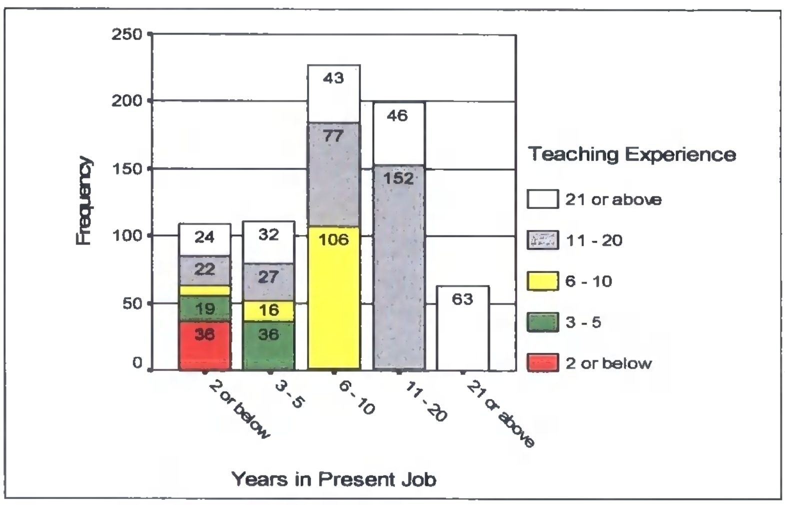


Figure 7.13 Teacher respondents' teaching experience and years in present job.

It is also found that within the last five years, a large number of technological subject teachers with substantial years of teaching experience (notably those in the "11 to 20" and "21 or above" groups) had changed job. Some of them might be people who have migrated to other countries around 1997 and returned to work in Hong Kong. This to a certain extent would have the side-effect of restricting professionally trained "new bloods" from entering the technology teaching profession and bringing in new ideas and practices conducive to recent technology education reforms.

Based on the above evidence, it appears that the TE teaching profession in Hong Kong is male-dominated, like many other countries around the world. It is apparent that if TE is to serve the needs of both girls and boys, more females should be attracted into the profession as role models (Haynie, 1999; Volk, 2000; Zuga, 1996). As Zuga (1996) comments: "If technology educators wish to meet the goals that they set forth for teaching all students about technology, they must address the hegemony which exists in their profession" (p. 42).

Teacher respondents' major subject taught. In Item A8 of the questionnaire, the Teacher respondents were asked to specify which technological subject that they spend most of the time teaching in the current academic year from the following four groups of subjects:

Group A: Automobile Technology, Design Fundamentals, Design & Technology (Alterative Syllabus), Desktop Publishing, Graphical Communication, Technology Fundamentals, and Technological Studies. These are "New Subjects" in the New Technical Curriculum that start to be offered in the 2000/01 academic year.

Group B: Accommodation & Catering Services (S4-5), Design & Technology (at all levels), Electronics & Electricity, Electronics, Engineering Science, Fashion Design, Technical Drawing, and Textiles. These are "Existing/Survived Subjects" that are likely to be sustained for sometime, perhaps until the coming of the next wave of holistic curriculum reform.

Group C: Accommodation & Catering Services (S1-3), Auto Repairs, Electrical Studies, Fashion & Clothing (S1-3), Printing, and Metalwork. These are trade-oriented subjects to be phased out within the very near future as recommended by CDC (2000b).

Group D: Integrated subjects with technological elements incorporated.

Table A-6 (Appendix IV) presents the distribution of the Teacher respondents according to their teaching experience and the major subject taught. It was found that at the time of the survey, nearly half (44.7%) of the Teacher respondents were involved in teaching the "New Subjects" for most of the time. Whilst about one-third (30.1%) of the teachers were involved in teaching the "Existing/Survived Subjects", only a small proportion (6.8%) of them were teaching the "Phasing-out Subjects", and about one-fifth (18.5%) of the teachers were involved in teaching 'Integrated Subjects" with technological elements incorporated. It is also noted that the titles of the integrated subjects taught by the teacher respondents varied (e.g., "living technology" and "creative technology"), but in essence they were mostly combinations of "D&T and Art", "D&T and IT", "D&T and Home Economics". This indicates that among the participating schools, subject integration as recommended by CDC (2000b) was actually taking place, in one form or another and to various extents.

Mode of offering technological subjects in the junior secondary curriculum. Figure 7.14 below shows that the majority of the schools offered technological subjects in the junior secondary curriculum as discrete subjects, whereas just a small number of the schools (mostly Prevocational Schools and Grammar Schools) offered technology as an integrated subject. (See also Table A-7, Appendix IV)

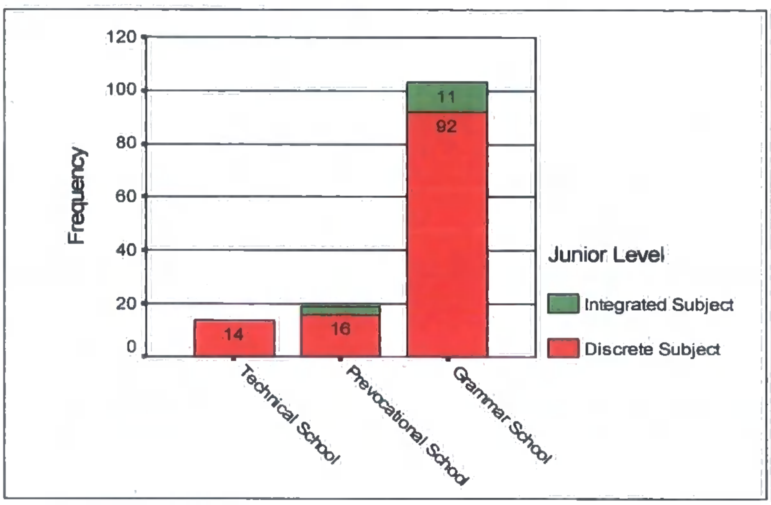


Figure 7.14 Mode of offering technological subjects in the junior secondary curriculum.

Technological subjects offered in the junior secondary curriculum (by gender). From Figure 7.15 below and Table A-8 (Appendix IV), it can be seen that for the majority of the schools involved technological subjects were offered to both boys and girls at the junior secondary level. A small number of schools reported that technological subjects were offered to boys only. Most probably these were single-sex schools for boys. It is unlikely that school administrators in Hong Kong would act against the Equal Opportunities Commission's (1999) verdict that during the compulsory years of schooling, both boys and girls should have equal access to technology education. This point will be further discussed in Chapter 8 that follows.

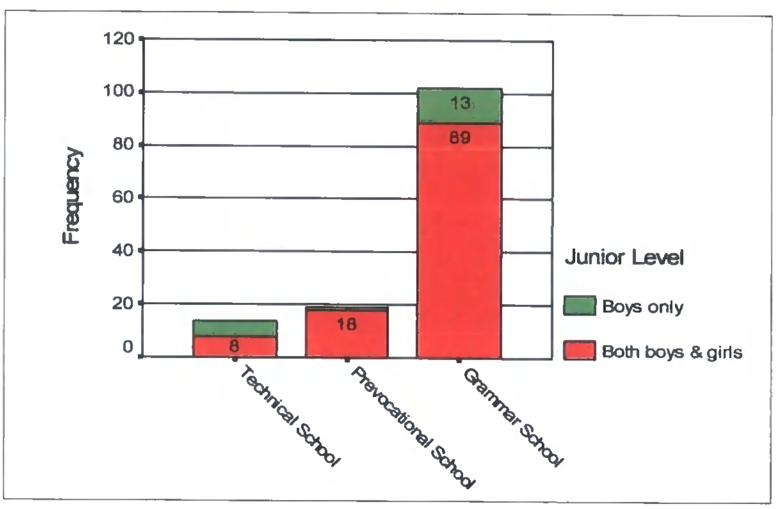


Figure 7.15 Technological subjects offered in the junior secondary curriculum (by Gender).

Mode of offering of technological subjects in the senior secondary curriculum. From Figure 7.16 below and Table A-9 (Appendix IV), it can be seen that slightly less than half of the schools offered technological subjects in the senior secondary curriculum as discrete subjects; whilst a very small number of the schools offered technology as an integrated subject. It is also found that most Grammar Schools did not offer any technological subjects at all in their senior secondary curriculum. Surprisingly, one technical school reported that technical/technological subjects were not offered in the school at the senior secondary level at all. This is against the Education Department's (1997a) recommendation that technical schools, after the adoption of the New Technical Curriculum (NTC), should not change the existing proportion of technical content attached to the school curriculum.

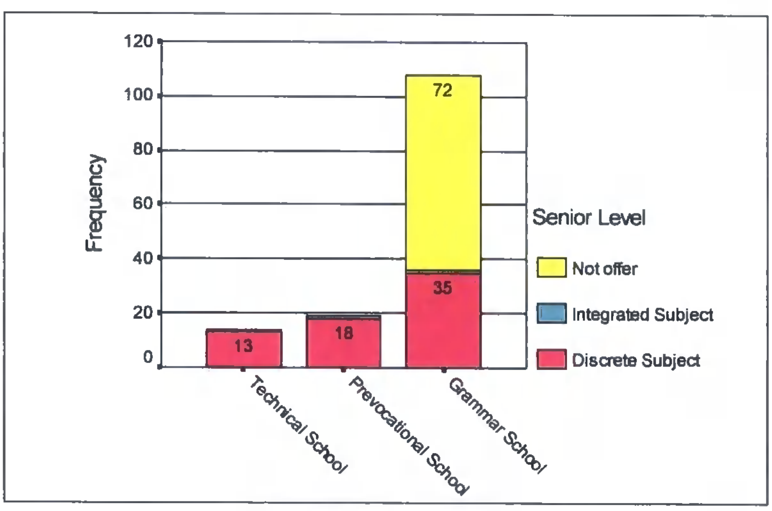


Figure 7.16 Mode of offering technological subjects in the senior secondary curriculum.

Technological subjects in the senior secondary curriculum (by gender). From Figure 7.17 below and Table A-10 (Appendix IV), it can be seen that at the senior secondary level, about one-third (36.2%) of the schools offered technological subjects to both boys and girls; whereas a small number (13.8%) of the schools (most probably the single-sex schools) offered technological subjects only to boys. Half (50.0%) of the schools (mostly Grammar Schools) did not offer any technological subject in the senior secondary curriculum at all.

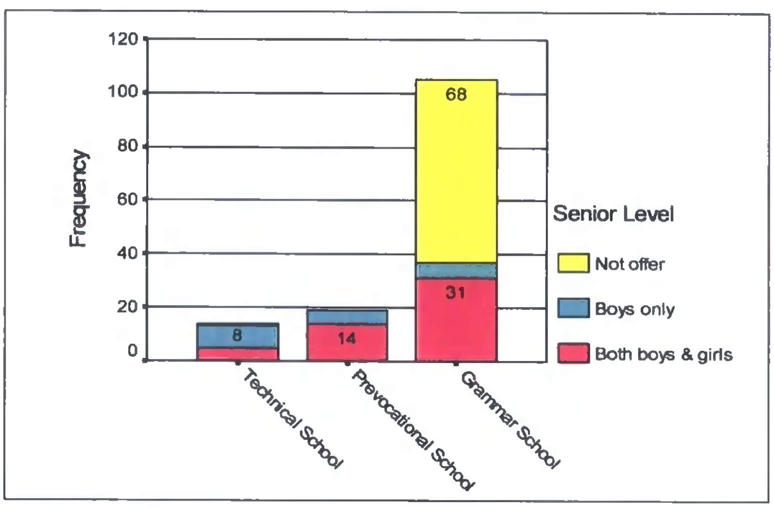


Figure 7.17 Technological subjects offered in the senior secondary curriculum (by Gender).

Any change in offering technological subjects in the near future. In Item A14 of the questionnaire, the Administrator respondents were asked "Will there be any changes in the list of Technological Subjects offered in your school in the near future?" Those answered "yes" were requested to elaborate further about which existing subject(s) was/were to be phased out, and which new subject(s) was/were to be adopted. Data analysis results show that the majority (81.8%) of the schools had no intention of making any changes to Technological Subjects offered in their school in the near future; less than one-fifth (18.2%) reported that they would make some changes. (See Figure 7.18 below and Table A-11, Appendix IV)

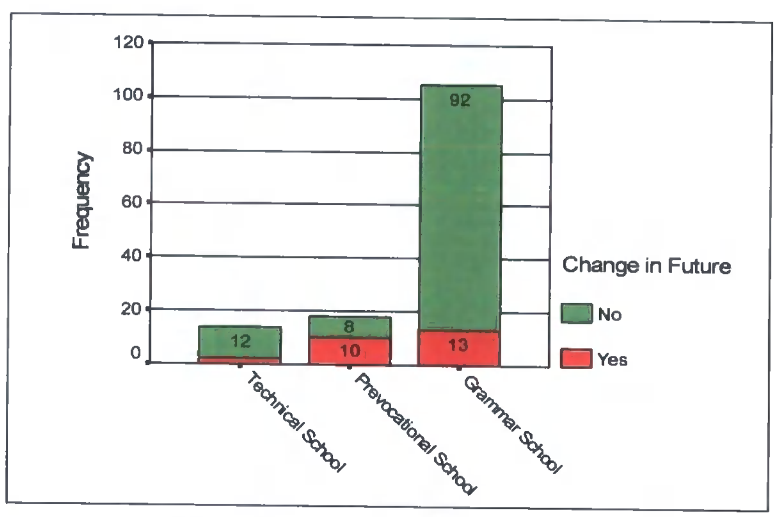


Figure 7.18 Any change in technological subjects in the near future.

Typical changes in the near future as reported by the Administrator respondents are listed below:

- "Not determined yet. Curriculum integration is on the way." (Administrator Respondent 104-A-01)
- "TE subjects will be offer for both boys and girls." (Administrator Respondent 130-A-01)

- "Considering the elimination of Design & Technology and offering Living Technology." (Administrator Respondent 096-A-01)
- "Will revise the curriculum content of individual [technological] subjects." (Administrator Respondent 148-A-01)
- "Will replace Technical Drawing with Graphical Communication at the senior secondary level." (Administrator Respondent 080-A-01)
- "Will close down Information Technology." (Administrator Respondent 082-A-01)
- "Will offer Information Technology." (Administrator Respondent 015-A-01)
- "Will merge Design Fundamentals and Graphical Communication into one single subject." (Administrator Respondent 048-A-01)
- "Will integrate all existing technological subjects together and restructure TE as a modular curriculum." (Administrator Respondent 106-A-01)

7.5. Familiarity with Recent Technology Education Reforms

In Item A9 of the questionnaire survey, respondents were asked to rate their perceived level of familiarity with recent TE curriculum reforms using a 4-point Likert scale, with 4 = "have very good knowledge", 3 = "have good knowledge", 2 = "have some knowledge", and 1 = "have little or no knowledge".

Administrator respondents' familiarity with recent TE reforms. Figure 7.19 below and Table A-12 (Appendix IV) show that about three-fifths (59.4%) of the Administrators responded that they "have little or no knowledge" or just "have some knowledge" about recent TE curriculum reforms. About two-thirds (40.6%) of them claimed that they "have good knowledge" or "have very good knowledge" about the reforms.

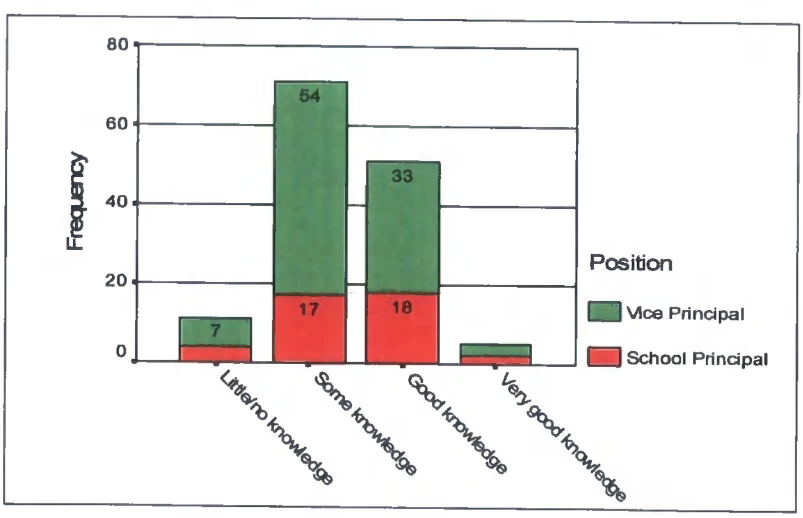


Figure 7.19 Administrator respondents' familiarity with recent TE reforms.

Teacher respondents' familiarity with recent TE reforms. Similar patterns were spotted in the Teacher respondents' responses. (See Figure 7.20 below and Table A-13, Appendix IV) The majority (70.4%) of the Teacher respondents reported that they "have little or no knowledge" or "have some knowledge" about recent TE curriculum reforms. Just about one-third (29.6%) of them claimed that they "have good knowledge" or "have very good knowledge" about the reforms. The above data analysis results imply that development and dissemination processes adopted for top-down technology curriculum reforms in Hong Kong need to be reconsidered to make them more effective.

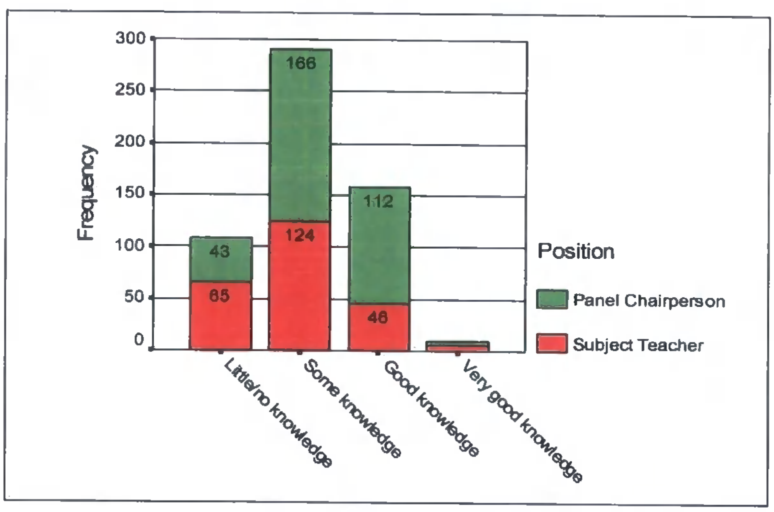


Figure 7.20 Teacher respondents' familiarity with recent TE reforms.

7.6. Teachers' Preparedness for Technology Education Reforms

In Item A10 of the questionnaire, the Teacher respondents were asked to rate their perceived level of preparedness towards recent TE reforms using a 4-point Likert scale, with 4 = "well prepared", 3 = "prepared", 2 = "need some help", and 1 = "need help".

From Table A-14 (Appendix IV), it can be seen that about three-fifths (57.5%) of the Teacher respondents reported that they were not well prepared for the TE reforms and might "need help" or "need some help". From Figure 7.21 below, it is observed that relatively, Panel Chairpersons felt that they were better prepared for the TE reforms than Subject Teachers.

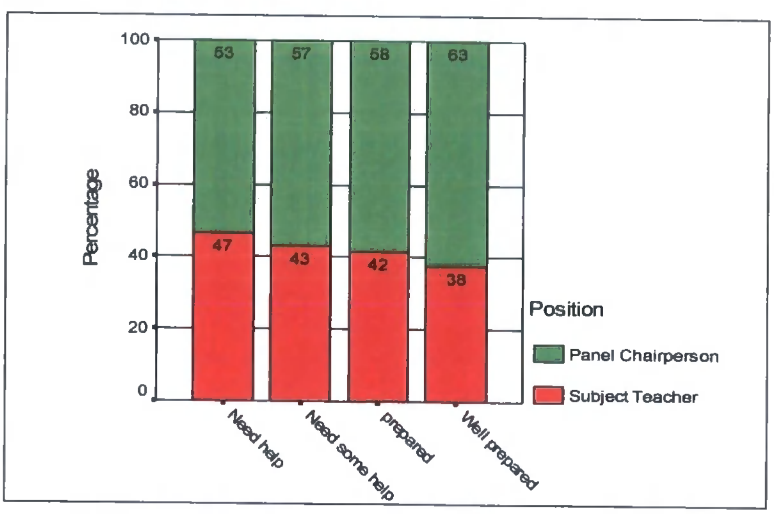


Figure 7.21 Teachers' preparedness for the TE reforms (by Position).

Teachers' preparedness for the TE reforms by major subject taught. From Figure 7.22 below and Table A-15 (Appendix IV), it is found that teachers teaching the "New Subjects" generally felt that they were better prepared as compared with teachers in the other categories; and many teachers in the "Integrated Subject" group felt that they might "need help" or "need some help". Given the recent TE reforms stress the importance of integrated learning within the TEKLA and among the KLAs, the above finding implies that professional development programmes and initial teacher training for technology teachers should have more weight on the integrated teaching and learning area in order for teachers to cope with curriculum reforms effectively.

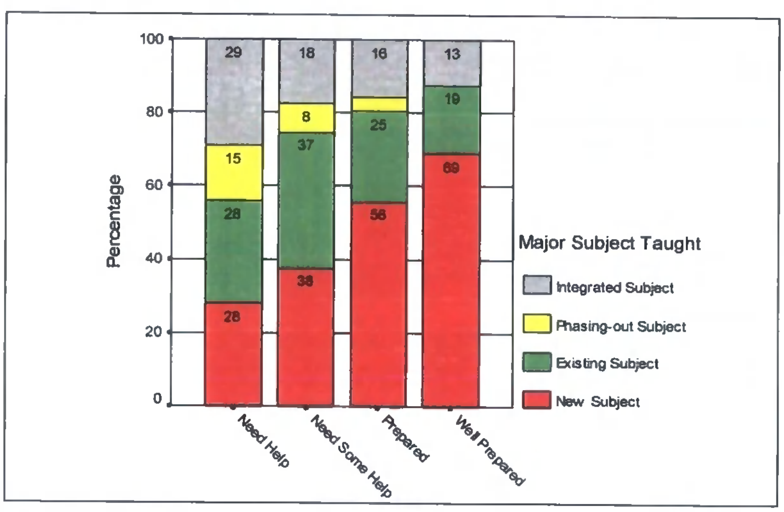


Figure 7.22 Teachers' preparedness for the TE reforms (by Major Subject Taught).

Relationship between teachers' familiarity with the TE reforms and their preparedness for the reforms. To determine if there were any relationships between the Teacher respondents' responses on their familiarity with the recent TE reforms and their preparedness for the reforms, the Spearman's *Rho* non-parametric test was performed. According to Shannon and Davenport (2001, p. 180), a correlation of +1.00 indicates a "perfect" positive relationship, whilst a correlation of -1.00 indicates a "perfect" negative relationship. Besides, the closer the coefficient is to zero, the weaker the relationship. From Table A-16 (Appendix IV), it can be seen that there was a "moderate" correlation ($r_s = .49, p < .01$) (Dancy & Reidy, 2002, p. 166) between the Teacher respondents' responses on their familiarity with and preparedness for the recent TE reforms. This can be interpreted in such a way that for teachers who have better knowledge of the reforms believe themselves to be better prepared for meeting the new challenges.

7.7. Perceptions towards Technology Education

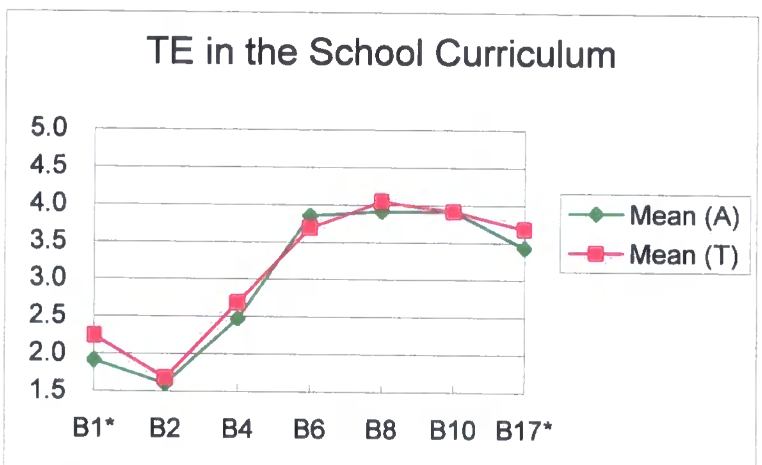
In Section B of the questionnaire survey, the Teacher respondents were asked to indicate their level of agreement with a set of 26 statements (Items B1–B26) about TE for Hong Kong secondary schools, using a 5-point Likert scale with 5 = strongly agree, 4 = agree, 3 = moderately agree, 2 = disagree, and 1 = strongly disagree. Mean responses of respondents to the items and results of *t*-tests for comparing mean responses from both respondent groups are reported in tabular form (Appendix IV).

The effect size (η), which provides indications on how consistently differences in the dependent scores are caused by changes in the independent variables, was also computed. The effect size ($\eta = .119$ and $\eta^2 = .014$) for the set of items in Section B can be regarded as very small (Cohen 1988, cited in Huck, 2000, p. 207), as only 1.4% of the variance in the dependent variable (Nature of TE) could be explained by the independent variable (the respondents' position). This indicates that the respondents' position (i.e., either administrator or teacher) had negligible effect on the dependent variable (Nature of TE).

Data analysis results in this section are organised under the following areas: Comparisons of the two respondent groups' responses on TE as a school subject; capacity of TE in developing students' generic skills; and the importance of TE for nurturing students of diverse abilities and backgrounds.

Comparisons of the respondent groups' perceptions on TE in the school curriculum. The following sub-section aimed at comparing the two respondent groups' perceived nature of TE and its relationships with other subject disciplines or areas, including Education Technology, Computer Studies, craft-based subjects, Science, Mathematics, and Technological Literacy.

Figure 7.23 below illustrates the pattern of responses (i.e., mean scores) of the two respondent groups' perceived nature of TE as a school subject.



Key:

B1 = TE is something similar to Educational Technology

B2 = TE is computer studies with a different name

B4 = TE is an extension of craft-based subjects

B6 = TE is a stand alone subject, separated from Science and Mathematics

B8 = TE is an essential part of the school curriculum that promotes technological literacy

B10 = TE contributes to the general education curriculum

B17 = TE serves to teach students to integrate knowledge and skills acquired from other subject disciplines such as languages, science, mathematics, and social studies

* Item that shows statistically significant difference between the two groups.

Figure 7.23 TE in the school curriculum.

From Figure 7.23 and Table A-17 (Appendix IV), it can be seen that both respondent groups indicated disagreement (i.e., mean rating < 3.0) towards the following three statements:

- Item B1, "TE is something similar to Educational Technology". This indicates that the Hong Kong administrators had better understanding of the nature of TE as compared with their counterparts elsewhere: A recent research report (Akmal *et al.*, 2004) shows that some state supervisors for Technology Education in the USA expressed that "TE and ET are most confusing", and that "Ed. Tech. versus Tech. Ed. is still a problem".
- Item B2, "TE is computer studies with a different name". This finding is in contrast with those in other countries where technology education is commonly referred to computer studies or information technology (e.g., in Canada, the UK, and the USA) (Petrina, in press).
- Item B4, "TE is an extension of craft-based subjects". The respondents' disagreement on this statement supports the CDC's (2000b, 2002) recommendation that TE in Hong Kong should move away from craft-based and trade-specific subjects such as metalwork and towards one that develops students' technological literacy (Item B8).

To explore whether there were any statistically significant differences between the Administrator and Teacher respondent groups' perceptions towards TE for the selected items, *t*-tests were performed. Table A-17 (Appendix IV) presents the *t*-test statistics for the two respondent groups' agreement with the seven "TE in the School Curriculum" statements. Levene's test for homogeneity of variation showed that two items (Items B1 and B6) had unequal variation for the two groups.

For these items, the unequal variance tests were used instead (George & Mallery, 2003; Shannon & Davenport, 2001).

As a rule of thumb, the significance level of the 2-tailed *t*-tests are set at the level of $p = .05$. However, multiple *t*-tests increase the risk of committing an "inflated" Type I error (i.e., accepting a difference when in reality there is no difference), the *t*-tests alpha level need to be set at a more stringent level (Huck, 2000; Shannon & Davenport, 2001). This is achieved using Bonferroni adjustment[25] to hold down the chances of an inflated Type I error by adjusting the alpha level of each individual test downwards to ensure that the overall risk for a number of tests remains .05 (Bryman & Cramer, 2005; Huck, 2000). However, it has to be noted that the Bonferroni method also increases the chances of a Type II error, i.e., accepting no difference when in reality there is a difference.

The *t*-tests showed that for two items, the differences were statistically significant at $p < .05$ level with Bonferroni adjustment applied (i.e., .05/26 = .002). These were Item B1, "TE is something similar to Educational Technology", and B17, "TE serves to teach students to integrate knowledge and skills acquired from other subject disciplines such as languages, science, mathematics, and social studies." The above results indicate that the respondent groups' views about the seven selected items on the nature of TE as a school subject were consistent, except for Items B1 and B17 that showed statistical significances between the two groups that might have occurred by chance. However, in view of the fact that the differences in perception between the two groups for these two items were not polarised, being statistically significant here does not necessarily mean that the

[25] For Bonferroni adjustment, the significance level for individual tests equals to the overall significance level divide by the number of individual tests to be performed.

effect is large enough to be of "practical significance".[26]

Table A-17 (Appendix IV) also reveals that both respondent groups held "strong" views (i.e., mean rating around 4.0) that "TE is an essential part of the school curriculum that promotes technological literacy" (Item B8). This is in accord with the results of the two ITEA polls conducted in 2001 and 2004 in the USA that "the development of technological literacy to be a priority for K-12 schools" and there is a "need to include technological literacy as part of the school's curriculum" (Rose *et al.*, 2004, p. 11).

Mathematics and science are in general being considered as important contributors to the development of technology. However, in this survey, both respondent groups perceived that "TE is a stand alone subject, separated from Science and Mathematics" (Item B6). This can be interpreted as that both the administrators and teachers were "quite against" the idea of integrating technology with other disciplines such as science and mathematics (Akmal *et al.*, 2004; Foster & Wright, 1996; Schell & Wicklein, 1993) for reasons that need further investigation.

Cross-checking items for trustworthiness. Item B12 served as a statement embedded in the questionnaire for cross-checking respondents' consistency in responses. The statement, "TE is not needed in the school curriculum because other subjects adequately promote technological literacy", was a negatively worded version of Item B8, "TE is an essential part of the school curriculum that promotes technological literacy". The polarity of Item B12 was reversed for data analysis. The value assigned to it was exactly the opposite of that assigned for Item B8. Pearson's

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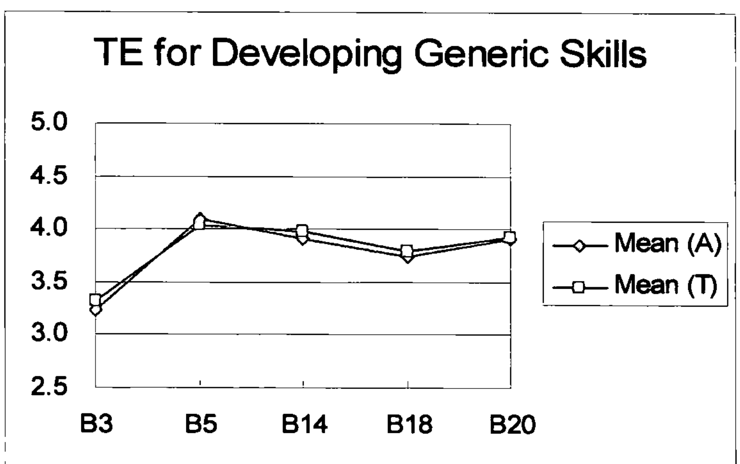
[26] "Practical significance" here implies research results that will be viewed as having importance for the practice of education (by teachers, school administrators, policy-makers, and others concerned about the day-to-day workings of education and efforts to improve it.)

product-moment correlation coefficient was used to examine the relationship between the two items. Table A-18 (Appendix IV) shows that the relationship between the items was "positive" and "strongly related" ($r = + .318$, $p < .001$) (Bryman & Cramer, 2005; Dancy & Reidy, 2002). This suggests that the two respondent groups' responses were mutually fairly consistent, reliable and trustworthy, at least for these two items.

Comparisons of respondent groups' perceived importance of TE in developing students' generic skills. This sub-section aimed at comparing the two respondent groups' perceived importance of statements on "TE for developing students' generic skills" as required to learn, to live and to work in a knowledge-based society.

According to the *t*-test results shown in Table A-19 (Appendix IV), no statistically significant differences were found in any items in this area, indicating that both respondent groups had very similar ratings among the five items in question. From Figure 7.24 below and Table A-19, it can be seen that both respondent groups held "strong" views (i.e., mean rating around 4) that TE is an appropriate vehicle for developing students' generic skills, such as creative thinking and problem solving skills; nurturing transferable skills, promoting integrative learning; and preparing students for lifelong learning in a technological society (Items B5, B14, B18, and B20).



Key:

B3 = TE provides an opportunity for students to develop Information Technology skills

B5 = TE provides an opportunity for students to develop creative thinking

B14 = TE can assist in the development of students' problem-solving and decision making skills

B18 = TE develops and nurtures students' transferable skills

B20 =TE prepares students for lifelong learning in a technological society

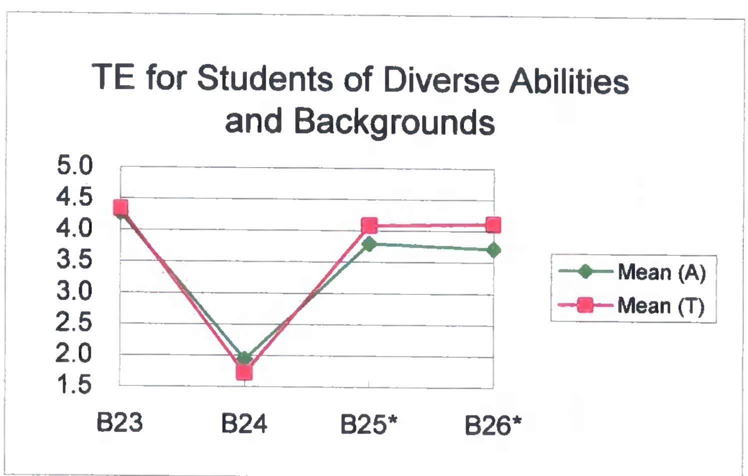
*Item that shows statistically significant difference between the two groups.

Figure 7.24 TE for developing students' generic skills.

It is also found that both respondent groups held "moderate" views (i.e., mean rating around 3) for TE as a vehicle for promoting students' IT skills (Item B3).

Comparisons of respondent groups' perceived importance of TE for nurturing students of diverse abilities and backgrounds. This sub-section aimed at comparing the two respondent groups' perceived importance of TE for nurturing students of diverse backgrounds, including gender, academic capability, and stream (subject specialisation). According to the *t*-test results shown in Table A-20 (Appendix IV), statistically significant differences were found in two items in this area, namely Items B25 and B26.

From Figure 7.25 below and Table A-20, it can be seen that both respondent groups indicated "strong disagreement" (i.e., Mean < 2) towards the statement that "TE is for the low achievers" (Item B24).



Key:
B23 = TE should be provided for both boys and girls
B24 = TE is for the low achievers
B25 = TE should be provided for both arts/humanity and science/technology students
B26 = TE should be a compulsory part of the secondary school curriculum
*Item that shows statistically significant difference between the two groups.

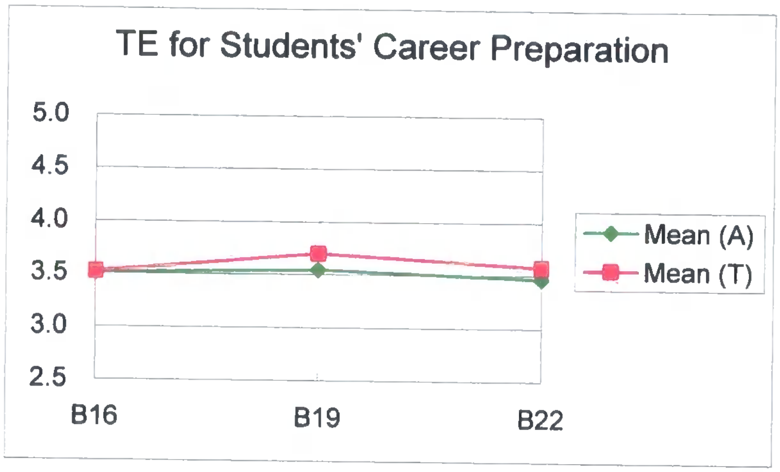
Figure 7.25 TE for nurturing students of diverse abilities and backgrounds.

It is also found that both respondent groups held "strong" views (i.e., mean rating around 4.0) that TE should be a "compulsory part of the secondary school curriculum" (Item B26), for "both boys and girls" (Item B23), irrespective of their subject specialisation (whether they are in the arts/humanity stream or in the science/technology stream) (Item B25).

The above data analysis shows that there was considerable agreement among Administrator and Teacher respondents that TE should be provided for all students, irrespective of their gender and programme of study. This is a perception long desired by technology educators as they sought to rectify the old stereotyped image of technological subjects as being "male-dominated" and worked to foster a programme that attracts the mainstream population of the school.

Comparisons of respondent groups' perceived importance of TE for students' future career preparation. This sub-section aimed at comparing the two respondent groups' perceived contribution of TE for students' career preparation. According to the *t*-test results shown in Table A-21 (Appendix IV), no statistically significant differences were found between the respondent groups' mean scores for any items in this area, indicating that both respondent groups had very similar ratings among the three items in question.

From Figure 7.26 below, it can be seen that both respondent groups "strongly agreed" (i.e., mean rating around 4.0) that TE "serves to provide students with basic technical skills and occupational guidance information to contribute to meaningful occupational choice" (Item B16), and "prepares students to apply knowledge and skills of industry" (Item B19).



Key:

B16 = TE serves to provide students with basic technical skills and occupational guidance information to contribute to meaningful occupational choice

B19 = TE prepares students to apply knowledge and skills of industry

B22 = TE prepares students for future working life

Figure 7.26 Contribution of TE for students' future career preparation.

7.8. Technology Education Curriculum Elements

In Section C of the questionnaire survey, respondents were asked to rate the level of importance on selected technology curriculum content areas for Hong Kong secondary schools. For the 21 items in this section, respondents were asked to give ratings on a 5-point Likert scale, with 5 = very important, 4 = important, 3 = quite important, 2 = less important, and 1 = unimportant.

Data analysis results in this section are organised under the following areas: Overall analysis of items in the section; and comparisons of the two respondent groups' responses on TE curriculum elements individually and in groups. The TE curriculum elements were grouped into six curriculum content areas according to the CDC (2000b), namely "Information and Communication Technology" (ICT), "Materials & Structures" (M&S), "Operations and Manufacturing" (O&M), "Strategies and Management" (S&M), Systems & Control (S&C), and "Technology and Living" (T&L). (See Table 7.3 below)

Table 7.3

Items in the Six TE Curriculum Content Areas

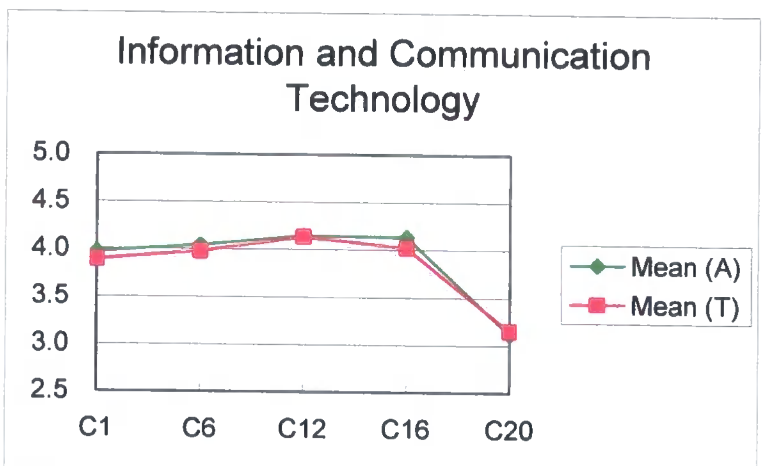
Technology Education Curriculum Content Areas	Items
Information and Communication Technology (ICT)	C1, C6, C12, C16, and C20
Materials & Structures (M&S)	C2, C7, and C13
Operations & Manufacturing (O&M)	C3, C8, C11, C14, C17, and C21
Strategies & Management (S&M)	C4 and C15
Systems & Control (S&C)	C9 and C18
Technology & Living (T&L)	C5, C10, and C19

Overall Analysis of the Items

An overall analysis of items in this section was performed, which included mean, standard deviation, and *t*-tests between responses of the Administrator and Teacher respondent groups. Based on the analysis, it is found that statistically the two respondent groups held similar perceptions towards the majority of items in the section. Out of the 21 items under scrutiny, statistically significant differences were found between the two respondent groups' mean scores on five items.

The effect size (η) for the set of items in Section C was also computed. The effect size ($\eta = .041$ and $\eta^2 = .002$) was found to be very small (Cohen, cited in Huck, 2000, p. 207), as only 0.2% of the variance in the dependent variable (TE Curriculum Content Areas) could be explained by the independent variable (the respondents' position). This indicates that the respondents' position (i.e., either administrator or teacher) had negligible effect on the dependent variable (TE Curriculum Content Areas). Detailed discussions on individual curriculum content areas are presented below.

Information & Communication Technology (ICT). Figure 7.27 below summaries the Administrator and Teacher respondent groups' mean scores for items in the Information & Communication Technology curriculum content area. Table A-22 (Appendix IV) presents statistical analysis results of these items.



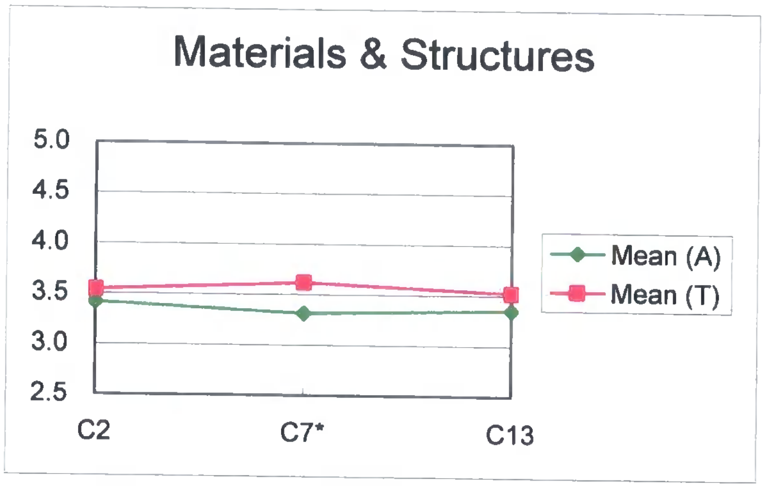
Key:
C1 = Basic computer architecture and computer operation
C6 = Computers and information systems
C12 = Computer applications
C16 = Computer communications and Internet access
C20 = Algorithm and computer programming

Figure 7.27 Curriculum element (Information & Communication Technology).

According to the *t*-test results shown in Table A-22, no statistically significant differences were found between the respondent groups' mean scores for any items in the ICT content area. Data analysis results also show that both respondent groups perceived four items out of five in the area as "important" (i.e., mean rating around 4). These items included: Item C12, "Computer applications, including text processing, graphic handling, multimedia presentation, and using databases"; Item C16, "Computer communications and Internet access"; Item C6, "Computers and information systems"; and Item C1, "Basic computer architecture and computer operation".

The respondents' strong endorsements on ICT curriculum elements can be seen as an indication of their supports to the Hong Kong SAR Government's recent effort to promote IT in education. The IT in education policy has the vision of linking up Hong Kong students with the vast network of knowledge and information, and developing students' capabilities to process information effectively and efficiently (EMB, 1998). As for Item C20, "Algorithm and computer programming", which requires students to formulate algorithms and develop computer programs for solving problems, the respondents might considered this area less appropriate to a TE curriculum that aimed at catering for a wide spectrum of student abilities and backgrounds, and hence assigned the item with a relatively low rating.

Materials & Structures (M&S). Figure 7.28 below summaries the Administrator and Teacher respondent groups' mean scores for items in the Materials & Structures content area. Table A-23 (Appendix IV) presents statistical analysis results of these items.

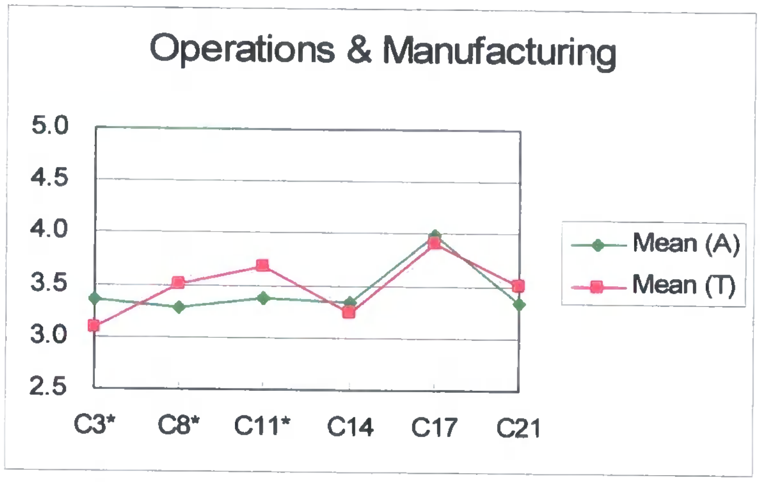


Key:
C2 = Materials and material processing
C7 = Tools and machinery for production
C13 = Structure system
* Item that shows statistically significant difference between the two groups.

Figure 7.28 Curriculum element (Materials & Structures).

According to the *t*-test results shown in Table A-23, a statistically significant difference was found between the respondent groups' mean scores for Item C7. Data analysis results also show that the Administrators respondent group perceived all three items in the M&S content area as "less important" (i.e., mean rating around 3); whist the Teacher respondents perceived the three items as "quite important".

Operations & Manufacturing (O&M). Figure 7.29 below summaries the two respondent groups' mean scores for items in the Operations & Manufacturing content area. Table A-24 (Appendix IV) presents statistical analysis results of these items.



Key:

C3 = Logistics management

C8 = Product analysis and product life cycles

C11 = Design for manufacturing

C14 = Production management

C17 = Safety and health

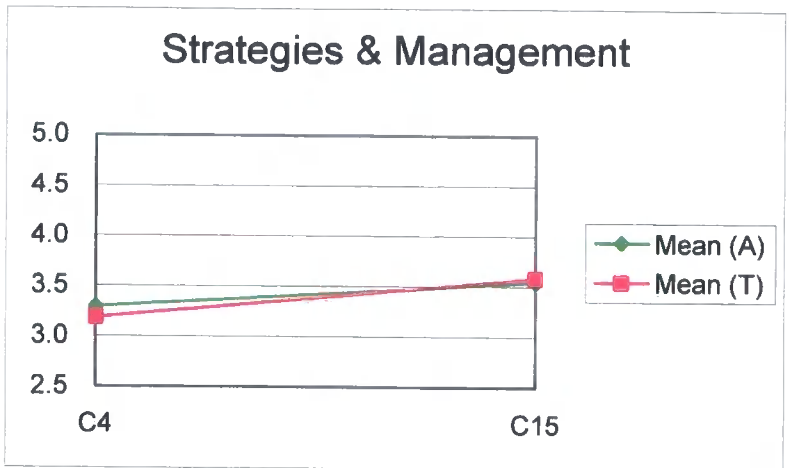
C21 = Common industrial processes

* Item that shows statistically significant difference between the two groups.

Figure 7.29 Curriculum element (Operations & Manufacturing).

According to the *t*-test results shown in Table A-24, statistically significant differences were found between the respondent groups' mean scores for three items in the O&M area, namely Item C3, "Logistics management"; Item C8, "Product analysis and product life cycles"; and Item C11, "Design for manufacturing". Data analysis results also show that both respondent groups' views on items in the area were mixed. The Administrator respondents considered that Item C17 as "important" (i.e., mean rating around 4.0), and the Items C3, C8, C11, C14 and C21 as "less important" (i.e., mean rating around 3.0). Whilst the Teacher respondents considered that Items C8, C11, C17 and C21 were "important", and Items C3 and C14 as "less important".

Strategies & Management (S&M). Figure 7.30 below summaries the Administrator and Teacher respondent groups' agreement scores for items in the Strategies & Management content area. Table A-25 (Appendix IV) presents statistical analysis results of these items.



Key:

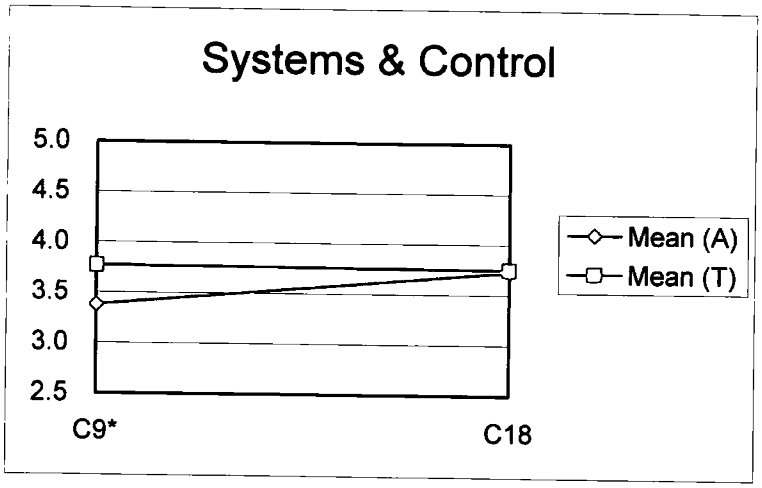
C4 = Human resource management

C15 = Decision making, planning and control

Figure 7.30 Curriculum element (Strategies & Management).

According to the *t*-test results shown in Table A-25, no statistically significant differences were found in any items in the S&M area. Data analysis results also show that the two respondent groups' perceived levels of importance on the two items in the area were similar. Both groups perceived Item C15, "Decision making, planning and control" as "important" (i.e., mean rating around 4.0), and Item C4, "Human resource management" as "less important" (i.e., mean rating around 3.0).

Systems & Control (S&C). Figure 7.31 below summaries the Administrator and Teacher respondent groups' mean scores for items in the Systems & Control content area. Table A-26 (Appendix IV) presents statistical analysis results of these items.



Key:

C9 = Control systems - electronics, mechanical, hydraulic, pneumatics, and computers

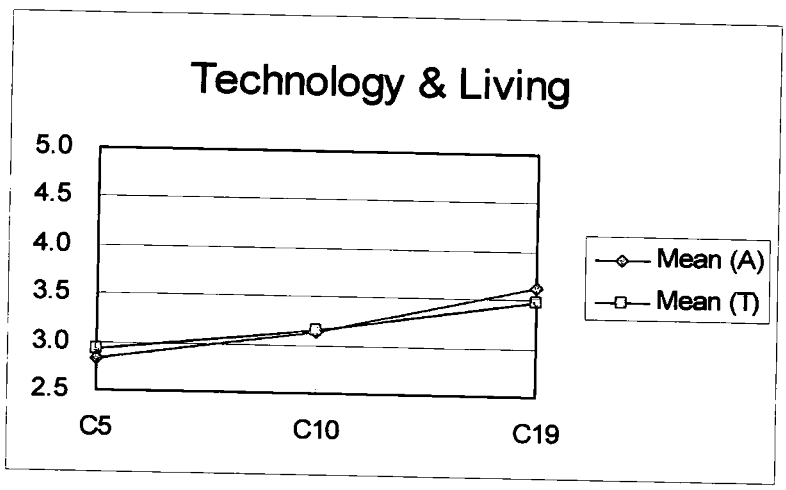
C18 = Application of energy

* Item that shows statistically significant difference between the two groups.

Figure 7.31 Curriculum element (Systems & Control).

According to the *t*-test results shown in Table A-26, a statistically significant difference was found in Item C9. Data analysis results also show that the two respondent groups' perceived levels of importance on items in the S&C area were mixed. The Administrator respondents perceived Item C18, "Application of energy" as "important" (i.e., mean rating around 4.0), and Item C9, "Control systems - electronics, mechanical, hydraulic, pneumatics, and computers" as "less important" (i.e., mean rating around 3.0). However, the Teacher respondents considered both Items C9 and C18 were "important". "Control systems" is an important content area commonly found in technology-related curricula in Hong Kong. It is also a core concept in the *Standards for Technological Literacy* in the USA (ITEA, 2000a) and the D&T National Curriculum in the UK (QCA, 1999). The Administrators' relatively low ratings assigned to Item 9 might be explained in such a way that they considered some areas such as hydraulic and pneumatics too technical or difficult for students to comprehend at the secondary level.

Technology & Living (T&L). Figure 7.32 below summaries the Administrator and Teacher respondent groups' mean scores for the Technology & Living content area. Table A-27 (Appendix IV) presents statistical analysis results of these items.



Key:
C5 = Food packaging
C10 = Fashion design
C19 = Consumer education

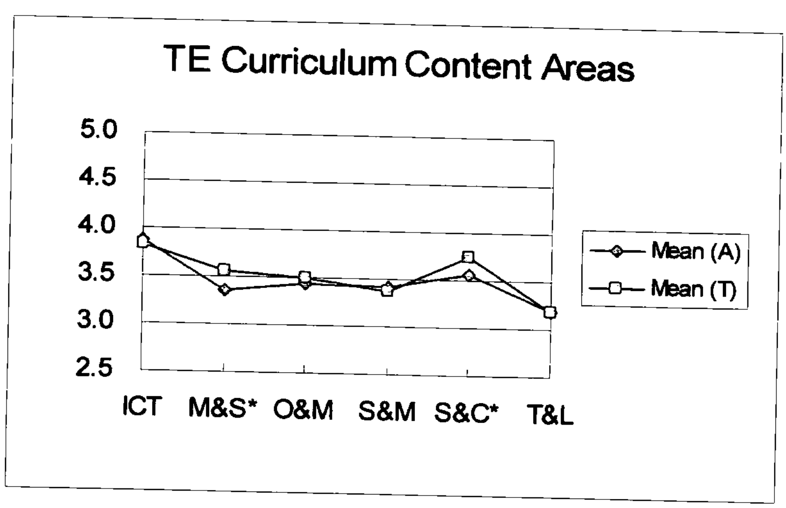
Figure 7.32 Curriculum element (Technology & Living).

According to the *t*-test results shown in Table A-27, no statistically significant differences were found in any items in the T&L area. Data analysis results also show that both respondent groups' views on the three items in this area were quite similar. The Administrator respondents perceived Item C19, "Consumer education" as "important" (i.e., mean rating around 4.0), and Item C5, "Food packaging" and Item C10, "Fashion design" as "less important" (i.e., mean rating around 3.0). As for the Teacher respondents, they considered all the three items as "less important".

According to CDC (2000b), these three T&L content elements are subsumed in both the Home Economics and Technological Subjects. It seems that Teacher respondents in this survey, however, had reservations about such an arrangement, in particular for "food packaging" and "fashion design".

Summary

Figure 7.33 below and Table A-28 (Appendix IV) summarise the two respondent groups' averaged mean scores for the six TE Curriculum Content Areas.



* Content area that shows statistically significant difference between the two groups.

Figure 7.33 Respondent groups' mean scores on the six TE curriculum content areas.

It is observed that both groups' ratings for the ICT area were high. There are statistically significant differences (at $p < .05$ with Bonferroni adjustment, i.e., .05/6

= .008) between the two respondent groups' mean scores in two TE curriculum areas, namely Materials and Structures (M&S) and Systems and Control (S&C), with the Administrators' mean scores considerably lower than those of the Teachers in both cases.

The above findings indicate that both Administrator and Teacher respondents in this study in general endorsed the TE curriculum elements presented in the survey (i.e., mean rating < 3.0). Based on the above analysis, it is found that statistically the two respondent groups held similar perceptions towards the majority of items in the TE curriculum areas. Out of the 21 items under scrutiny, statistically significant differences were found between the two respondent groups' mean scores in just five items. Besides, it is also noted that the top 5 curriculum elements on both respondent groups' priority lists were identical and with similar ranking priority. Four of the items were in the Information and Communication Technology (ICT) area, and one was in the Operations & Manufacturing (O&M) area relating to health and safety. The above findings indicate the high value that both respondent groups placed on ICT and health and safety as important learning areas in the technology education curriculum.

Items in this section were extracted from the list of curriculum elements stated in the CDC's (2000b) *Learning to Learn – Technology Education Key Leaning Area* document. Given that most teachers in Hong Kong have a single discipline background, it would be difficult to have a single teacher who could be familiar with and capable of teaching all these TE curriculum content areas. Team teaching is one way forward. Obviously, appropriate initial and in-service teacher education programmes of TE are essential to the successful implementation of broad-based TE in schools. Further, collaborative team teaching should be supported by the school management to foster a new school culture and organisational structure.

7.9. Facilitating Factors for Implementing Technology Education in Hong Kong Secondary Schools

In Section D of the survey questionnaire, respondents were asked to rate the level of importance on each of the listed facilitating factors for implementing TE in Hong Kong secondary schools. There were 21 items in this section. Respondents were asked to give ratings on a 5-point Likert scale, with 5 = most facilitating, 4 = facilitating, 3 = quite facilitating, 2 = less facilitating, and 1 = least facilitating.

Data analysis results in this section are organised under the following areas: Overall analysis of items in the section; and comparisons of the two respondent groups' responses on (a) Subject Image and Value, (b) Change Characteristic - Time, (c) Support from Others, (d) Resources and Professional Development, (e) Other Professional Supports, and (f) Students' Attitudes towards TE.

Overall Analysis of the Items

An overall analysis of items in the section was performed, which included mean, standard deviation, and *t*-tests between responses of the two respondent groups. The effect size (η) for the set of items in Section D was also computed. The effect size ($\eta = .157$ and $\eta^2 = .025$) was found to be very small (Cohen, cited in Huck, 2000, p. 207), as only 2.5% of the variance in the dependent variable (Facilitating Factors for Implementing TE) could be explained by the independent variable (the respondents' position). This indicates that the respondents' position (i.e., either administrator or teacher) had very small effect on the dependent variable (Facilitating Factors for Implementing TE).

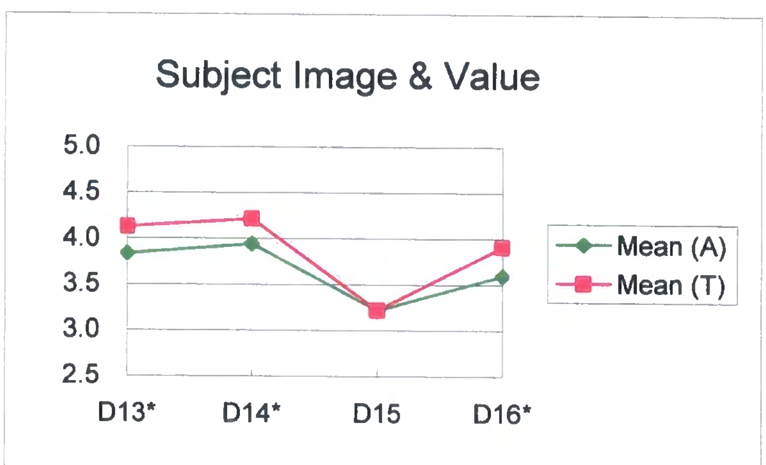
Based on data analysis, it is found that out of the 21 items under scrutiny, statistically significant differences were found in ten items. The following four items were common within both respondent groups' top 5 priority lists:

- Item D8, "Adequate financial support";
- Item D10, "Availability of quality instructional materials and teaching resources";
- Item D11, "Availability of necessary facility"; and
- Item D12, "Appropriate professional development programme for teachers".

Item D15, "Phasing out of craft-oriented technical subjects", was last on both respondent groups' lists. Detailed discussions on the two respondent groups' responses on individual areas are presented below.

Subject Image and Value. Four items in Section D of the questionnaire (i.e., Items D13-D16) considered "Subject Image and Value" as facilitating factor for the implementation of TE in schools. According to the *t*-tests results shown in Table A-29 (Appendix IV), statistically significant differences were found in three items in this area, namely Items D13, D14, and D16.

Figure 7.34 below shows that both respondent groups had quite similar response patterns for all items within this sub-area. Both respondent groups perceived that a good subject image for technological subjects (Item D13), an advantage for students taking the subjects to further studies or gain admission to tertiary institutions (Item D14), and the growing popularity of these subjects in the school curriculum (Item D16), were all "facilitating" factors (i.e., mean rating around 4) for promoting TE in schools. Phasing out of craft-oriented technical subjects in schools (Item D15), however, would not do much help.

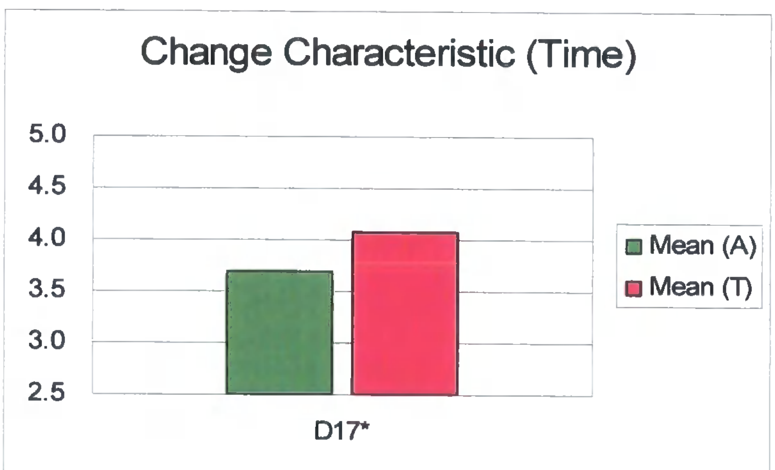


Key:
D13 = Good subject image for technological subjects
D14 = Studying technological subjects is useful for students' further study
D15 = Phasing out of craft-oriented technical subjects
D16 = Technological subjects are growing in popularity
* Item that shows statistically significant difference between the two groups.

Figure 7.34 Facilitating factor (Subject Image & Value).

Change Characteristic (Time). Item D17 in Section D considered time allowed for teachers to prepare lessons as a "Change Characteristic" factor that might facilitate the implementation of TE in schools.

According to the *t*-test results shown in Table A-30 (Appendix IV), a statistically significant difference was found in this item. Figure 7.35 below shows that both respondent groups' perceived teachers having ample time to cope with change, including adequate time for lesson preparation, a "facilitating" factor (i.e., mean rating around 4.0) for implementing TE in schools.



Key:

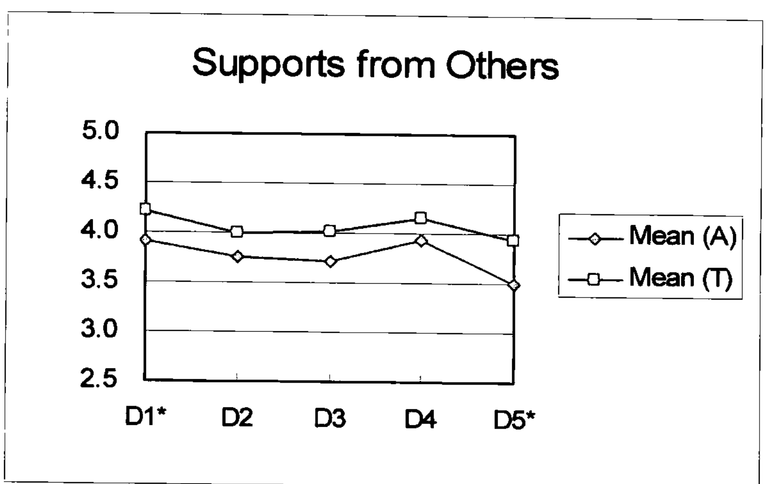
D17 = Teachers have ample time to cope with change, including adequate time for lesson preparation

* Item that shows statistically significant difference between the two groups.

Figure 7.35 Facilitating factor (Change Characteristic - Time).

Supports from Others. Five items in Section D of the questionnaire (i.e., Items D1-D5) sought to explore the respondents' perceived level of importance of "Supports from Others" as facilitating factor for the implementation of TE in schools. According to the *t*-tests results shown in Table A-31 (Appendix IV), statistically significant differences were found in two items, namely Items D1 and D5.

Figure 7.36 below and Table A-31 show that both respondent groups had quite similar response patterns for all items within this sub-area with high ratings (i.e., mean rating around 4.0). The above analysis indicates that both Administrators and Teachers perceived supports from others within and external to the school community, including supports from school administrators and the community at large, as well as from peers and parents, as important for the implementation of TE in schools. Besides, the respondents considered that government's mandatory for students to study TE is also essential. At present, the lack of rigorous government enforcement resulted in schools decreasing the time for technological subjects, or determining which subjects to offer or not offer at all.



Key:

D1 = Support from school administrators

D2 = Support from peers

D3 = Support from parents

D4 = Support from the community at large

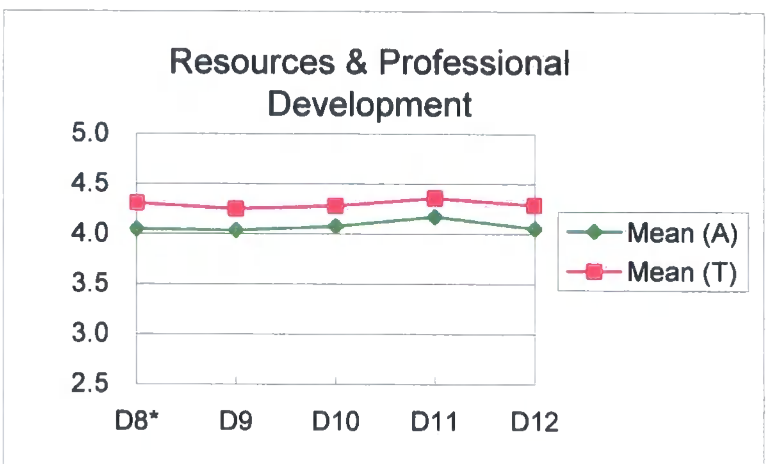
D5 = The HKSAR Government mandates students to take TE

* Item that shows statistically significant difference between the two groups.

Figure 7.36 Facilitating factor (Supports from Others).

Resources and Professional Development. Five items in Section D of the questionnaire (i.e., Items D8-D12) considered "Resources and Professional Development" as facilitating factor for the implementation of TE in schools. According to the *t*-tests results shown in Table A-32 (Appendix IV), a statistically significant difference was found in Item D8, which was about the importance of "Adequate financial support".

Figure 7.37 below and Table A-32 show that both respondent groups had very similar response patterns for all items within this sub-area with high ratings (i.e., mean rating above 4.0). The above findings indicate that both Administrators and Teachers perceived the availability of adequate financial support (Item D8), extra grant funding (Item D9), quality instructional materials and teaching resources (Item D10), necessary facilities (Item D11), and appropriate professional development programme (Item D12), all are vital for successful implementation of TE in schools.

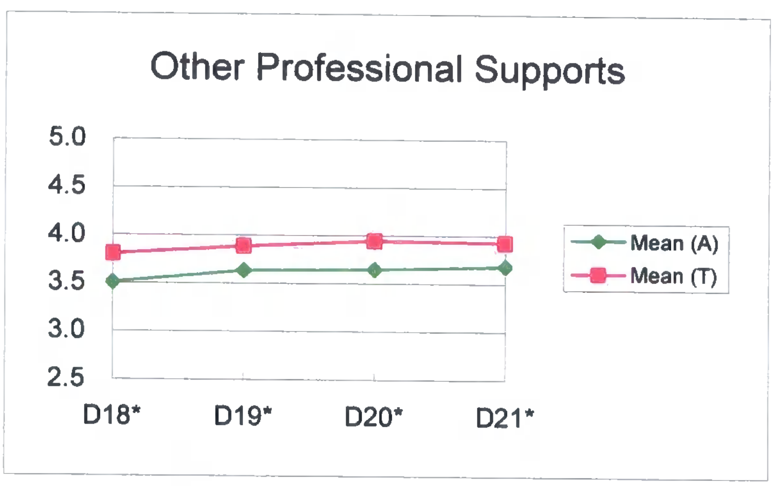


Key:
D8 = Adequate financial support
D9 = Availability of extra grant funding
D10 = Availability of quality instructional materials and teaching resources
D11 = Availability of necessary facility
D12 = Appropriate professional development programme for teachers
* Item that shows statistically significant difference between the two groups.

Figure 7.37 Facilitating factor (Resources and Professional Development).

Other Professional Supports. Four items in Section D of the questionnaire (i.e., Items D18-D21) concerned "Other Professional Supports" (e.g., TE research, journals, websites, and visits) as facilitating factor for the implementation of TE in schools. According to the *t*-test results shown in Table A-33 (Appendix IV), statistically significant differences were found in all the four items under scrutiny.

Figure 7.38 below and Table A-33 show that both respondent groups had very similar response patterns for all items within the "Other Professional Supports" sub-area with high ratings (i.e., mean rating above 4.0). It is also noted that the Teacher respondents' ratings were in general higher than those of the Administrator respondents.



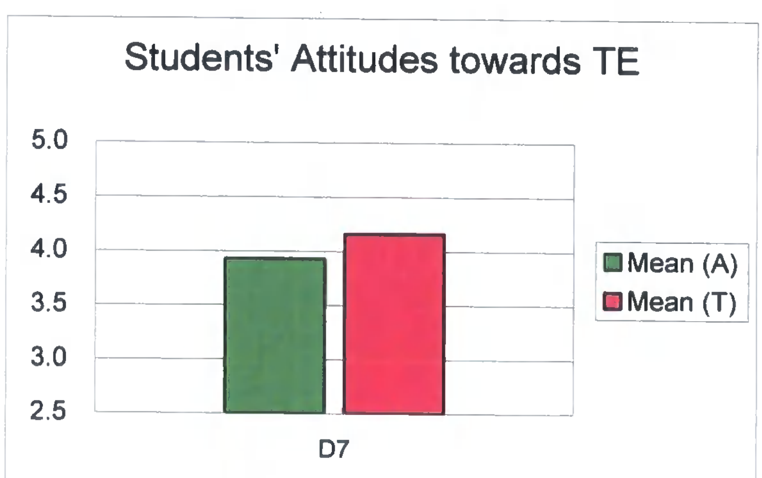
Key:
D18 = More articles on TE in local journals & magazines
D19 = More research in TE
D20 = A website for promoting TE
D21 = Opportunity of visiting / observing TE facilities and outcome of students in other schools
* Item that shows statistically significant difference between the two groups.

Figure 7.38 Facilitating factor (Other Professional Supports).

The above findings indicate that school administrators and teachers, both key change agents of TE at the school and the classroom levels, perceived that more professional support would be helpful to facilitate the implementation of TE in schools. These included more articles on TE in local journals & magazines (Item D18), more research in TE (Item D19), a website for promoting TE (Item D20), and opportunity of visiting and observing TE facilities and outcome of students in other schools (Item D21).

Students' Attitudes towards TE. Item D7 in Section D of the questionnaire considered students' attitudes on TE as one contributing factor that might facilitate the implementation of TE in schools.

Figure 7.39 below and Table A-34 (Appendix IV) show that both respondent groups' perceived students' positive attitudes towards TE a "facilitating" factor (i.e., mean rating around 4.0) for implementing TE in schools. This finding echoes results in other research studies that students' perceptions affect the rate at which they select and actively participate in technology education (See for example Raizen *et al.*, 1995; Volk & Yip, 1999).



Key:
D7 = Positive attitudes of students towards technology education

Figure 7.39 Facilitating factor (Students' Attitudes towards TE).

7.10. Impeding Factors for Implementing Technology Education in Hong Kong Secondary Schools

In Section E of the questionnaire, the respondents were asked to rate the level of impedance of the listed factors that might hinder the implementation of TE in Hong Kong secondary schools. There were 26 items in this section. Respondents were asked to give ratings on a 5-point Likert scale, with 5 = most impeding, 4 = impeding, 3 = quite impeding, 2 = less impeding, and 1 = least impeding.

Data analysis results in this section are organised under the following areas: Overall analysis of the items in the section; and comparisons of the two respondent groups' responses on (a) Change Characteristic – Time Frame, (b) Subject Image and Value, (c) Supports from Others, (d) Teacher Factors, (e) Resources and Professional Development, (f) Characteristics of TE, (g) Shortage of Subject Specialist and Leadership, and (h) Student Factors.

Overall Analysis of the Items

An overall analysis of the 26 items in the section was performed, which included mean, standard deviation, and *t*-tests between responses of the two respondent groups. Based on the analysis, it was found that statistically the two respondent groups held similar perceptions on all items in Section E, except Item E21, "Closing or elimination of TE programmes in schools".

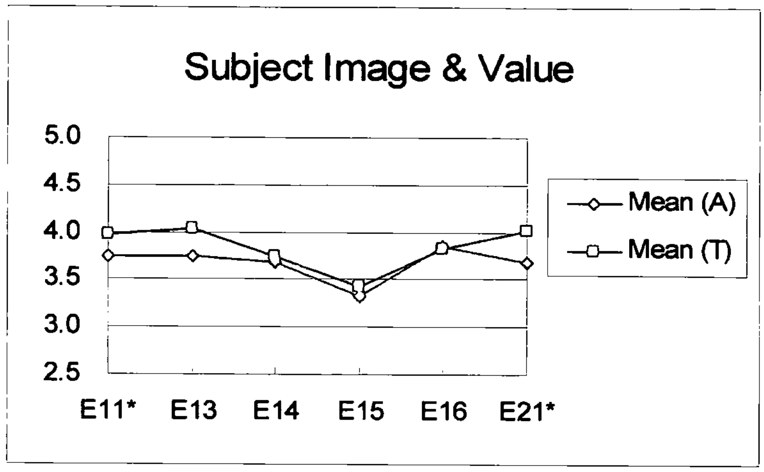
The effect size (η) for the set of items in Section E was also computed. The effect size ($\eta = .051$ and $\eta^2 = .003$) was found to be very small (Cohen, cited in Huck, 2000, p. 207), as only 0.3% of the variance in the dependent variable (Impeding

Factors for Implementing TE) could be explained by the independent variable (the respondents' position). This indicates that the respondents' position (i.e., either administrator or teacher) had very small effect on the dependent variable (Impeding Factors for Implementing TE).

Top on the Administrators' priority list were items relating to teacher quality and lack of expertise and leadership in their school (Items E1-E3). Items high on the Teachers' list were related to school administrators' misunderstanding and unfavourable decisions made towards TE (Items E7, E11, E13, and E21). The lack of appropriate facilities and resources (Item E8) was considered as a potential impeding factor by both the Administrators and Teachers. Detailed discussions on the two respondent groups' responses on individual areas are presented below.

Subject Image & Value. Six items in Section E concerned "Subject Image and Value" as impeding factor for the implementation of TE in schools. These were Items E11, E13, E14, E15, E16 and E21. According to the *t*-test results shown in Table A-35 (Appendix IV), statistically significant differences were found in two items, namely Item 11, "Unfavourable positioning of Technology Education in the school curriculum", and Item D21,"Closing or elimination of TE programmes in schools".

Figure 7.40 below and Table A-35 show that five items were perceived by both groups as "impeding" factors (i.e., mean rating around 4.0), including Items E11, E13, E14, E16 and E21. Whereas Item E15, "Subject traditions of technological subjects (e.g., gender biased)" was seen by both groups as "quite impeding" (i.e., mean rating around 3.0).



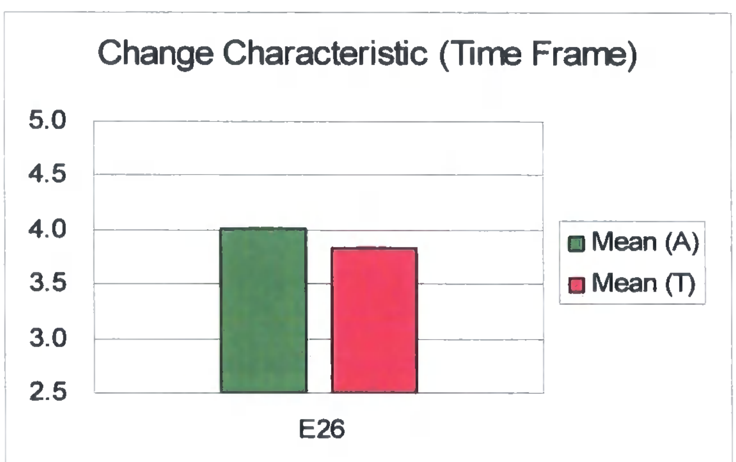
Key:
E11 = Unfavourable positioning of Technology Education in the school curriculum
E13 = School administrators using Technology Education as a dumping ground
E14 = Poor subject image of technological subjects
E15 = Subject traditions of technological subjects (e.g., gender biased)
E16 = Lack of timeslot in the congested curriculum
E21 = Closing or elimination of Technology Education programmes in schools
* Item that shows statistically significant difference between the two groups.

Figure 7.40 Impeding factor (Subject Image & Value).

Figure 7.40 also shows that both respondent groups perceived the unfavourable positioning of TE in the school curriculum (Item E11), school administrators using TE as a dumping ground (Item E13), poor subject image of technological subjects (Item E14), lack of timeslot in the congested curriculum (Item E16), and closing or elimination of TE programmes in schools (Item 21), were all "impeding" factors (i.e., mean rating around 4.0) that might hinder the implementation of TE in schools. The subject traditions of technological subjects (e.g., gender biased), however, was being considered by both respondent groups as a "quite impeding" factor (i.e., mean rating around 3.0), indicating that the male-dominated, manual-training image of technological subjects has slightly changed with time but still need to further improve if TE is to strive for a central position in the school curriculum. Furthermore, the differences of the mean scores for Items E11, E13 and E21 between the Administrators and Teachers reflect the differences in mindsets and values that the two different groups of people put on TE.

Change Characteristic (Time Frame). Item E24 considered short time frame as a "Change Characteristic" factor that might hinder the implementation of TE in schools. According to the *t*-test results shown in Table A-36 (Appendix IV), no statistically significant difference was found in this particular item.

Figure 7.41 below and Table A-36 show that both respondent groups had very similar high ratings for the item under scrutiny. This indicates that both groups considered that short time frame for preparing and implementing curricular change was an "impeding" factor (i.e., mean rating above 4.0) that might hinder the implementation of TE reform in schools.

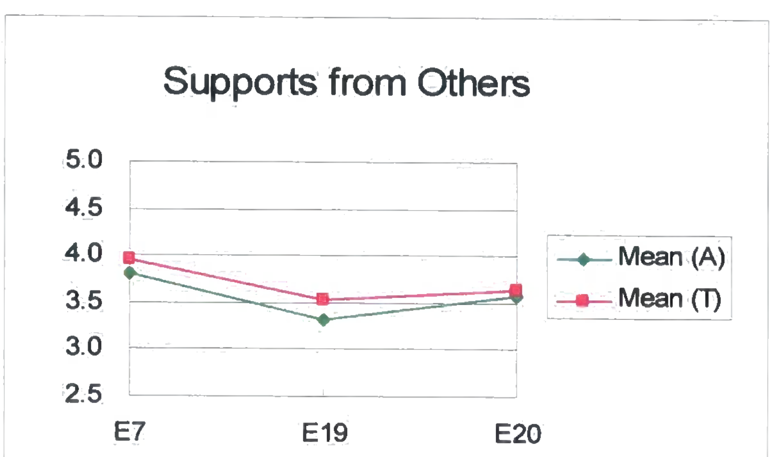


Key:
E26 = Short time frame to prepare and implement curricular change

Figure 7.41 Impeding factor (Change Characteristic - Time Frame).

Supports from Others. Three items in Section E considered supports from other people in the school community as factor that might impede the implementation of TE in schools. These included Items E7, E19 and E20. According to the *t*-tests results shown in Table A-37 (Appendix IV), no statistically significant differences were found in any items in this area.

From Figure 7.42 below and Table A-37, it can be seen that two of the items were perceived by both respondent groups as "impeding" factors (i.e., mean rating around 4.0), including Item E7, "Lack of knowledge and understanding of TE from school administration", and Item E20, "Lack of parents' understanding, interest and support of TE". The above findings highlight the importance of supports from the school administration and parents for any educational reform. As regards the importance of the supports from other teachers on TE (Item 19), the Administrator respondents perceived this as "quite impeding" (i.e., mean rating around 3.0), whilst the Teacher respondents considered it as "impeding" (i.e., mean rating around 4.0).



Key:

E7 = Lack of knowledge and understanding of TE from school administration

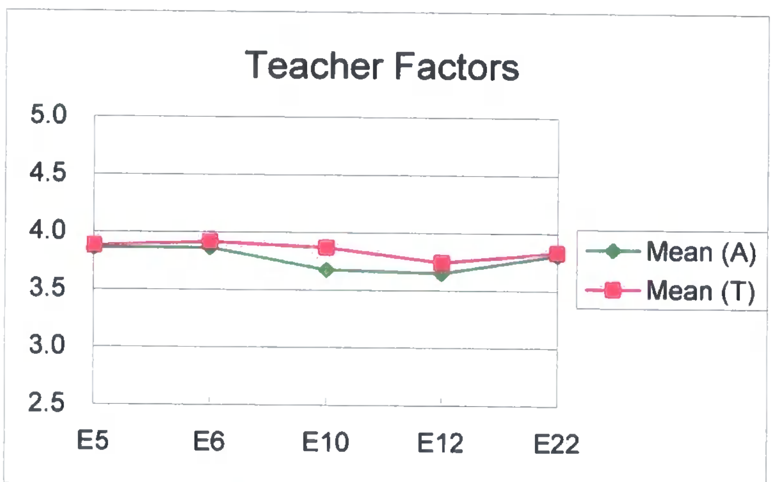
E19 = Lack of other teachers' support of TE

E20 = Lack of parents' understanding, interest and support of TE

Figure 7.42 Impeding factor (Supports from Others).

Teacher Factors. Five items in Section E considered teacher as impeding factor for the implementation of TE in schools. These included Items E5, E6, E10, E12 and E22. According to the *t*-tests results shown in Table A-38 (Appendix IV), no statistically significant differences were found in any items in this area.

Figure 7.43 below and Table A-38 show that both respondents groups had similar high ratings for all the five items under scrutiny. All the five items were perceived by both respondent groups as "impeding" factors (i.e., mean rating around 4.0).



Key:

E5 = Reluctance of teachers to change

E6 = Teacher's stress associated with short learning time of technological knowledge due to rapid pace of technological change

E10 = Negative attitudes of technological subject teachers towards technology education

E12 = Teachers' lack of understanding of the curricula reform(s)

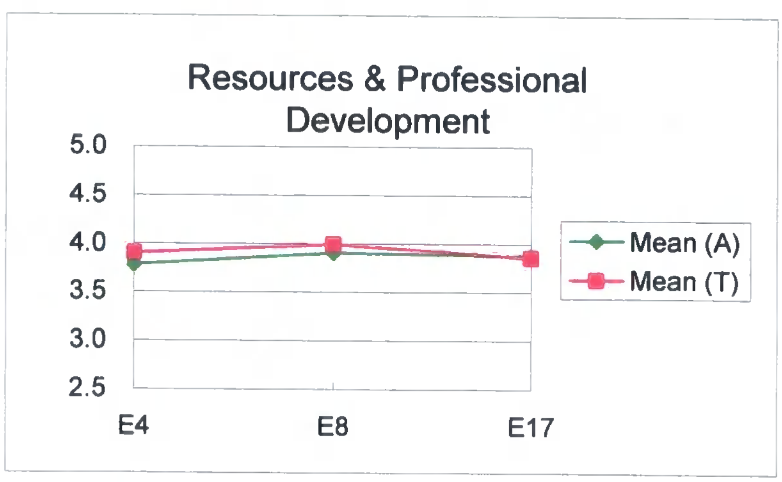
E22 =Teachers have inadequate training or expertise in the subject area

Figure 7.43 Impeding factor (Teacher Factors).

The above results indicate that both groups endorsed the view that teachers were important change agents in the educational reform process. Teachers' reluctance to change (Item E5) attributed to their negative attitudes towards TE (Item E10), and their lack of understanding of curricula reforms (Item E12), all would be potential barriers for change. Furthermore, issues relating to teachers' stress induced by the rapid pace of technological change (Item E6) and lack of appropriate professional development (Item E22) need to be seriously dealt with.

Resources & Professional Development. Three items in Section E considered "Resources and Professional Development" as impeding factor that might hinder the implementation of TE in schools. These included Items E4, E8 and E17. According to the *t*-tests results shown in Table A-39 (Appendix IV), no statistically significant differences were found in any items in this area.

Figure 7.44 below and Table A-39 show that both the two respondent groups had very similar pattern of ratings on the three items. All the three items were being perceived as "impeding" factors (i.e., mean rating around 4.0) by both groups. The above analysis indicate that the lack of quality instructional materials and teaching resources (Item E4), the lack of appropriate facilities and resources (Item E8), and inappropriate professional development programmes for teachers (Item E17), would all be potential factors that might hinder the implementation of TE in schools.

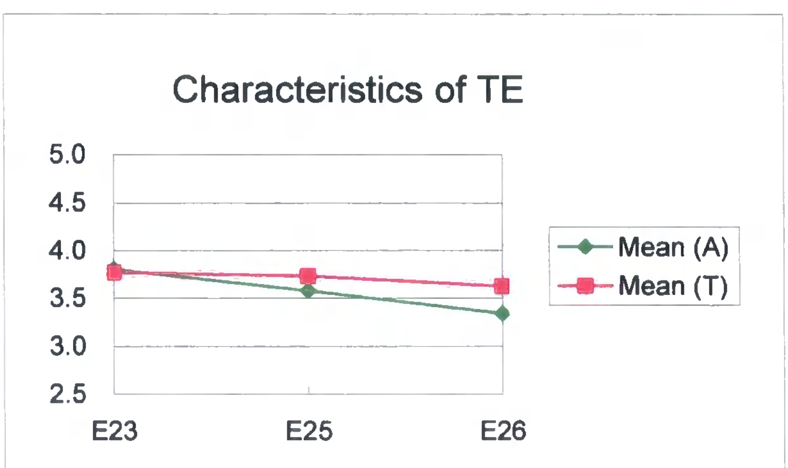


Key:
E4 = Lack of quality instructional materials and teaching resources
E8 = Lack of appropriate facilities and resources
E17= Inadequate or lack of appropriate professional development programmes for teachers

Figure 7.44 Impeding factor (Resources & Professional Development).

Characteristics of TE. Three items in Section E considered "Characteristics of TE" as impeding factor that might hinder the implementation of TE in schools. These included Items E23, E25 and E26. According to the *t*-tests results shown in Table A-40 (Appendix IV), no statistically significant differences were found in any items in this area.

Figure 7.45 below and Table A-40 show that the two respondent groups had very similar pattern of ratings on the three items. The Teacher respondents considered that the lack of consensus of curriculum content for TE (Item E23), a recognised knowledge base in TE (Item E25), and confusion of TE with computers and educational technology (Item E26), were all potential "impeding" factors (i.e., mean rating around 4.0) for the implementation of TE in schools. As for the Administrator respondents, Items E23 and E25 were being considered as "impeding" factors, whilst Item E26 was considered as merely a "quite impeding" factor (i.e., mean rating around 3.0).

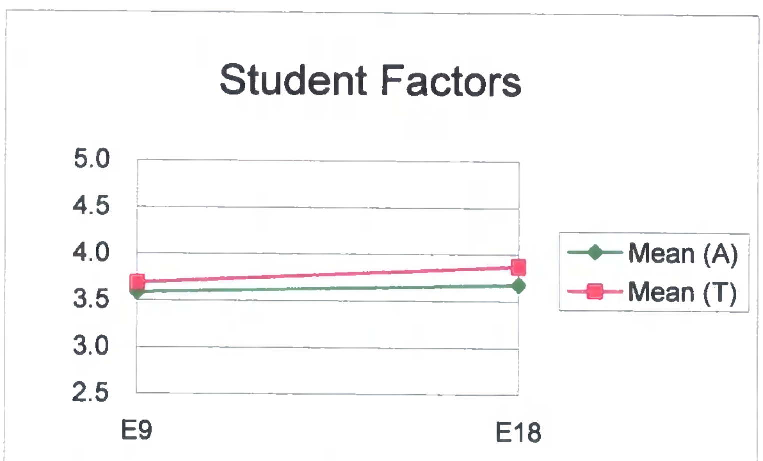


Key:
E23 = Lack of consensus of curriculum content for TE
E25 = Lack of a recognised knowledge base in TE
E26 = Confusion of TE with computers and educational technology

Figure 7.45 Impeding factor (Characteristics of TE).

Student Factors. Two items in Section E considered student as a factor that might hinder the implementation of TE in schools. These included Items E9 and E18. According to the *t*-tests results shown in Table A-41 (Appendix IV), no statistically significant differences were found in any items in this area.

Figure 7.46 below and Table A-41 show that the two respondent groups had very similar pattern of ratings on the two items. Both respondent groups perceived that students' negative attitudes towards TE (Item F9) and their lack of academic abilities (Item E18), were both "impeding" factors (i.e., mean rating around 4.0) for successful implementation of TE in schools.

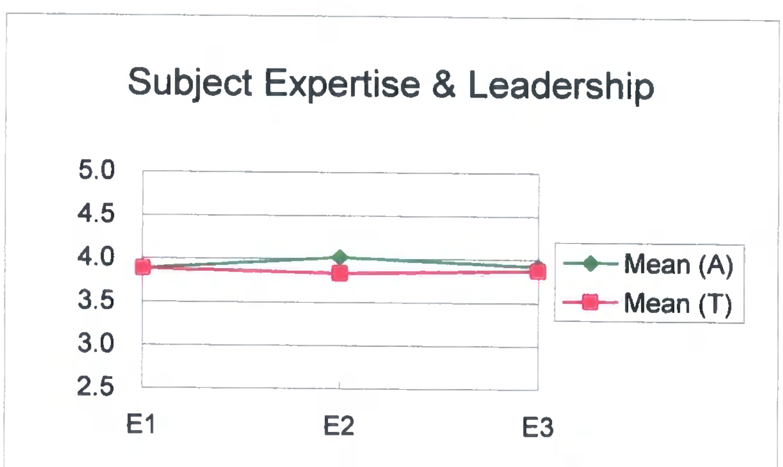


Key:
E9 = Negative attitudes of students towards TE
E18 = Students' lack of academic abilities in studying technological subjects

Figure 7.46 Impeding factor (Student Factors).

Shortage of Subject Expertise and Leadership. Three items in Section E considered "Shortage of Subject Expertise and Leadership" as impeding factor that might hinder the implementation of TE in schools. These included Items E1 to E3. According to the *t*-tests results shown in Table A-42 (Appendix IV), no statistically significant differences were found in any items in this area.

Figure 7.47 below and Table A-42 show that the two respondent groups had very similar pattern of ratings on the three items, all of which were being perceived as "impeding" factors (i.e., mean rating around 4.0) by both groups. The above analysis indicates that both groups agreed that the lack of leadership in technological subjects (Item E1), insufficient number of subject specialist in school for teaching the subject(s) (Item E2), and shortage of well-trained and qualified technological subject teachers (Item E3), would all be potential impeding factors that should be well taken care of when implementing TE in schools.



Key:
E1 = Lack of leadership in the subject(s) in school
E2 = Insufficient number of subject specialist in school for teaching technological subject(s)
E3 = Shortage of well-trained and qualified technological subject teachers

Figure 7.47 Impeding factor (Shortage of Subject Expertise and Leadership).

7.11. Desirable Competences for Newly Qualified Teachers of Technological Subjects

In Section F of the questionnaire, the respondents were asked to rate the level of importance of selected competences for newly qualified teachers of technological subjects. The 56 items in this section were separated into four major categories, namely General Pedagogical Knowledge Competence (GPKC), Subject Matter Knowledge Competence (SMKC), Pedagogical Content Knowledge Competence (PCKC), and Continuing Professional Development Competence (CPDC). (See Table 7.4 below)

General Pedagogical Knowledge Competences are general abilities that teachers possess for teaching. Subject Matter Knowledge Competences are knowledge and skills of a subject discipline. Pedagogical Content Knowledge Competences refer to the knowledge and skills that enable professional blending of the content and pedagogy so as to organise and adapt teaching topics to diverse student populations. Continuing Professional Development Competences refer to competences for teachers to update or enhance their professional knowledge and skills, and sharing with others.

Respondents were asked to give ratings on a 5-point Likert scale, with 5 = very important, 4 = important, 3 = quite important, 2 = less important, and 1 = unimportant. Data analysis results in this section are organised under the following areas: Analysis of items in individual competence categories; and comparisons of the two respondent groups' responses on the four competence categories.

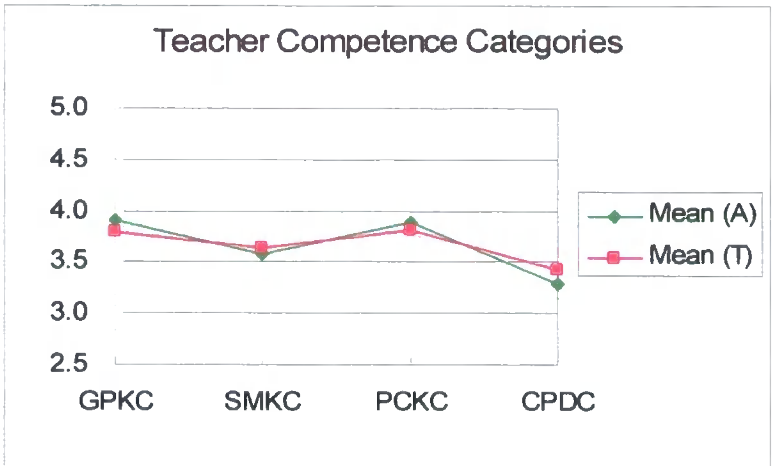
Table 7.4

Items in the Four Teacher Competence Categories

Category	Items
General Pedagogical Knowledge Competence (GPKC) (9 items)	F14, F25, F26, F32, F35, F36, F38, F51, and F55
Subject Matter Knowledge Competence (SMKC) (16 items)	F6, F10, F11, F16, F18, F19, F28, F31, F34, F37, F43, F48, F49, F50, F52, and F54
Pedagogical Content Knowledge Competence (PCKC) (22 items)	F1, F2, F3, F4, F7, F8, F12, F13, F17, F20, F22, F23, F29, F40, F41, F42, F44, F45, F46, F47, F53, and F56
Continuing Professional Development Competence (CPDC) (9 items)	F5, F9, F15, F21, F24, F27, F30, F33, and F39

The effect size (η) for the set of items in Section F was also computed. The effect size ($\eta = .008$ and $\eta^2 = .000$) was found to be negligible (Cohen, cited in Huck, 2000, p. 207). This indicates that the respondents' position (i.e., either administrator or teacher) had negligible effect on the dependent variable (the NQTs' Desirable Competences).

Comparisons of responses of the two respondent groups on the four competence categories. From Figure 7.48 below and Table A-43 (Appendix IV), it can be seen that both respondent groups' rankings on the four competence categories were nearly identical. Based on the data analysis, no significant differences were found between the two respondent groups' averaged mean scores for the four competence categories. It is also observed that in general both respondent groups rated items in the General Pedagogical Knowledge Competences and Pedagogical Content Knowledge Competences categories higher than those in the Subject Matter Knowledge Competences and Continuing Professional Development Competences categories. This indicates the expectations of the Administrators and Teachers on the NQTs knowledge and skills on teaching (pedagogy).



Key:

GPKC = General Pedagogical Knowledge Competences

SMKC = Subject Matter Knowledge Competences

PCKC = Pedagogical Content Knowledge Competences

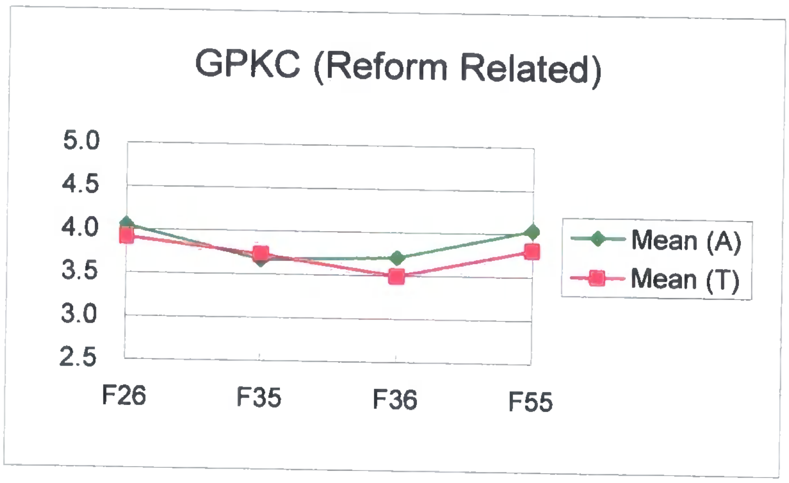
CPDC = Continuing Professional Development Competences

Figure 7.48 Perceived level of importance on the four competence categories.

7.11.1. General Pedagogical Knowledge Competence (GPKC)

There were nine items in the General Pedagogical Knowledge Competence category. These items were separated into two groups for data analysis, namely "reform related" and "generic". Items in the first group were competences conducive to the "paradigm shift" induced by recent educational reforms in Hong Kong. Competences in the second group were more generic in nature, which were desirable for teachers of all subjects and levels.

General Pedagogical Knowledge Competence (Reform Related). Four items were considered in this analysis, namely Items F26, F35, F36, and F55. The perceived levels of importance for items in the General Pedagogical Knowledge Competence (Reform Related) area are summarised in Figure 7.49 below.



Key:

F26 = Select, produce and use appropriate resources, including information technology, to support teaching and learning

F35 = Promote equality of opportunity and the avoidance of stereotype in curriculum planning, teaching, and working with students

F36 = Contribute to school-based curriculum development activities

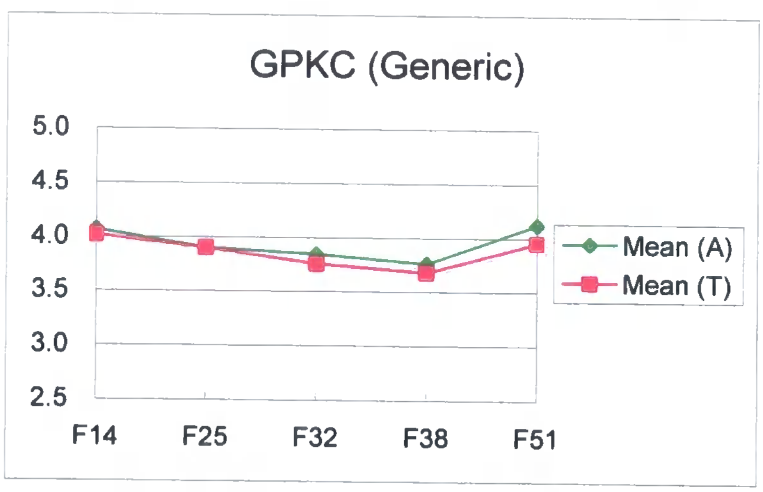
F55 = Promote interdisciplinary learning activities that enable students to integrate and transfer knowledge and skills to other subject disciplines

Figure 7.49 General pedagogical knowledge competence (Reform Related).

Table A-44 (Appendix IV) shows means, standard deviations, and *t*-values for mean scores of the items with the corresponding statistical significance indicators. From the Table, it can be seen that statistically significant differences were found in two items: Item F36, "Contribute to school-based curriculum development activities"; and Item F55, "Promote interdisciplinary learning activities that enable students to integrate and transfer knowledge and skills to other subject disciplines". Furthermore, data analysis reveals that both respondent groups considered all the four items in the GPKC (reform-related) sub-category as "important" (i.e., mean rating around 4.0) competences for the NQTs, although the mean ratings for Items F35 and F36 were just above 3.5.

The patterns of responses given by the two groups' were considered reasonable. For instance, the Administrator respondents seemed to rate higher items that portray them or their job as school leader and key change agent at the school level (e.g., to promote interdisciplinary learning activities across subject areas).

General Pedagogical Knowledge Competence (Generic). Five items were considered in this analysis, namely Items F14, F25, F32, F38, and F51. The perceived levels of importance for items in the General Pedagogical Knowledge Competence (Generic) area are summarised in Figure 7.50 below.



Key:

F14 = Set expectations for students that are clear, challenging and achievable

F25 = Set appropriately demanding and progressive expectations for individual students of all abilities

F32 = Employ appropriate strategies to meet the needs of gifted students and those with special educational needs or learning difficulties

F38 = Structure teaching and students' learning to provide context within which students can be encouraged to clarify their own values and examine those of society

F51 = Create and maintain stimulating, purposeful and orderly learning environments that supports and enhances students' learning

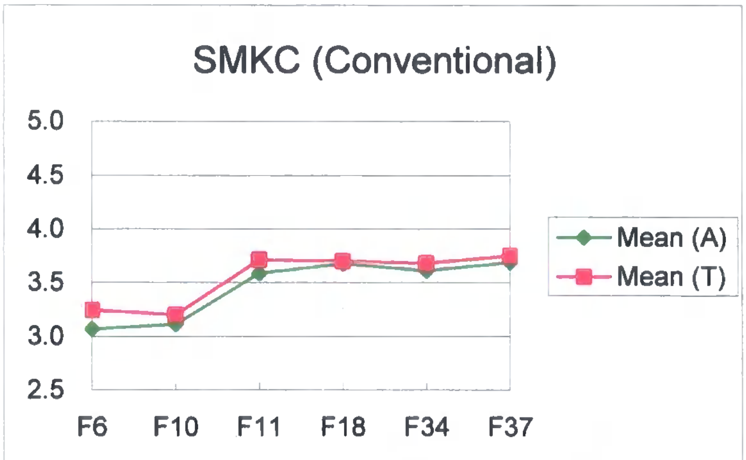
Figure 7.50 General pedagogical knowledge competence (Generic).

Table A-45 (Appendix IV) displays the means, standard deviations, and *t*-values for mean scores with the corresponding statistical significance indicators of the items under scrutiny. Based on the data analysis, statistically significant differences were not found in any of the items within this sub-category. This indicates that the perceptions of the two groups were consistent for all the items under scrutiny. Furthermore, data analysis reveals that both respondent groups perceived all the five items to be "important" (i.e., mean rating around 4.0) competences for the NQTs, although the mean rating for Items F32 and F38 were just above 3.5.

7.11.2. Subject Matter Knowledge Competence (SMKC)

There are 16 items in the Subject Matter Knowledge Competence category. The items were broken down into four separated groups for data analysis, namely "Conventional", "Renewed", "Design, Technology and Society", and "School Subject Knowledge" competences. "Conventional" SMK competences were those generally accepted as normal and right by most people in the profession. "Renewed" SMK competences were those catered for recent curricular and technological changes. "Design, Technology and Society" competences, as the name implies, are knowledge, attitude and skills related to the influence of all facets of design and technology on society. "School Subject Knowledge" competences refer to acquaintance about school knowledge of technology delivered in school.

Subject Matter Knowledge Competence (Conventional). Six items were considered in this analysis, namely Items F6, F10, F11, F18, F34, and F37. The perceived levels of importance for items in the Subject Matter Knowledge Competence (Conventional) area are summarised in Figure 7.51 below.



Key:

F6 = Prepare materials, equipment and tool purchases requests

F10 = Maintain technological tools and equipment

F11 = Select and use a range of basic machine tools properly and safely for making artefacts

F18 = Select and use a range of computer controlled machine tools and devices properly and safely for making artefacts

F34 = Select and use a range of technological materials and processes properly and safely for making artefacts

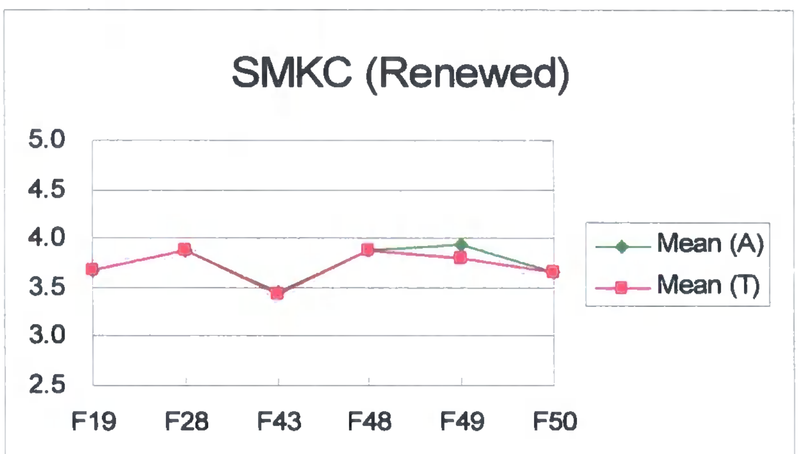
F37 = Select and use a range of hand tools properly and safely for making artefacts

Figure 7.51 Subject matter knowledge competence (Conventional).

From Table A-46 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. Data analysis reveals that both respondent groups considered Items F11, F18, F34, F37 to be "important" (i.e., mean rating around 4.0) competences for the NQTs; whilst Items F6 and F10 as "quite important" (i.e., mean rating around 3.0).

The above data analysis indicates that both respondent groups considered that the NQTs should be able to properly select and use a wide range of technological materials and processes (Item F34), conventional basic hand tools (Item F37), machine tools (Item F11), as well as computer-controlled machines and devices (Item F18) for making artefacts. The above findings also suggest that both Administrators and Teachers held relatively high expectations on the NQTs to demonstrate safe practices with the tools, equipment, and materials used.

Subject Matter Knowledge Competence (Renewed). Six items were considered in this analysis, namely Items F19, F28, F43, F48, F49, and F50. The perceived levels of importance for items in the Subject Matter Knowledge Competence (Renewed) area are summarised in Figure 7.52 below.



Key:

F19 = Understand and apply scientific and mathematical principles to technological problem solving

F28 = Demonstrate an ability to solve problems, think critically, and make decisions

F43 = Demonstrate knowledge on "Hi-Tech" equipment such as laser and robotics

F48 = Use a variety of graphical communication techniques including sketching, modelling, and recording design decisions

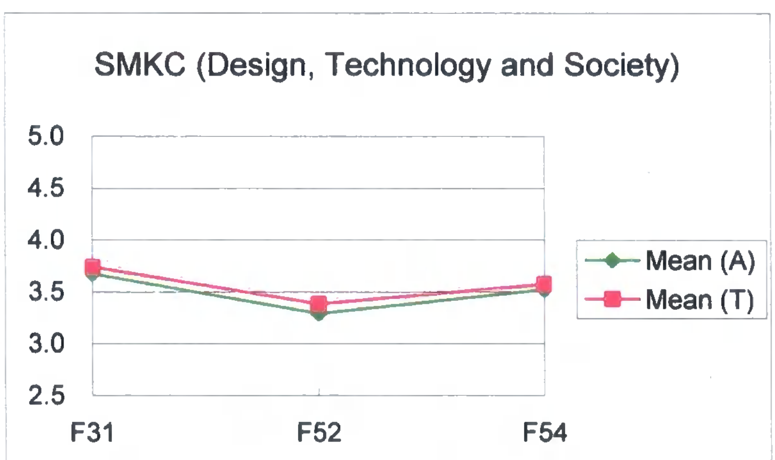
F49 = Use information technology for communicating and data handling

F50 = Use information technology for modelling, controlling and manufacturing

Figure 7.52 Subject matter knowledge competence (Renewed).

From Table A-47 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. This indicates that the perceptions of the two groups were consistent for all items in this sub-category. Besides, data analysis reveals that both respondent groups considered Items F19, F28, F48, F49, and F50 to be "important" (i.e., mean rating around 4.0) competences for the NQTs. Whereas both respondent groups considered Item 43 as "quite important" (i.e., mean rating around 3.0).

Subject Matter Knowledge Competence (Design, Technology and Society). Three items were considered in this analysis, namely Items F31, F52, and F54. The perceived levels of importance for items in the Subject Matter Knowledge Competence (Design, Technology and Society) area are summarised in Figure 7.53 below.



Key:
F31 = Consider different values (technical, economic, aesthetic, social, environmental and moral) when designing
F52 = Assess the use of technology in selected industries
F54 = Assess the immediate impacts and long-term effects of technology

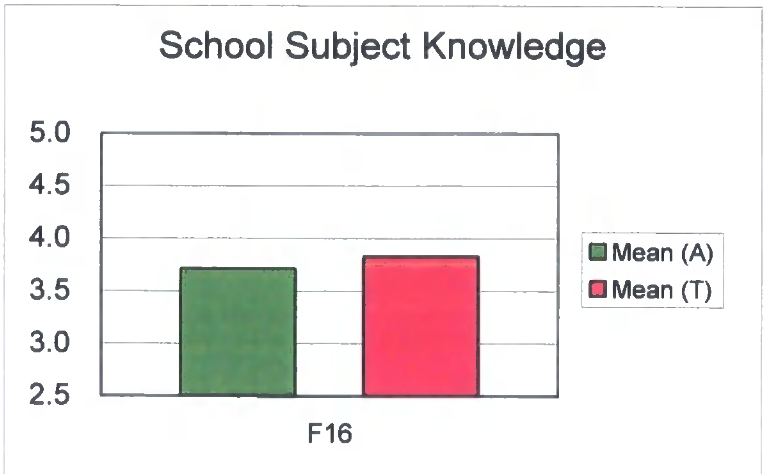
Figure 7.53 Subject matter knowledge competence (Design, Technology and Society).

From Table A-48 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. This indicates that the perceptions of the two groups were consistent for all items in this sub-category. Besides, data analysis reveals that both respondent groups considered Items F31 and F54 to be "important" (i.e., mean rating around 4.0) competences for the NQTs; whereas both respondent groups considered Item F52 as "quite important" (i.e., mean rating around 3.0).

Traditionally, technology programmes have concentrated on technical techniques and know-how, but now the goals of technological literacy also required serious consideration of purposes, influences and impacts – on know-why, and with what outcome. The above results indicate that both the Administrator and Teacher respondents acknowledged the importance of the knowledge and skills of the NQTs on the social aspects and values in design and technology.

Subject Matter Knowledge Competence (School Subject Knowledge). The perceived levels of importance for the item (F16) in the Subject Matter Knowledge Competence (School Subject Knowledge) area are summarised in Figure 7.54 below.

From Table A-49 (Appendix IV), it can be seen that statistically significant difference was not found in the item under scrutiny. This indicates that the perceptions of the two groups were consistent for the item. Besides, data analysis reveals that both respondent groups considered the item as "important" (i.e., mean rating around 4.0) competences for the NQTs.



Key:
F16 = Demonstrate a breadth of subject knowledge and skills sufficient to teach technological subjects at S1 to S6 levels

Figure 7.54 Subject matter knowledge competence (School Subject Knowledge).

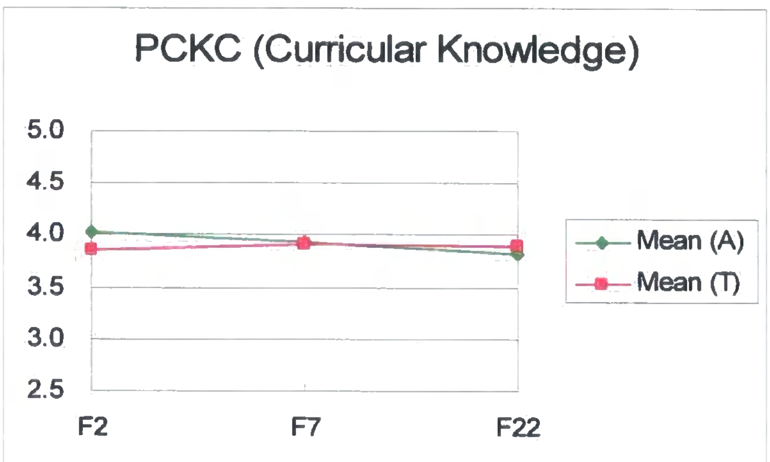
School technology grows out of a general body of knowledge which is different from technology as practised in the world outside the school. The above result implies that the NQTs of technological subjects should be acquainted with school subject knowledge in technology for effective teaching and learning of the subject in the school context.

7.11.3. Pedagogical Content Knowledge Competence (PCKC)

Pedagogical content knowledge is often labelled as "subject application" in UK government documents and the Design and Technology Association's publications (see e.g., DATA, 2003; DFE & WO, 1992). In the survey questionnaire, the Pedagogical Content Knowledge Competence category comprised 22 items. These items were broken down into five separated areas for data analysis, namely (a)

Curricular Knowledge, (b) Curriculum and Instruction Planning, (c) Workshop-related and Health & Safety, (d) Support and Enhancement of Student Learning, and (e) Language Skills.

Curricular Knowledge. Three items were considered in this area, namely Items F2, F7, and F22. The perceived levels of importance for items in the Pedagogical Content Knowledge Competence (Curricular Knowledge) area are summarised in Figure 7.55 below.



Key:

F2 = Demonstrate knowledge and understanding of the TE Curriculum Framework as recommended by the CDC

F7 = Demonstrate an understanding of the nature of TE and its role within the whole secondary school curriculum

F22 = Demonstrate a knowledge and understanding of examination syllabuses of Technological Subjects

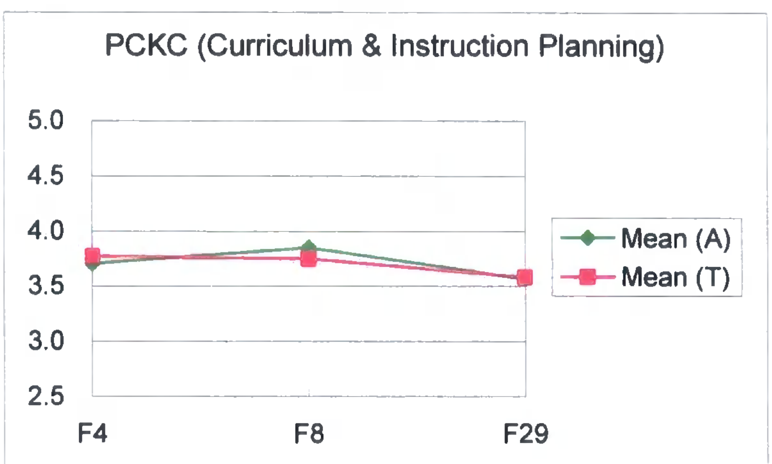
Figure 7.55 Pedagogical content knowledge competence (Curricular Knowledge).

From Table A-50 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. This indicates that the perceptions of the two groups were consistent for all items in this sub-category.

Besides, data analysis reveals that both respondent groups considered all the three items to be "important" (i.e., mean rating around 4.0) competences for the NQTs.

The high ratings of the items assigned by the two respondent groups endorsed the ideas that teachers should possess knowledge about the curriculum (its goals, purposes, and rationales) and the teaching media. Such curricular knowledge is necessary to enable teachers to evaluate text books, computer software and other instructional materials for the development and implementation of educational programmes (Jenkins, 2003).

Curriculum and Instruction Planning. Three items were considered in this analysis, namely Items F4, F8, and F29. The perceived levels of importance for items in the Pedagogical Content Knowledge Competence (Curriculum and Instruction Planning) area are summarised in Figure 7.56 below.



Key:
F4 = Plan, manage and evaluate units of work and lessons taking account of the TE Curriculum Framework and the school's curriculum policy
F8 = Plan their teaching on the basis of recent, relevant pedagogical research in TE
F29 = Relate teaching and learning activities to current theories

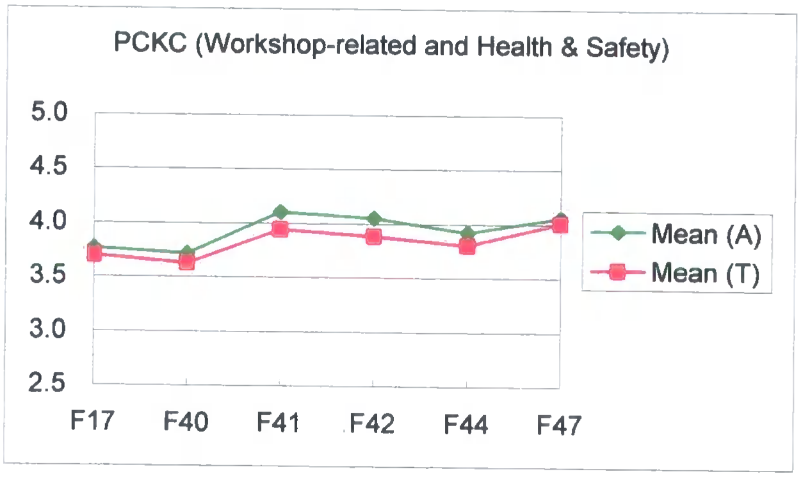
Figure 7.56 Pedagogical content knowledge competence (Curriculum and Instruction Planning).

From Table A-51 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. This indicates that the perceptions of the two groups were consistent for all items in this sub-category. Besides, data analysis reveals that both respondent groups considered all three items to be "important" (i.e., mean rating around 4.0) competences for the NQTs.

The above results indicate that the NQTs are expected to be capable of planning lessons according to the intended curriculum set down by the government and the formal curriculum adopted by the school. Besides, they are expected to be capable of planning their teaching on the basis of current research and contemporary education theories.

Workshop-related and Health & Safety. Six items were considered in this analysis, namely Items F17, F40, F41, F42, F44, and F47. The perceived levels of importance for items in the Pedagogical Content Knowledge Competence (Workshop-related and Health & Safety) area are summarised in Figure 7.57 below.

From Table A-52 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. This indicates that the perceptions of the two groups were consistent for all items in this sub-category. Besides, analysis data reveals that both respondent groups considered all six items to be "important" (i.e., mean rating around 4.0) competences for the NQTs.



Key:

F17 = Plan and layout technology laboratories and instructional areas

F40 = Manage effectively TE provisions in schools including the storage of materials, tools and equipment

F41 = Work confidently with students in accordance with the appropriate health and safety regulations

F42 = Apply appropriate health and safety measures to make risk assessments for themselves and others

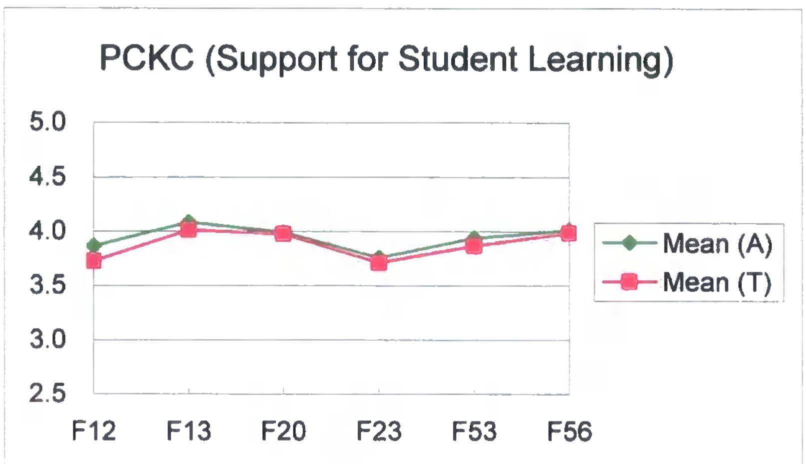
F44 = Identify environmental and safety concerns related to technological activities and facilities

F47 = Maintain a safe working and learning environment through appropriate health and safety procedures and students' routines

Figure 7.57 Pedagogical content knowledge competence (Workshop-related and Health & Safety).

Technological subject teachers typically are responsible for conducting technological activities in workshop/laboratory settings that contain a variety of potentially hazardous tools, equipment, and materials. The above results are in accordance with DATA's (2004b) assertion that design and technology teachers and trainees should demonstrate both personal and professional competences in health and safety. The teachers and trainees should be competent of undertaking risk assessment and ensuring that the learning environments do not contain health and safety hazards. They should also demonstrate that they can adopt appropriate teaching strategies to ensure safety within design and technology activities and have secure knowledge and understanding of equipment, processes, tools, materials and components before using them.

Support for Student Learning. Six items were considered in this analysis, namely Items F12, F13, F20, F23, F53, and F56. The perceived levels of importance for items in the Pedagogical Content Knowledge Competence (Support for Student Learning) area are summarised in Figure 7.58 below.



Key:

F12 = Structure teaching and learning activities to provide students with opportunities to work with industry, commerce, and the local community

F13 = Demonstrate an understanding of how TE enhances students' conceptual, creative and practical developments

F20 = Effectively use a suitable range of teaching and learning strategies for technology learning activities which match students' age, ability, gender, and individual needs

F23 = Contribute to the development of students' language and communication skills through the clear use and promotion of technological vocabulary

F53 = Effectively plan and manage individual students' technology learning activities

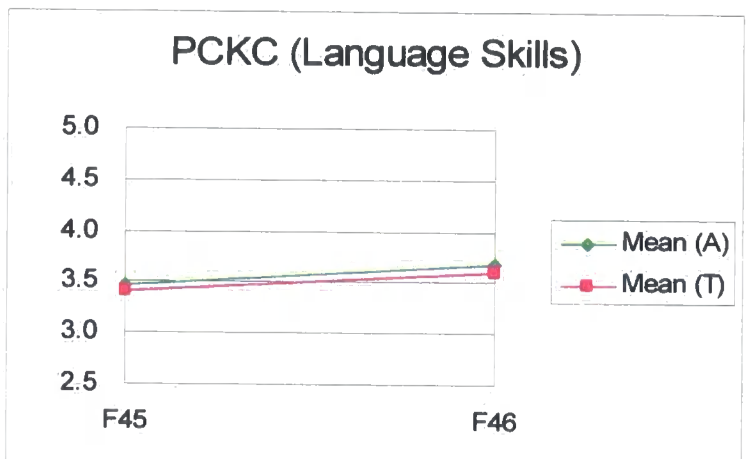
F56 = Effectively monitor and support students' design and making activities

Figure 7.58 Pedagogical content knowledge competence (Support for Student Learning)

From Table A-53 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. This indicates that the perceptions of the two groups were consistent for all items in this sub-category.

Besides, data analysis reveals that both respondent groups considered all six items to be "important" (i.e., mean rating around 4.0) competences for the NQTs.

Language Skills. Two items were considered in this analysis, namely Items F45 and F46. The perceived levels of importance for the two items in the Pedagogical Content Knowledge Competence (Language Skills) area are summarised in Figure 7.59 below.



Key:
F45 = Demonstrate oral and written English language skills for teaching technological subjects
F46 = Demonstrate oral and written Chinese language skills for teaching technological subjects

Figure 7.59 Pedagogical content knowledge competence (Language Skills).

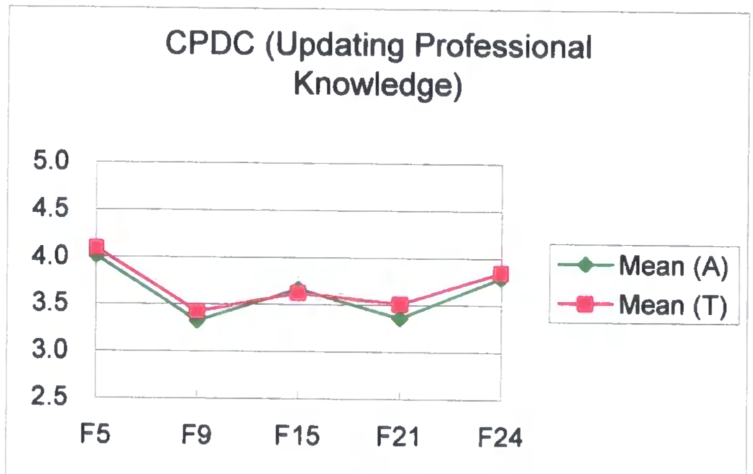
From Table A-54 (Appendix IV), it can be seen that statistically significant differences were not found in the two items under scrutiny. This indicates that the perceptions of the two respondent groups were consistent for the two items in this sub-category. Besides, data analysis reveals that both the Administrators and Teachers generally agreed with the Education Commission's (2005, para. 3.12) conception that "to be able to communicate subject contents effectively, teachers must possess, in addition to subject and pedagogical knowledge, sufficient proficiency in language." It is also found that both respondent groups considered the proficiency of the Chinese language was more important than English for the NQTs in teaching technological subjects.

It is important to recognise that the development of a technological language is integral to the development of technology itself (Jenkins, 2003). The above findings support the notion that, given the unique nature of technology and technology education, technological subject teachers in Hong Kong must be proficient in both Chinese and English. The argument is that for students whose medium of instruction for technology is the local language Chinese, they still need to have an adequate level of English to help them to learn from the Internet and other sources about the latest development of technology. In this regard, teachers of technological subjects in Hong Kong must be proficient in English and must understand the problems students face in learning *about* and *through* technology in English, and be able to help them overcome these problems.

7.11.4. Continuing Professional Development Competence (CPDC)

There were nine items in the Continuing Professional Development competence category. Five of which required the NQTs' active participation in professional activities to update and enhance their knowledge and skills, the other four were items relating to the "sharing of knowledge and good practices with others" aspect as delineated in the ACTEQ's (2003) Teacher Competencies Framework (TCF).

Continuing Professional Development Competence (Updating and Enhancing Professional Knowledge and Skills). Five items were considered in this analysis namely, Items F5, F9, F15, F21, and F24. The perceived levels of importance for the first set of Continuing Professional Development Competence items are summarised in Figure 7.60 below.



Key:
F5 = Further attend a qualification awarding programme related to technology or TE
F9 = Conduct a research related to TE
F15 = Read professional journals and other literature related to technology education
F21= Keep current through active membership in professional organisations in TE
F24= Employ mechanisms to stay current in technology

Figure 7.60 Continuing professional development competence (Updating and Enhancing Professional Knowledge and Skills).

Table A-55 (Appendix IV) shows that no statistically significant differences were found in any of the items under scrutiny. The rank orders of the items were identical for both respondent groups, indicating that the perceptions of the two groups were consistent for all items in this sub-category.

Besides, data analysis reveals that both respondent groups considered the following three items to be "important" (i.e., mean rating around 4.0) competences for the NQTs: Items F5, "Further attend a qualification awarding programme related to technology or TE"; Item 24, "Employ mechanisms to stay current in technology"; and Item F15, "Read professional journals and other literature related to technology education". The above findings indicate that both the Administrators and Teachers acknowledged that the NQTs of technological subjects should be committed to life-long learning to keep up with the rapid pace of changes in a technological and knowledge-based society.

Continuing Professional Development Competence (Sharing of Knowledge and Good Practices with Others). Four items were considered in this analysis, namely Items F27, F30, F33, and F39. The perceived levels of importance for items in this area are summarised in Figure 7.61 below.

Key:
F27 = Write an article or book for publication relating to TE
F30 = Write a proposal for applying a grant (e.g. Quality Education Fund)
F33 = Present a paper or teaching and learning activity at a TE meeting / conference
F39 = Participate in TE electronic panel discussions on the web / via e-mail

Figure 7.61 Continuing professional development competence (Sharing of Knowledge and Good Practices with Others).

From Table A-56 (Appendix IV), it can be seen that statistically significant differences were not found in any of the items under scrutiny. This indicates that the perceptions of the two groups were consistent for all items in this sub-category.

Besides, data analysis reveals that both respondent groups had very low ratings (i.e., mean rating around 3.0) for three out of the four items in this sub-category: Items F27 and F30, about writing a book for publication and a proposal for applying for a grant; and Item F33, about presenting a paper at a conference. The above findings might be interpreted as that both respondent groups (the Administrators in particular) considered that beginning teachers should devote more time on teaching as a first priority. Anyhow, the NQTs should be prepared to engage in professional discourse and share their expertise and experience with colleagues in a growing learning community at a time of rapid technological and educational changes.

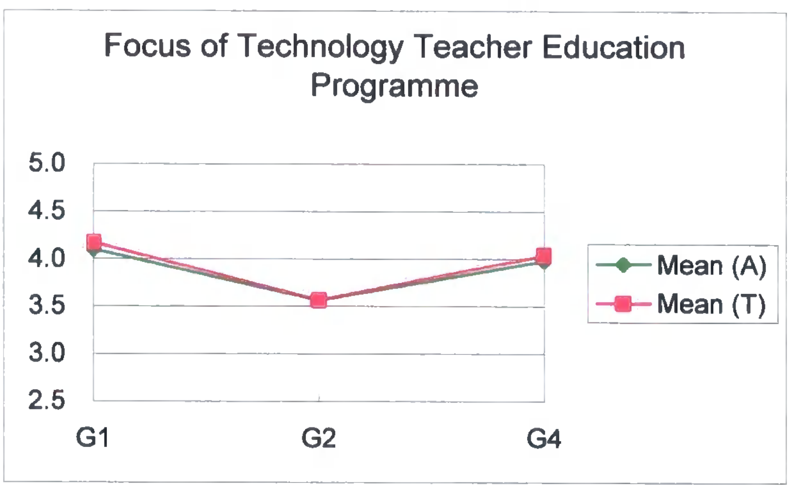
7.12. Technology Teacher Education Programme

In Section G of the questionnaire, the respondents were asked to indicate the extent of their agreement or disagreement with statements about technology teacher education programmes.

The effect size (η) for the set of items in Section G was also computed. The effect size ($\eta = .066$ and $\eta^2 = .004$) was found to be very small (Cohen, cited in Huck, 2000, p. 207), as only 0.4% of the variance in the dependent variable (Technology Teacher Education Programme) could be explained by the independent variable (the respondents' position). This indicates that the respondents' position (i.e., either administrator or teacher) had negligible effect on the dependent variable (Technology Teacher Education Programme).

Data analysis results in this section are organised under the following areas: Comparisons of the two respondent groups' responses on the focus of initial teacher education programme for technological subject teachers; pre-requisites for entry to technology teacher education programmes; and initial teacher training mode.

Focus of initial teacher education programme for technological subject teachers. Figure 7.62 below summaries the respondent groups' mean scores on the statements relating to the focus of initial teacher education programme for technological subject teachers.



Key:

G1 = Training programmes for technological subject teachers should emphasise the provision of a thorough foundation in subject matter

G2 = Training programmes for technological subject teachers should focus on the use of new technologies (e.g., Robotics and automation)

G4 = Pre-service technology teacher education should consist of equal studies in technology, academic, and professional courses

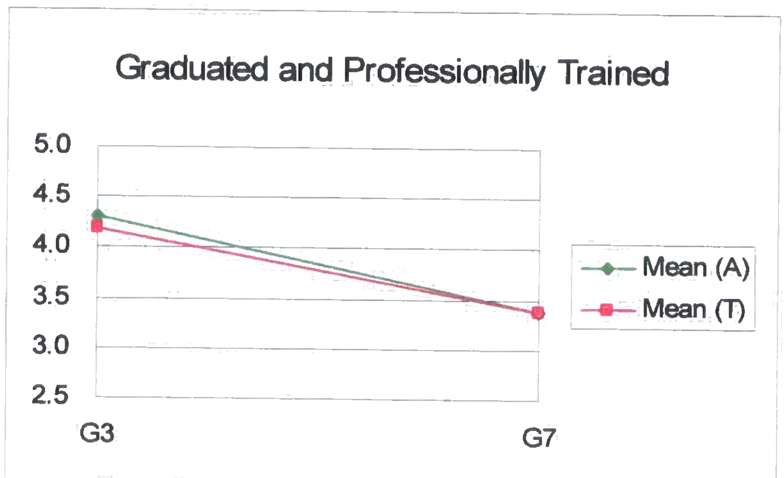
Figure 7.62 Focus of technology teacher education programme.

From Table A-57 (Appendix IV), it can be seen that both respondent groups were "strongly agreed" (i.e., mean rating around 4.0) with all the three items under scrutiny. The above data analysis indicates that initial teacher training programmes for technological subject teachers should provide a comprehensive foundation in subject matter (Item G1), including the use of new technologies, such as robotics and automation (Item G2). Besides, initial teacher education programme for technological subject teachers should have equal emphasis on the technology, academic, and professional aspects (Item G4).

The above results are consistent with previous findings in this study (on the NQTs' Subject Matter Knowledge Competences) and in accordance with the literature that technology teachers should have a strong foundation in subject matter. However, what curriculum should constitute a technology teacher education programme is an issue confronted by many teacher educators today: The balance among technology, academic and professional components; and the relevance of what is learned in teacher education institutions for the "authentic" teaching in schools (Olsan, 2003).

Qualification of newly qualified technological subject teachers. Figure 7.63 below summaries the respondent groups' agreement scores on the statements that considered whether newly qualified technological subject teachers should be graduated in a relevant field and professionally trained.

From Table A-58 (Appendix IV), it can be seen that all respondents in this study, school administrators and serving teachers alike, "strongly agreed" (i.e., mean rating around 4.0) that "Technological Subject Teachers should be professionally trained before entering the teaching profession" (Item G3). Besides, both respondent groups "moderately agreed" (i.e., mean rating around 3.0) that technological subject teachers need to be degree holders in a relevant field (Item G7). The above findings support the idea that teachers should be professionally trained before entering the teaching profession. Results of a recent meta-analysis study (Darling-Hammond *et al.*, 2005) show that certified teachers are in general more effective and produce stronger student achievement than teachers without formal professional preparation.



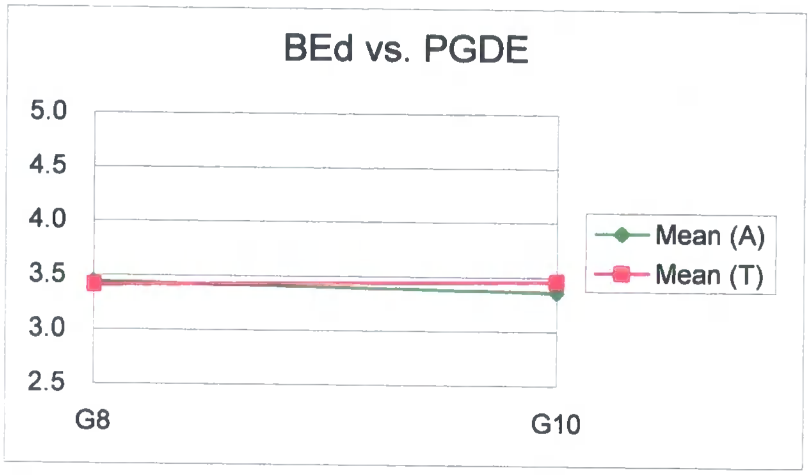
Key:

G3 = Technological subject teachers need to be professionally trained before entering the teaching profession

G7 = Technological subject teachers need to possess a relevant bachelor degree before entering the teaching profession

Figure 7.63 Graduated in a relevant field and professional trained.

Initial teacher training mode (BEd vs. PGDE). Figure 7.64 below summaries the respondent groups' agreement scores on the statements relating to the appropriateness of BEd and PGDE programmes for training technological subject teachers.



Key:
G8 = A BEd programme is appropriate for training competent technological subject teachers
G10 = A PGDE programme is appropriate for training competent technological subject teachers

Figure 7.64 Initial teacher training mode (BEd vs. PGDE).

From Table A-59 (Appendix IV), it can be seen that both respondent groups considered that either the four-year Bachelor in Education (BEd) programme or the Postgraduate Diploma in Education (PGDE) programme for degree holders is appropriate for training competent technological subject teachers.

Given that school administrators are key persons in making decisions for hiring teachers, it is worthwhile to find out whether their backgrounds have any correlation with their preferences on the mode of initial teacher training of technological subject teachers. Analysis of variance (ANOVA) testing was performed for comparing the perceptions of Administrator respondents according to their Subject Major on Items G8 and G10. No statistical significance differences were found between the responses from the Administrators with different academic backgrounds. (See Figure 7.65 below, and Table A-60 in Appendix IV)

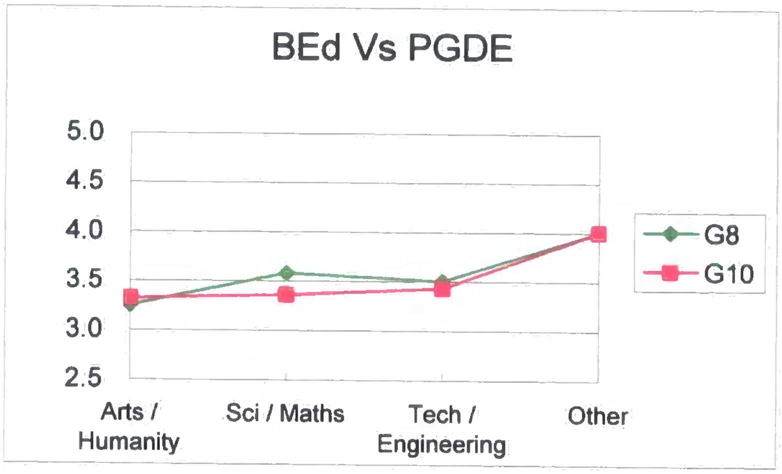
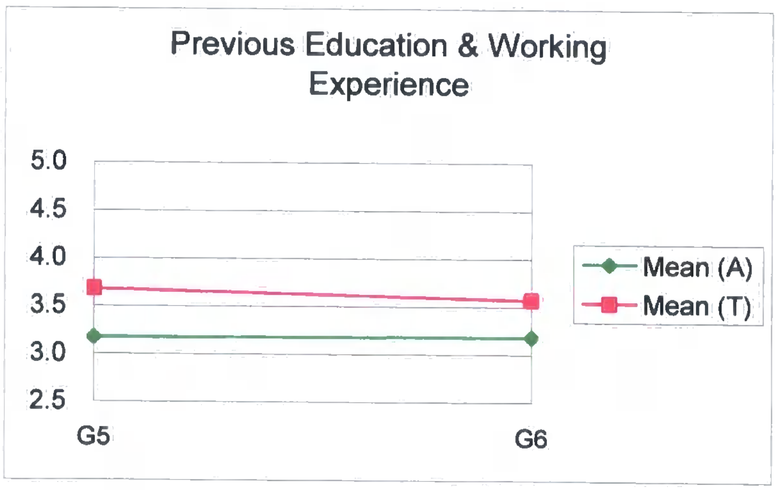


Figure 7.65 BEd vs. PGDE as perceived by administrators.

Pre-requisites for entry into technology teacher education programmes. Figure 7.66 below summaries the two respondent groups' agreement scores for the two statements relating to pre-requisites for entry into technology teacher education programmes (i.e., Items G5 and G6).



Key:

G5 = Completion of a secondary school TE course should be a major criterion in selecting students for technology teacher education programme

G6 = Relevant working experience should be a major criterion in selecting students for technology teacher education programme

Figure 7.66 Previous education and working experience as entry requirement for technology teacher education programme.

Table A-61 (Appendix IV) depicts the respondents' perceptions of whether "Completion of a secondary school TE course" (Item G5) and "Relevant working experience" (Item G6) should be major criteria in selecting students for entering technology teacher education programmes. Data analysis results reveal that both respondent groups agreed that "completion of a secondary school TE course" and "relevant working experience" are both relevant pre-requisites for selecting students for technology teacher education programme.

CHAPTER 8

QUALITATIVE DATA ANALYSIS AND FURTHER OBSERVATIONS

8.1. Introduction

Qualitative data collected in the interviews generated a data base of considerable size. This included transcripts of interviews and field notes. Other than that, numerous remarks were being made by respondents in the questionnaire's "additional comment" columns after each section. Qualitative analysis interpreting interview transcriptions, field notes and the additional comments was done and is presented as "further observations" in this chapter. Comments concerning different viewpoints of TE and technology teacher education are reported in such a way as to keep a balance between the views in order to avoid making the study descend "into a bedlam where the battles … are won … by those who shout the loudest" (Silverman, 2002, p. 174).

8.2. Technological Subjects in the School Curriculum

Most schools participated in the survey reported that technological subjects were offered to both boys and girls at the junior secondary level, but not at the secondary level. One teacher explains:

> Both boys and girls [in my school] have the opportunity to study D&T at the junior secondary level because the EOC (Equal Opportunities Commission) requires that. However, my school does not have the intention to offer D&T in the senior forms. (Subject Panel Chairperson, Grammar School)

In the questionnaire survey, a small number of schools reported that technological subjects were offered to boys only. Follow-up contacts and interviews revealed that these were single-sex schools for boys operated mainly by the missionary bodies. One school administrator clarified his school's particular situation:

> We are a technical school for boys. Our school was established in 1952 and we have a long tradition in technical education in Hong Kong. (Vice Principal, Technical School)

8.3. Familiarity with Recent Technology Education Reforms

Some teachers reported in the survey that they had little or no knowledge of recent TE reforms. One teacher interviewee provided the following reason:

> My school's General Office hasn't passed any information or circulars to me about recent technology curriculum reforms. So I know nothing about activities related to the reforms. (Subject Panel Chairperson, Grammar School)

However, a school principal has another story:

> Teachers are busy people; they would not care about educational reforms. This is true for teachers of D&T as well as for teachers of other subjects. ... Teachers would just care about the stuff within three feet's reach on their desk top. They would not bother about anything by their side. They are not willing to attend seminars and workshops because they have to make up a missed lesson for their students afterwards. (School Principal, Grammar School)

8.4. Teachers' Preparedness for Technology Education Reforms

Some teachers felt that they were not well-prepared for the reform because of insufficient time elapsed, inadequate supporting instructional materials, and difficulties for coping with new subject content areas that incorporate "advanced" technologies:

> I still felt that I am not well-prepared for the reform. ... The coming of the reform was rather quick. The ED (Education Department) did not provide us with the necessary instructional materials as promised in the first year of implementation. We have to sort things out by ourselves and prepare instructional materials on our own. (Subject Teacher, Secondary Technical)

> I seldom used CAD software in the past because it was not required in the public exam. I do not feel confident teaching CAD in front of a large group of students in class. Other than problems relating to the software itself, there are other problems on general computer operations that I could not handle all on my own. It would be better if I've had more time to learn, or it would be even better if there is someone by my side [when I am teaching in the classroom]. (Subject Teacher, Prevocational School)

8.5. Perceptions towards Technology Education

There are contrasting views on the roles of TE in the school curriculum:

TE as an Alternative to Mainstream Curriculum for Some

> TE ... is an alternative curriculum for students who are not interested in the mainstream curriculum. For some students, taking some hands-on programmes would be useful for them. Schools should provide more alternative curricula for students to opt for. (Subject Teacher, Technical School)

TE is Only Suitable for the More Able Students

> In my view, the new technical curriculum subjects are more suitable for the able students rather than those less able students in my (prevocational) school, because the new subjects are more demanding and need lots of self-motivation. For my students, you better give them some concrete tasks to perform which do not require using their head, or otherwise you would get into real trouble. They would cross their arms for the whole lesson doing nothing. They are simply not motivated to learn. (Subject Panel Chairperson, Prevocational School)

TE for Both Boys and Girls

> In the past, technical subjects were practical in nature, biased towards manual skill training. Many girls declined to take D&T because of their perceived physical constraints. Today, one major change for D&T is that the subject emphasises creative thinking. Both boys and girls can do equally well in this regard. (Subject Teacher, Grammar School)

> I think more girls should be given the opportunity to take D&T. I found that many female students were performing pretty well in D&T, for example in learning CAD software. (Subject Teacher, Grammar School)

8.6. Technology Education Curriculum Elements

Among the 724 respondents, 73 of them cited "other curriculum content" areas they considered as important in the "additional comments" column at the end of Section C of the survey. On a closer reading, these items appeared to relate in some way to areas such as history and evolution of technology, technology and society (environmental protection, ethical issues), technology and living (food-technologies, bio-technologies, medical technologies), technological problem solving, and computer applications (CAD, CAM, and ICT).

There are also different views pertaining to technology curriculum content areas as remarked by the interviewees:

On Breadth and Depth

I think the technology curriculum should aim at breath rather than depth. Given that technology changes rapidly, students need to learn about technological development and ways of acquiring such information rather than on technological knowledge itself. (School Principal, Grammar School)

I think the new curriculum as proposed by the CDC is too broad. Some teachers would "shirk the heavy work and choose the light". Some teachers would skip the topics that they are not familiar with, like pneumatics. In theory, team teaching is a good way to tackle this problem, but you could hardly find one school [in Hong Kong] that has succeeded so far. (Subject Panel Chairperson, Technical School)

General vs. (Pre-) Vocational Education

I agree with the idea of TE that aims at promoting technological literacy. ... At the secondary level, it would be inappropriate if TE is just targeted at certain trades. Secondary education is not vocational education. It should aim to prepare students for their future career or life, thus early specialisation is unnecessary and inappropriate. (Subject Teacher, Technical School)

In order to help students to face technological changes and to promote creative thinking, I think the amount of hands-on craft skills has to be reduced. (Subject Teacher, Grammar School)

Should keep a reasonable proportion of basic metalwork, woodwork, and practical electricity ... These areas should not be totally removed. (Subject Teacher, Technical School)

8.7. Facilitating Factors for Implementing Technology Education in Hong Kong Secondary Schools

Teacher Characteristics

Teachers are central to the change process. Both individual teacher characteristics and collegial factors play important roles in determining implementation of reform in schools. This perspective was echoed by one school principal being interviewed:

> Having an ideal alone would not work. Teachers are the ones who actually carry out the implementation, and that is why they are so important. Teachers need to be organised and have a common vision. There is no guarantee whether this [strategy] would really work, but we should move towards that direction, so as not to let our students down. (School Principal, Prevocational School)

Fullan (2001) suggests that teachers' active involvements in promoting the subject, sharing of successful practices and the provision of support to other teachers would help reduce professional isolation. One teacher shared his experience with us:

> This year, we have organised several workshops on robotics. About forty teachers and eighty pupils from neighbouring primary schools attended. I would suggest all D&T teachers to come out and support the development of TE in primary schools in their own district. This would increase the exposure of the subject. ... It is worthwhile to participate in inter-school competitions as well. The main purpose is not to win any prizes. Of course eventually you will get one if you persisted on. I mean this is a good opportunity for learning from each other. (Panel Chairperson, Grammar School)

Subject Leadership

A large part of the problem of educational change may be less a question of resistance and more a question of the difficulties relating to planning and coordinating a multilevel social process involving many people (Fullan, 2001). Successful implementation of broad-based TE in schools requires a strong "subject" leader and middle manager who can lead with vision, manage the team of staff involved, confident to take risks, and fight for curriculum time and resources from the senior school management. One teacher tells his story:

> Just recently, our school succeeded in getting support from QEF (Quality Education Fund) for a multi-disciplinary drama project. The project involves A&D, D&T, HE, PE and Music. A&D is responsible for the props; D&T for stage design; HE for the costumes; PE for performance on dancing; and Music for the songs. We use three cycles of formal school time for preparatory works and putting things together for the final performance. We need to rearrange the timetable and extra-curricular activities for the whole form. … The idea (of the project) is very good but involves lots of things. It cannot be achieved without a very powerful person in the school to supervise and coordinate all subjects involved. This person should know all the subjects involved well and their particular ways of thinking and working. (Panel Chairperson, Grammar School)

Principal Leadership

Principal leadership is one factor frequently quoted in the interview. One interviewee remarked that a supportive principal encourages educational innovation, welcomes teacher's contribution, and listens to teacher's views:

> My school principal is quite supportive. He comes to the D&T workshop quite often after school and asks me whether there is anything new and interesting for him to see. … The previous D&T teacher was quite old-fashioned. He used to request students to turn a wooden lamp post as a D&T project. Perhaps the principal thinks that I am relatively young and would be willing to try new things, and so often encourages me to break new ground. He thinks that D&T is a subject that can help inspiring students. … All in all, my school principal provides me with many supports. (Panel Chairperson, Grammar School)

Availability of Curriculum and Instructional Materials

> I really hope to have a detailed curriculum guide published as soon as possible: One that would at least point to a certain direction rather than leaving us in the dark tailoring our own school-based curriculum. Up to this moment, I am still not quite sure whether I am teaching the right stuff to my students or not. I hope I have not taught them anything wrong (i.e., not within the curriculum). (Panel Chairperson, Grammar School)

Resources and Funding

Interviews with teachers highlight the importance of adequate resources in terms of facilities, funding and time:

> They (CDC) say they want [a curriculum that is] hi-tech, but just allocated HKD 600,000 [for each new subject], what's the use? Have a [new] curriculum, but no intention of investing more money to upgrade the workshop and supply appropriate equipment to support [the implementation]. ... They (CDC) want to promote technology, but they just manage to provide a CNC (Computer Numerical Control) miller [to each schools involved]. (Panel Chairperson, Technical School)

> If the ED officials consider TE as important, they should mandate schools to allocate appropriate resources and time for TE subjects rather than just giving out brief guidelines. ... In the past, each of the four or five subjects under the so-called [TEKLA] had its own timeslots, but now students are taking these subjects in alternative cycles [or weeks]. This is to deprive of students' learning of the subjects. Things would not go right if the ED just gives out [unbinding] guidelines as what it has been doing in the past. (Panel Chairperson, Grammar School)

Professional Development for Change

Professional development is central to educational change in practice. Fullan (2001) asserts that the essence of educational change is about learning new ways of thinking and doing, new skills, knowledge, and attitudes. One teacher stresses the importance of good "mentors" during teaching practice and the "induction" years at a time of radical curriculum reforms:

> Most of my skills and subject knowledge for teaching the new technical curriculum subjects were acquired during my teaching practice. During the third year of my teacher training, I had my teaching practice at NY Secondary School where Mr. N and Mr. C were D&T teachers there. I have studied D&T for so many years but have never seen teachers who are so earnest and devoted (like Mr. N and Mr. C). They gave me advice out of deep-felt affection. They took the initiative to approaching me and giving me advice when I had free time-slots. About 80% of the curriculum that I teach today was learned during that time. I still keep in touch with Mr. N and Mr. C. I visit their school quite often and each time they would teach me something new. (Subject Teacher, Grammar School)

Student and Teacher Motivation

> Student motivation is an important factor. It depends on whether they could get satisfaction from this (technological) subject. Teacher's influence on students is also great .... Other than student's initiatives, teacher's teaching approach and level of involvement are also vital. (Panel Chairperson, Grammar School)

Promotional Activities

During the interviews, some teachers suggested organising seminars and promotional activities typically focused on school administrators and parents to make them fully understand what TE is all about:

> Support from the school principal is crucial! The principal's knowledge and perception of a subject can determine the life-or-death of the subject. ... I think more seminars should be organised for school principals to let them know more about the history of D&T and the subject's recent developments. ... Other than school principals, parents should also be targeted. Parents have serious concerns about their children's future prospects. (Panel Chairperson, Grammar School)

Endorsement from the Government

> I think putting D&T under the TEKLA would help raise the status and value of the subject. This can be seen as a kind of blessing or endorsement from the government. It would not be a good sign if there is no mentioning of the subject at all [in the TEKLA]. (Subject Teacher, Grammar School)

8.8. Impeding Factors for Implementing Technology Education in Hong Kong Secondary Schools

Cultural Factors

The significance of education stands out in the Chinese tradition. In Hong Kong, education is perceived as important for personal advancement and social mobility.

Besides, the occupational system values education as appropriate preparation for work.

> I think the problem that faced by TE might be related to the commonly held Chinese traditional belief that "A manual worker would not be distinguished in society." Many colleagues in general perceived that the subject is for those unmotivated students who cannot follow the mainstream curriculum. In the eyes of these people, no matter how you call it, a technical subject is still a technical subject, which does little or no help for advancing to the senior forms or university admission. This point is admitted by many parents, teachers, school principals, and even those government officials who initiated the educational reforms. (Subject Teacher, Grammar School)

Lack Subject Expertise or Leadership

There are great pressure and incentives to become innovative, many schools adopt reforms for which they do not have the capacity (individually or organisationally) to put into practice. One consequence of this, as described by a teacher during the interview:

> I think it would be a kind of waste if resources are allocated to schools but teachers are incapable or do not have clear ideas of what to do. (Subject Teacher, Grammar School)

Teacher Resistance / Reluctant to Change

It has been mentioned quite often in the literature that teachers in general are resistant to change. One explanation is that once teachers have got use to their ways of teaching, it is very difficult for them to make changes. The teachers being interviewed had other reasons:

> New teaching strategies such as interdisciplinary learning and teaching that involve many subjects would take a long time for teachers to work collaboratively together. Inevitable the workload would increase progressively as the change is taking place. Nobody knows how much workload would be added. This might be a source of resistance for change. (Subject Teacher, Grammar School)

> My first reaction is quite resistive when I first heard about putting D&T under the TEKLA with other subjects. … I believe that each subject has its unique characteristics. Integrating several subjects into one would certainly take away some essential elements from each of the composing subject. … I would not accept it unless I see with my own eyes that successful integration has been actually taking place. (Subject Teacher, Prevocational School)

Falling student enrolment as a result of falling birth rate is now hitting secondary schools which are facing growing numbers of surplus teachers. Some teachers being interviewed mentioned that they dared not to resist any reforms openly in school because they want to keep their job. One teacher had made the following remark:

> Fresh grad teachers are more ready to accept new things. Some experienced teachers would be more resistive. There were always complaints, but they would still do as requested in order to keep their job. … Given that a person's effort is rather limited and that one cannot look after many things at one time, so gains are offset by losses. … There are only 24 hours a day; they (the teachers) would do whatever thing that comes first. (Panel Chairperson, Grammar School)

Teacher Organisation

> At present, only a handful of [D&T] teachers are willing to come out and run the D&T association or participate in activities organised by the association. If the present situation does not change, D&T would be gradually "invaded" and "knock down" by other subjects. (Panel Chairperson, Grammar School)

Parental Power

Chinese parents are very demanding and holding high achievement expectations of their children. As one teacher commented:

> Parents determine that their kids are going to university, and school administrators reflect this mentality. (Subject Teacher, Grammar School)

University Admission Requirements

> I personally do not believe the new technology curriculum would work unless universities do seriously consider public exam results of technical or technological subjects in their admission requirement. (Subject Teacher, Grammar School)

School Principals' Misconceptions about TE

> My school principal knows nothing about TE. In his mind, computer is TE. … Many schools "cut" D&T and converted the workshops into computer labs or even staff rooms. (Panel Chairperson, Grammar School)

Lack of School Principals' Support

> My school principal just gives out encouragements in words that would not do much help in real substance. I think this is not a real kind of support. (Subject Teacher, Grammar School)

However, school principals would have their own problems and their own world of pressure (Fullan, 2001):

> We are a newly established school. In our plan, we have reserved enough manpower and space for D&T and HE in Secondary 4 and 5, but the time to start offering these subjects is really an issue. This depends very much on the pace of current educational reforms. Until then, we have no idea of how the two public examinations would be merged together. This move has great implications for admissions to universities and the combination of subjects to be offered by our school. In fact, this is a very practical question that we have to face. At the junior secondary level, one can always talk about freedom of subject choices according to student's own interest. However, when it comes to the senior secondary level, students, parents and teachers all would consider that students' future prospects are more important. (School Principal, Grammar School)

Lack of Funding or Resources

> The New Technical Curriculum is primarily intended for Technical and Prevocational Schools. For Grammar Schools like us wishing to adopt the new curriculum for the benefit of our students, the government would not provide us with funding to convert the D&T workshops or to upgrade the facilities. ... Although we can apply funding through the QEF (Quality Education Fund), but I think this is not a fair and proper way for implementing a massive technology curriculum reform which is so resource-intensive. (Subject Panel Chairperson, Grammar School)

Lack of Quality Instructional Materials

According to the Education Department (1997a), for each new subject in the New Technical Curriculum, a set of teaching materials would be developed by local publishers and provided free to schools. However, they were not issued on schedule and were not of acceptable quality. Two teachers had the following comments:

> The ED's provisions could not follow closely the pace of the educational reform. For example, instructional materials should be provided to schools so that teachers do not have to design their own. These should include at least teaching packages with detailed guidelines and the necessary hardware. It would even be better if some exemplars are also included. (Subject Panel Chairperson, Grammar School)

> [In the instructional materials provided]... there are still many errors in basic concepts, not to mention the typo ones... To have one is better than none. In the past, there were not many textbooks in the market to choose from because the number of students taking technical subjects was rather small. (Subject Panel Chairperson, Technical School)

Consensus and Collaboration

> There might be difficulties when putting it (broad-based technology education reform) into actual practice in schools. ... Having consensus among teachers and panel chairpersons in different subjects on the direction of change is vital. Given that there are four to five subjects being involved, it would be difficult to put anything into action if one or two subjects do not agree with it. (Subject Panel Chairperson, Grammar School)

Inappropriate Professional Development Programme

The Curriculum Development Institute (CDI) had organised a series of professional development programmes for frontline teachers, most of them were on the new content areas, and the others were on teaching methodologies. It seemed that teachers were not contented with the programmes they had participated in:

> I have attended an in-service training course in control technology run by the PolyU (the Hong Kong Polytechnic University). I found the course not very useful. I guess the materials supplied were originally targeted for their own students and not specifically prepared for the in-service course. (Subject Teacher, Prevocational School)

> I have no confidence on those workshops and seminars [organised by the CDI]. The contents do not correspond to the title [of the programme]. It is just a waste of time. (Subject Teacher, Grammar School)

Reform Overloaded

Many Hong Kong schools do not have the capacity to say no in the face of innovation overload. Teachers expressed that they lacked the time and space for exchange among themselves.

> In recent years, there are too many education reforms implementing at one time. ... Faced with such rapid changes, we feel lots of pressure and burn-outs. (Subject Teacher, Grammar School)

Teachers Felt Incapable of Teaching New Content Areas

Some teachers worried about whether they could use "new" teaching and assessment methods that they were not familiar with. For example, guiding students' project works and the assessment techniques involved.

> I used to teach craft courses. I have much concern about whether I could teach students using the project approach. I do wish the ED could provide us with training in this area. (Subject Teacher, Prevocational School)

No Proper Evaluation Mechanism on Implementation

Often, in Hong Kong, "implementation of a particular reform initiative stops short at a grand opening", and "spending money is regarding as an achievement" (Cheng, 2002, p. 166 & 167). For the government officials, it seems that delivering the machines and spending the assigned money were the only goal when it came to implementation. In fact, there were no plans on evaluating the effectiveness of implementation. As one panel chairperson notes:

> Much money was spent on workshop conversion, CNC machines, and teaching kits, etc. ... However, many schools received the machines and equipment with indifference. I have seen a large number of such machines were underused, or not used at all for teaching, and soon became obsolete. (Subject Panel Chairperson, Technical School)

8.9. Desirable Characteristics and Competences for Newly Qualified Teachers of Technological Subjects

General Comments on TE Teacher Competence

> Teachers should have a good grasp of the curriculum, in particular knowledge about new technologies. Teachers should have marketing skills to promote the image of technological subjects to the school management, parents, students, and the general public. They should have the attitude for change, and keep changing and upgrading themselves. (Subject Teacher, Grammar School)

Using New Technologies

> Technological subject teachers in the 21st Century should be capable of using technology, including computers; acquiring new information; willingness to explore new things; and have the attitude for change. In fact there are still some teachers who are resistant to new technologies; they still adopted the D&T programme that has been used for over ten years. (Panel Chairperson, Grammar School)

> New teachers should have a comprehensive knowledge of using the computer, from basic computer software applications to computer numerical-controlled devices. (Subject Teacher, Technical School)

Appropriate Pedagogical Knowledge for Teaching Boys and Girls

> New teachers should know how to use different methods for teaching boys and girls, because they have different interests. (Subject Teacher, Grammar School)

Subject Matter Knowledge is More Important

One school principal being interviewed stressed the importance of technological subject teachers' subject matter knowledge. As he remarks:

> For student teachers with a weak foundation in subject matter, their problems would surface during [actual] teaching practice. Peter Smith[27] once commented (on the teaching performance of a student teacher): "Teaching rubbish beautifully", meaning that the teaching method adopted by the student teacher was alright, but the subject content delivered was totally wrong, and so the lesson's objectives could not be achieved. ... In any case, [as a school principal], I would seriously consider an applicant's subject matter knowledge and not merely on whether he or she has any [professional] training in teaching methodology. If a teacher knows nothing about the "standard" equipment and tools inside a school workshop, how can he/she have the confident to teach his/her own students using these equipment and tools? (School Principal, Prevocational School)

8.10. Technology Teacher Education Programme

Mode of Delivery (BEd vs. PGDE)

Those interviewees who favoured BEd graduates considered that BEd programmes have a relatively longer duration as compared with the PGDE. This allows student teachers learning about teaching while testing their pedagogical knowledge and skills as they progress.

> I would prefer the BEd graduates because they have taken longer time for training. ... Within the four years' training, they would have more contact with all aspects of teaching and learning. As for the PGDE graduates, they only take one-year professional training on top of their subject-specific training during their undergraduate degree programme. ... You cannot force

[27] Peter Smith was the first Principal of the Technical Teachers' College.

[any PGDE student] to absorb things instantly like taking tonic injection; learning to teach really takes time and actual practice. (Panel Chairperson, Grammar School)

The four-year BEd would be an appropriate route, so long as it could provide students with a balanced and comprehensive training. This would enable them to get hold of the areas required in teaching technological subjects in secondary schools. ... The BEd [programme] should be comprehensive, meaning that there should be a balance between professional training and subject matter knowledge. (Subject Panel Chairperson, Technical School)

Others thought differently. Interviewees who were in favour of PGCE/PGDE programmes considered that the graduates from these programmes will have a more solid training in an academic subject because of the extended period of discipline-focused training during their undergraduate studies. They queried the insufficient background or subject strength of the BEd graduates in teaching at the secondary level.

The PDGE graduates would be better, because they are more mature and would have better subject strength and understanding of what they need to acquire from the professional training course. (Subject Panel Chairperson, Grammar School)

Trained Professionals

When hiring teachers, it is common practice in Hong Kong that the panel chairperson of the subject area be invited as a member of the interviewing panel. Their views would have important implications for the final hiring decision. One panel chairperson had the following comments:

Some engineering degree holders entered the profession without any professional training. They took an in-service training course afterwards. Nowadays, more and more people enter the teaching profession by taking the later route. I think it would be better if they received professional training first so that they know beforehand what TE in secondary schools is all about. (Subject Panel Chairperson, Prevocational School)

A school principal has similar view:

> I would certainly favour those people who have been professionally trained, because they would have a clear idea of what is going to happen in the classroom and the workshop, and how the curriculum is organised; it would be helpful if they have more advanced skills like counselling. (School Principal, Grammar School)

8.11. Summary

This chapter presented findings of qualitative data from the follow-up interviews and additional comments made by respondents in the questionnaire survey. The chapter detailed School Administrators' and Technological Subject Teachers' views on (1) the current status and roles of technology education in Hong Kong, (2) the major factors that would facilitate or impede the implementation of Technology Education in Hong Kong schools, (3) the professional knowledge, skills and attitudes for newly qualified teachers of technological subjects, and (4) technology teacher education programmes.

In general, findings from this chapter further explained and endorsed the quantitative data analysis findings given in Chapter 7 of this thesis. As regards the implementation of technology education reforms in Hong Kong schools, findings from this study indicated that: Schools and teachers might not be ready for the implementation of recent technology education reforms; the reforms had imposed heavy workload on teachers; and teachers indicated strong need for the provision of quality professional development opportunities and timely support for the implementation of the reforms.

CHAPTER 9

CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

9.1. Introduction

Dalin and Rust (1996) describe the 21st Century society as a learning society in which the key to success is knowledge. The rapidly changing technological society in the 21st Century demands more from our students. They need to perform well in order to cope, compete, cooperate and contribute in a knowledge-based society. Schools are charged with the responsibilities of preparing students to meet the challenges of living, learning and working in such a complex knowledge-based technological society.

This study sought to identify contemporary issues relating to technology education and technology teacher education in Hong Kong. Primarily, it was concerned with matters relating to the technology education curriculum, the ways in which the curriculum should be taught or delivered and assessed, the initial and in-service education of teachers, teacher supply, and the provisions of laboratories, workshops, equipment, instructional materials and other resources. The intention was to help policy-makers, school administrators, teachers and teacher educators in the field to identify, improve, strengthen or develop implementation policies and strategies for technology education at the secondary level.

Findings in this study in general support Fullan's (2002, 2001) theory of educational change. For example, the success of educational innovations rely heavily on the acceptance and active participation of teachers, and their perceptions towards the innovations and resistance to change should not be underestimated. Besides, the successful implementation of educational reforms in schools needs leadership at all levels to translate goals to policies, policies to programmes, and programmes to practice. Based on Fullan's (2001) educational reform implementation model, a framework for studying technology education reform was being developed (see p. 62 of this thesis).

Findings in this study are consistent with other studies pertaining to the implementation of technology education in schools (e.g., Bussey *et al.*, 2000; Chinien *et al.*, 1995; Hamilton & Middleton, 2002). In this study, it has been found that inadequate budget, facilities, and teaching resources are perceived to be potential barriers to implementing technology education in schools. Besides, supports from the school administration and other people in the school community, and appropriate professional development activities are all critical factors for successful programme implementation.

Based on the evidence provided in the study, it is clear that several factors need to be aligned for technology education reform to be successfully implemented in schools. Without strong principal leadership and support, without strong subject leadership, without teachers' whole-heartedly support, without clear communication and provision of resources by the central agency (the government) in terms of funding, facilities and quality curriculum materials, implementation is likely to lag far behind. Many of these factors have important policy implications for the success of the current and future technology education reforms in Hong Kong.

As regards the desirable competences for newly qualified teachers of technological subjects, findings from this study support the notion that technological subject teachers need more than just subject matter knowledge. This implies that initial teacher education programmes must therefore ensure that student teachers have sufficient depth and breadth in subject matter knowledge, and help them transform this into pedagogical content knowledge so that they can teach confidently and effectively. The identification of such competences could provide some definitions which would provide a starting point from which future studies could evolve.

This chapter provides the conclusions of the research study, and discusses some of the major implications. There are also recommendations for policy, practice and future research. The presentation is arranged around the four research questions pertaining to the following themes: (1) direction and goals of Technology Education for Hong Kong; (2) facilitating or impeding factors for implementing Technology Education reforms in secondary schools; (3) desirable competences for newly qualified technological subject teachers; and (4) technology teacher education programmes. Such an arrangement is essentially a matter of convenience; to be effective any policy for reforming technology education in schools must address all related issues in a coherent and integrated way.

9.2. Conclusions

Based on the findings of the study and the literature being reviewed, the following conclusions were reached.

9.2.1. Research Question 1

What direction and goals should technology education pursue in Hong Kong secondary schools in order to cater for students' personal needs and that of Hong Kong's economy in a knowledge-based society?

Direction and Goals of Technology Education

In this thesis, it has been argued that the study of technology is important because technology is a dominant force in a rapid-changing technological society. Students need to study, experience, and gain an appreciation of technology because they are to live, learn and work with it. It has also been argued that given the central focus of technology education is technological literacy for all students, it must be positioned as a key learning area in the school curriculum.

In view of the fact that Hong Kong's economy is increasingly being driven by technological innovation and because an increasing amount of jobs require technological skills, a raise in technological literacy of the Hong Kong people would generate a more abundant supply of technologically competent workers having the knowledge and abilities for jobs in the 21st Century workplaces. Further, improving the technological literacy of the Hong Kong people would also lessen its dependence on foreign workers to fill jobs in many technology-related sectors.

In Hong Kong, like many other countries around the world, technology education was often being perceived as a marginal learning area that has been slow to change. Technology education is in need of support and promotion to ensure that the wider community understands what it is all about, including the value of technology education as general education for all students and its contribution to a knowledge-based economy. Strategies need to be put in place to develop and support technology teacher education and professional development programmes; and to "educate" students, teachers, school administrators and parents about the worth of technology education.

There still appears to be considerable confusion in the wider community regarding the notions of "information technology", "educational technology" and the more encompassing term "technology". Technology educators need to be cautious in defining technology so broadly that anything and everything fits under the description. The definitions should clearly communicate what technology is and what it is not. To strive for a central position in the curriculum, technology educators should resist the temptation of embracing the goals of developing life skills and vocational education as central missions for technology education (Wright, 1993).

The knowledge-based society calls for a new kind of technology education. In a globalised knowledge-based society, teaching must change to accommodate the need for students to be innovative, enterprising and creative. Creativity is based on a deep understanding of the subject and the development of thinking skills that allows students to think divergently. This implies that technology teachers should have in-depth subject knowledge and pedagogical content knowledge to support student innovation.

The knowledge-based economy calls for a new kind of technology education which is distinct from technical or prevocational education in the past. It is not just "training" for specific jobs, but "education" for making decisions, identifying and solving problems, seeking solutions, and effective communication, which draws on a variety of disciplines and cultural contexts to make sense out of changes, challenges, and day-to-day operations in the workplace (Kimbell & Perry, 2001). In a sense, this leads to the integration of "prevocational" and "academic" education. To this end, a key and ongoing task for the profession is to conceptualise and clarify the curriculum content and knowledge base of technology education.

Technology Education Curriculum Content Areas

Clear and specific curriculum content can be a powerful catalyst for change in teaching and learning. Both global and national efforts have been put on the last decade or so to develop curriculum frameworks and content areas to support teaching and learning of technology (e.g., DES & WO, 1990; ITEA, 2000a). The curriculum content areas identified in this study encourage technology teachers and educators to focus on the most important goals for student learning. Findings in this study indicate that both administrators and teachers placed high values on curriculum contents in the information and communication technology and health and safety areas. This implies that once the new curriculum content areas are in place, professional development programmes and on-going supports should be available to strengthen teachers' knowledge and skills of the subject matter they teach and assessment on student learning, in particular for the areas indicated above.

9.2.2. Research Question 2

What are the perceived major factors that would facilitate or impede the implementation of technology education reforms in Hong Kong secondary schools?

One of the major objectives of the study was to identify institutional, operational, perceptual, and attitudinal barriers to implementing technology education reforms in Hong Kong secondary schools. The major facilitating and impeding factors identified are presented below.

Conducive School Climate

Implementing the Technology Education Key Learning Area (TEKLA) in the school curriculum would be a complex issue. In Hong Kong, there are no pre-existing models for large-scale interdisciplinary teaching, timetabling, and resourcing. It would be a great challenge to schools to re-think how they would organise their teaching programmes, timetables, and resources.

Schools differ widely in terms of their "readiness and capabilities" to change (Fullan, 2001). In the present study, it is found that some schools adopted a "wait and see" strategy if they felt that they were not prepared well enough. For individual schools to identify their potential for taking on education changes, it is advisable to conduct an "audit" of the organisation (Hargreaves & Hopkins, 1991; Morrison, 1994). The audit involves an examination of the "organisational health" and climate of the school, its openness to and tradition of change, the factors that would facilitate or hinder successful change, roles and working relationship among staff members, and major characteristics of the innovation. Some characteristics of an organisationally healthy institution, as identified by Morrison (1994) and Smith (1990), are in terms of its modes of communication, forms of support, morale, innovativeness and leadership style.

As with teachers of other subjects, technology teachers are likely to be most successful when working in supportive and effective schools. Findings from the present research study and the literature being reviewed suggest that schools which are conducive to the implementation of technology reforms are characterised by: (a) principal leadership which is supportive; and (b) a clear and shared meaning of change supported by consistency of practice and a collegial manner of working.

The Learning Teacher

Fullan and Hargreaves (1992) stress the need to relate teacher development and educational change. They argue that the process of implementation of any educational innovation is essentially a learning process and that teachers' professional development and implementation should go hand in hand.

Start with small steps. In this thesis, it has been shown that curriculum change is a complex and difficult process that would induce anxiety and resistance on the part of the teacher. It is suggested that the central agencies should direct their efforts towards those teachers who do not appear to be willing to make the change to a broad-based technology education. The process should be gradual and emphasise the similarities between elements of existing practice and what is expected in technology education. Progress should be recognised and rewarded. Efforts to reduce fear in the change process are essential (Bussey *et al.*, 2000). Start slowly with small, manageable steps. Once teachers gain experience and have the feeling of mastery and success, the more complex components could be added.

Professionals learning together. Massive educational changes require government agencies and teachers to have a long-term commitment to formal professional development. Teachers need numerous opportunities to learn, reflect, and share ideas with peers. "No teacher is an island", when it comes to technology education curriculum change. Teachers can acquire new knowledge and skills through a combination of individual learning and collaboratively working with colleagues. In view of the recent revolution in information and communication technologies, teachers can make use of the new technologies to their best advantage to facilitate teaching and learning of design and technology inside and outside the schools. The Hong Kong CAD/CAM Network Project[28] led by the present author was an example of building a territory-wide networked learning community for design and technology students and teachers to carry out collaborative computer-aided design and manufacture (CAD/CAM) activities via the Internet (Lo & Tam, 2002). A project website was set up where CAD/CAM teaching and learning resources were posted up on the website for sharing. Through the engagement of activities provided by the project, teachers became active learners and change agents in the curriculum development, dissemination and implementation processes.

Leadership

In this thesis, it has also been argued that implementing technology education in schools needs leadership at all levels from those in a position to translate goals to policies, policies to programmes, and programmes to teaching practices. Key leaders in the processes of initiation, adaptation and implementation, as identified in this study, are policy-makers, curriculum developers, teacher educators, assessment specialists, school administrators, and subject specialists. They function in ways that control and regulate the processes of reform, and help reduce constraints and provide support and feedback for innovative practices.

[28] This project was supported by the Quality Education Fund (QEF) (Project No. : 2000/2170). For detail, please visit http://qcrc.qef.org.hk/qef/result.phtml?mode=code&nature_id=-1&proposal_id=2000/2170&lang=2

Subject leadership and role models. Given that technology education is not supported or understood in many schools in Hong Kong, subject leaders have an important role to bring about smooth and successful changes in technology education. DATA (2004a) suggests that at the school level an effective subject leader in D&T is a person who can represent the subject at meetings with the school's senior management, fighting for the case for curriculum time and resources. The subject leader is also expected to act as a positive role model and lead by example to influence and change the professional working practices and expectations of colleagues. This implies that it is vital to provide subject leaders with the best possible preparation and development in this direction.

Principal support and leadership. The school principal is one of the main agents or blockers of change at the school level. School principals have top authority to determine and change the priorities and resource deployment, class scheduling, and re-allocation of workload to allow for provisions of technical support and collaborative planning for the change. Teachers in this study found the perceived lack of understanding and support of administrators as most frustrating. In view of this, it is vital for school principals to attend seminars and workshops relating to the change so that they can gain a basic understanding of the value of the change and teachers' concerns, and to provide support for implementation.

Resources

Findings from this study indicate that the availability of resources, in terms of funding, quality teaching resources, and necessary facilities are clearly important to the implementation of technology education in Hong Kong. Change agents should inform and work with the government and school administration to assure appropriate and adequate resources can be available in time.

Appropriate practical accommodation, facilities and equipment. It is recognised that hands-on activities such as designing and making are at the heart of technology education programmes, and thus appropriate practical accommodation, along with facilities and equipment are essential. The facilities and equipment available need to be adequate to support the demands of practical work in the technology education curriculum. However, this would be a severe problem for implementing a territory-wide full-scale technology education reform in all Hong Kong secondary schools. Hence, it has to argue for a generous definition of "practical work" that does not always involve activities at the work bench. Some "practical activities", such as computer-aided design and simulation, may be carried out off the work bench and can lead to enhanced student motivation and learning. Other activities such as field trips and visits to industrial sites, interactive on-line learning, case studies, and design and writing tasks of various kinds do not always confine learning even in the classroom. Financial constraints provide an opportunity to revisit the issue of supply and maintenance of workshop and laboratory facilities and equipment. In all cases, it is necessary to collect information on how effective such teaching resources are utilised for teaching and learning and whether any high-cost items of equipment, e.g., the CNC machines as reported in this study, are used very infrequently. Given the fact that practical activities (in both the broad and narrow senses) have a fundamental role to play in technology education, it is argued that difficulties of teaching and resourcing should not be allowed to obscure this fact.

Quality curriculum and instructional materials. Fullan (2001) cautions that large-scale top-down curriculum change requires attention to high-quality instructional materials or otherwise it can result in inadequate quality of change and poor student learning outcomes. The importance of curriculum materials has been highlighted by a World Bank study which indicates that expenditures on curriculum materials is a more significant factor in promoting student learning than investments in physical infrastructure (Herz *et al.*, cited in Jenkins, 2003). Findings in this study reveal that at a time of curriculum change when teachers are not familiar with the new curriculum content or a shortage of subject expertise in the school is acute, whatever teaching resources available could become the repository of school knowledge and act as the *de facto* prescribed curriculum. In this regard, teachers should learn how to evaluate and select curriculum materials, to see whether content and instructional strategies are aligned with the learning goals.

Ample time for change. Time is a major concern for teachers in the reform context. In this study, having ample time to cope with change is being perceived as a potential "facilitating" factor for implementing technology education in schools. These include adequate time for lesson preparation and planning, and the time required working with fellow teachers to plan and coordinate the new venture. Additional time is required for formal learning, for example through workshops or other professional development programmes. However, to reform technology education in the full sense demands more than the acquisition of new teaching strategies and techniques. Of central importance to the technology education reforms are changes in values and beliefs about the goals of teaching and the means of fostering student learning. Changes in beliefs and values take time. This implies that efforts must be made to establish the working conditions under which teachers have the time and space planning together, reflecting on the results of the work and challenging each others' conceptions of appropriate goals and content. Block scheduling, common lesson preparation periods for teaching teams, and released time for collaborative planning are illustrative of such efforts.

9.2.3. Research Question 3

What are the desirable competences for newly qualified teachers of technological subjects which are conducive to recent technology education curriculum reforms?

As with all good teaching, technology teachers need to provide students with the settings and activities to engage in learning that resulted in gains in students' knowledge and understanding. Based on findings in this study, the most desirable competences identified for newly qualified teachers of technological subjects are listed below.

General Pedagogical Knowledge Competences

General Pedagogical Knowledge Competences (GPKC) are general abilities that teachers possess for teaching. The most desirable competences identified in this category include: Select, produce and use appropriate resources, including information technology, to support teaching and learning; promote equality of opportunity and the avoidance of stereotype in curriculum planning, teaching, and working with students; contribute to school-based curriculum development activities; and promote interdisciplinary learning activities that enable students to integrate and transfer knowledge and skills to other subject disciplines.

Subject Matter Knowledge Competences

Subject Matter Knowledge Competences (SMKC) are knowledge and skills of a subject discipline. The most desirable competences identified in this category include: Use a variety of graphical communication techniques including sketching, modelling, and recording design decisions; demonstrate an ability to solve problems, think critically, and make decisions; use information technology for communicating and data handling; and demonstrate a breadth of subject knowledge and skills sufficient to teach technological subjects at S1 to S6 levels.

Pedagogical Content Knowledge Competences

Pedagogical Content Knowledge Competences (PCKC) refer to the knowledge and skills that enable professional blending of the content and pedagogy so as to organise and adapt teaching topics to diverse student populations. The most desirable competences identified in this category include: Assess students' progress in technology learning activities using a variety of assessment methods such as design portfolios, and project work; demonstrate an understanding of how technology education enhances students' conceptual, creative and practical developments; and maintain a safe working and learning environment through appropriate health and safety procedures and students' routines.

Continuing Professional Development Competences

Continuing Professional Development Competences (CPDC) refer to competences for teachers to update or enhance their professional knowledge and skills, and sharing with others. The most desirable competences identified in this category include: Further attend a qualification awarding programme related to technology or technology education; employ mechanisms to stay current in technology; read professional journals and other literature related to technology education; and keep current through active membership in professional organisations in technology education.

A competence-based model of technology teacher education specified in these terms may be beneficial to both teacher educators and potential teachers for setting appropriate standards. It also allows teacher education provisions be inspected against a set of criteria so that any weaknesses can be addressed and improvements made. In addition, schools which employ newly qualified teachers of technological subjects will know what to expect from them, especially if the outcomes of the initial teacher education programmes are specified in the form of a career entry profile. Such a profile has also constituted a basis upon which programmes of induction and further professional development can be built. However, the advantages of a competence-based approach to teacher education should not be overestimated. As discussed earlier in Chapter 5 (Section 5.6) of this thesis, teaching cannot be reduced simply to a set of competences, and standards of teaching are unlikely to be raised by deploying a routine practice unless such standards are very narrowly defined.

9.2.4. Research Question 4

What are the implications of these changes for technology teacher education programmes?

Based on findings in this study and the literature being reviewed, it has to be recognised that teachers need more than just subject matter knowledge. Initial teacher education programmes must therefore ensure that student teachers have sufficient depth and breadth in subject matter knowledge, and help them transform this into pedagogical content knowledge so that they can teach both confidently and effectively. Besides, initial teacher education need to form part of a coherent programme of initial professional training, induction and continuing professional development.

Professional development programmes for change. Recent research (Forret *et al.*, 2001) has shown that to improve and sustain teaching and learning in technology, it is necessary to enhance both teachers' technological knowledge and their understanding of technological practice. Teacher development programmes based on these goals have proved very successful in improving teachers' confidence and competence in teaching technology. The current educational and curricular reforms in technology education require paradigm shift in teaching and learning theories and major changes in curriculum content; appropriate and on-going professional development is thus vital and fundamental. In this respect, universities, teacher education providers, and schools have a role. Given that teachers largely learn on the job, positive outcomes could only be achieved if they are given time and space for more thoughtful lesson planning and support. Further, in view of the increasing demands on multidisciplinary, integrative teaching and learning, more professional development programmes should be organised in these areas to encourage each and every technology teacher to extend beyond their subject boundary and to integrate across disciplines.

Initial teacher education. As discussed earlier in Chapter 8 (Section 8.10) of this thesis, participants in this study in general had the feeling that the subject (technology) component of integrated BEd programmes is less than adequate, and graduates from these programmes need upgrading in the subject discipline area. On the other hand, the PGDE programmes are of shorter duration and often follow a more specialised degree level study in design or engineering. In view of the demands upon technology teachers keep changing and broadening, e.g. with the development of programmes that embraced design, science and technology, the limitations of what can be achieved during these shorter programmes become more evident.

Whatever the form and content of initial teacher education programmes, they must all be concerned with the development of the technology teacher's personal pedagogical content knowledge. The concept of pedagogical content knowledge reflects the fact that much more is involved in teaching than subject matter knowledge, essential though this is. Furthermore, initial teacher education programmes should also include knowledge of learners and of learning, of curriculum and context, and of aims and values of technology education, because these are fundamentally concerned with the act of teaching and learning technology (Jenkins, 2003). Findings from this research study endorsed such notions.

Induction. Induction programmes for leading newly qualified teachers of technology into the profession should be an integral part of teacher education and of teachers' professional development. School-based induction programmes, which are based on a career entry profile, can help newly qualified teachers to stay in the profession, enhance their sense of professionalism and reduce the difficulties they encounter in managing classes of students.

Continuing professional development. Both newly qualified and experienced technology teachers need opportunities to learn about advances in technological knowledge and skills and to relate these to their own teaching. This is likely to involve collaboration with universities or other tertiary institutions and with the private sector. Teachers also need time to transform newly acquired knowledge, ideas and skills into their personal pedagogical content knowledge. Discussions and sharing with other teachers in school or professional association is likely to be helpful in this regard.

9.2.5. Technology Education for Hong Kong in the 21st Century

In previous years, Hong Kong has failed in getting technology education recognised as an important learning area for all students in schools, and at attracting female students in appropriate numbers. In this regard, the HKSAR Government needs to put more efforts in making technology education available to all students, for both girls and boys, and at all levels of schooling. The introduction of technology as an entitlement for all students and the inclusion of technology as a key learning area in the new curriculum framework are recent moves towards establishing technology in the curriculum. In conclusion, a picture of an ideal technology education for Hong Kong in the 21^{st} Century is outlined below:

(1) Technology education is provided for all students in their compulsory years of school education. Technology education should be introduced in early days of schooling to awaken the interest of young children.

(2) Technology education is perceived as contributing to the personal developments of students and the economic and social well-being of Hong Kong.

(3) The technology curriculum is relevant to the needs, concerns and personal experiences of individual students.

(4) Teaching and learning of technology is centred on developing students' problem solving skills, critical thinking skills, and creativity; and encourages integrative applications of technological knowledge across disciplines in solving authentic daily problems.

(5) Assessment serves the purpose of learning and is consistent with the philosophy and goals of technology education, and accommodates the full spectrum of students' gender, aptitudes and capabilities.

(6) Technology teaching-learning environments and activities are characterised by enjoyment, fulfilment, ownership of and engagement in learning.

(7) There are adequate and appropriate facilities, equipment and resources to support teaching and learning technology, in particular practical work.

(8) Adequate timeslots, manageable class sizes with properly trained supporting staff that make it possible for technology teachers to employ a wide range of teaching, learning and assessment strategies.

(9) Technology education is valued by the school administration, parents, and the wider community, and has high priority in the school curriculum.

(10) Changes in university admission policy to accommodate students with all talents and capabilities.

(11) Employers to take into consideration of all technological learning experiences of students rather than merely on trade-specific skills.

(12) Technology teachers are lifelong learners who are supported, nurtured and resourced to build the understanding, competences and competencies required of contemporary best practice in technology education.

(13) Technology teachers have a recognised career path based on sound professional competences and standards framework developed and endorsed by the profession.

(14) Teachers' professional development is being viewed as a career-long process that allows teachers of technology education to acquire and regularly update their subject matter knowledge and pedagogical tools needed to teach in ways that enhance student learning and achievement in the subject area.

9.3. Recommendations for Policy and Practice

The accomplishment of this research study identified a number of practical recommendations and areas requiring further investigation. The following recommendations for policy, practice and further research need to be followed to develop further understanding of the issues undertaken in the study are proposed below:

(1) ***Early technology education***. The OECD (1997) suggests that if public interest and understanding in technology and technology education are to be improved, the main effort should be made in the area of education. According to the OEDC, interest in technology essentially develops at the primary and secondary levels of education. Later learning is important but it is very difficult to fill the gaps left in the early years. Thus, technology education should be introduced in early days of schooling to awaken the interest of young children. Given the recognised importance of early education in technology, one of the focuses of attention should be on teachers at the primary level. In the past, many primary school teachers in Hong Kong felt uneasy when faced with teaching topics relating to the technology area, owing to a lack of initial training. As a short term measure, efforts need to be made to train teachers currently in service who lack sufficient training in technology. In the long run, technology education should be a core component in all initial teacher education programmes, for all subject disciplines, and at all levels.

(2) ***Government legislation***. It has been mentioned earlier that current Hong Kong government policy in imposing technology curriculum reform seems not binding. In the past, school administrators and teachers with such freedom would not give full support to the implementation of technological subjects in terms of curriculum time, resourcing and staffing. Technology education in Hong Kong would, again like its predecessors, be classified as "marginal" and has no future.

For a discipline like technology education in Hong Kong with only a recent history, the school system does not present a level playing field. Technological subjects in general are "elective" subjects at the senior secondary level, competing for time in the school curriculum with "core" subjects with longstanding disciplinary traditions. Schools must ensure equity by re-examining how curriculum time is allocated in the light of contributions of technology education towards recent socio-economic and technological changes. In fact, a handful of innovative schools in Hong Kong have attempted to reorganise their timetable so that groups of teachers with a shared professional interest can plan, prepare and conduct lessons together.

Problem solving, critical thinking and interdisciplinary learning are important skills for students to face the current and future challenges in an ever-changing knowledge-based society in the 21st Century. Findings in this study and the literature being reviewed supported the view that Technology Education has such a potential. However, until recently, this goal has never been taken seriously in the school curriculum. The curriculum time allotted to technological subjects in many Hong Kong schools at present does not match with this grand intention. Technological Subjects are in danger of being sidelined by the senior secondary curriculum proposed by the Education and Manpower Bureau (2004a).[29] Given the contribution of Technology Education towards students' intellectual and generic skills developments, it is recommended that the HKSAR Government should make obligatory that more time should be allotted to subjects in the Technology Education Learning Key Area (TEKLA).

(3) ***Teachers really matter.*** It has been argued earlier in this thesis that the success of any educational innovation or change relies heavily on the acceptance and active participation of frontline teachers. Findings in this study reveal that Hong

[29] On October 21, 2004, the Education and Manpower Bureau (EMB) has released a document entitled *Reforming the Academic Structure for Senior Secondary Education and Higher Education - Actions for Investing in the Future* for public consultation. It proposes Hong Kong to adopt a so called "3+3+4" system in which students would have three years of junior secondary and three years of senior secondary education and that universities offer four-year degree courses. The proposed new senior secondary curriculum will have the following components: four core subjects, i.e. Chinese, English, Mathematics and Liberal Studies, two or three elective subjects, and other learning experiences.

Kong teachers tend to react negatively or indifferently to top-down changes which often fail to match their schools' conditions, which involve no sense of ownership, and which are, at times, threatening and confusing.

It is recommended that, for successful implementation of reforms in schools, teachers need to be respected and involved at the outset in order for them to create and develop ownerships of the reforms; they also need to make sense of the reforms within the reality of their classroom context; and opportunities are to be provided for leadership and professional learning.

Technology teachers have primary responsibility for developing and teaching technological literacy programmes in schools. Continuing advancements in technology implies that teachers in the field need to keep abreast of developments and have mastery of the knowledge and skills as required for implementing changes in technology curriculum reforms. At present, practising teachers mainly rely on the Education and Manpower Bureau commissioned one-time training courses, workshops and seminars to update their knowledge and skills. Though these professional development programmes were planned with good intentions, it has been shown in this study that most of these programmes were designed separately from teachers' classroom context, and were not pitched at the right level. It is recommended that, as a long-term policy, technology teachers should be provided with the opportunities to learn about advances in technological knowledge and techniques which are conducive to their teaching and student learning.

(4) ***Technology Education and gender.*** Despite some progress in addressing gender inequity in technology education in Hong Kong, many problems and issues remain. It is recommended that clear government policies on gender issues

must be developed for schools and other institutions concerned with technology education. Attention needs to be given to the interactions that take place within classrooms, laboratories and workshops by, for example, increasing the awareness of teachers of gender issues and adopting a variety of collaborative teaching styles. Further, every effort should be made to ensure that curriculum content, school textbooks and other curriculum materials are as free as possible from gender bias (EOC, 2004).

In the Chinese culture, boys and girls are reared differently according to their gender and there are different assumptions about the social roles that they are expected to fulfil as adults. In view of this, role models for girls are important. Strategies include encouraging more females into the technology teaching field, using various kinds of media for promoting technology education, involving parents, and establishing links with female technologist, technology teachers and teacher trainees.

9.4. Implications for Policy and Practice

(5) ***Implications for assessment of student learning.*** Assessment should serve the purpose of learning. It should be consistent with the philosophy and goals of technology education and should accommodate the full spectrum of students' gender, aptitudes and capabilities. The Hong Kong Examinations and Assessment Authority's (2003) recent practice of broadening through formative School Based Assessment (SBA) is one positive move through pubic examination in this direction. Another example is the student-centred standards-referencing proposal for five levels of achievement put forward by the Education and Manpower Bureau

(2004a), which is consistent with the constructivist views of progressive knowledge-building.

(6) ***Implications for teacher quality and competences.*** This study extends the findings of desirable competences for technology teachers in other countries into the Hong Kong setting. The perceived importance of the list of competences in this study provided guidelines for specifying goals, objectives, and expected outcomes for technology teacher preparation especially in the Hong Kong context. The list of competences should be made part of each trained technology teacher's repertoires, available for use, depending on the specific student population involved and the content domain. In addition, the instrument for the assessment of perceived competences of technology teachers developed in this study provides a basis for future scale refinements. As a measure to enhance the quality and professionalism of the Hong Kong teaching force, it is recommended that the Advisory Committee on Teacher Education and Qualifications (ACTEQ) should continue its task of formulating appropriate professional standards for practising teachers based on the draft Teacher Competencies Framework (TCF). The next step should be aiming at developing competences for newly qualified teachers, which adopts an integrated approach rather than separate or discrete competencies.

(7) ***Implications for technology teacher education.*** The changing education scene in Hong Kong presents a unique and critical concern for practising teachers as well as for student teachers entering the profession. Student teachers of technological subjects should be adequately prepared with the knowledge, attitudes and the required competences before they join the profession, and the focus and contents of initial teacher education programmes should be adjusted accordingly.

It is recommended that the Hong Kong Institute of Education (HKIEd), being the major provider of technology teacher education in Hong Kong, should constantly review and restructure its technology teacher education programmes to make the programmes more responsive to the key issues and change contexts in which student teachers will have to operate in schools, and to better align them with the changing needs of schools and school teachers. This also implies that teacher education providers in general should review and revise their initial and in-service teacher education programmes accordingly to include new ingredients for assisting school teachers to understand and actuate education reforms, for helping them appreciate the new philosophy and develop new attitudes towards teaching, learning and assessment, and for supporting them to develop essential competences required for effective implementation of the reforms.

As for the technology teacher educators, their own continuing professional development is essential to their fulfilment of the role of providing effective guidance to student teachers and facilitating the process of professional learning to practising teachers in an era of rapid curriculum changes and technological development.

9.5. Implications for Future Research

(8) ***Long-term research programme***. To successfully introduce and sustain curriculum reforms in schools requires a long-term research and development programme that informs classroom practice. It is recommended that such a research programme should include teacher development, resource development and strategy

development to enhance teacher knowledge and classroom practice, and mechanisms for the dissemination of the research findings to inform all teachers involved and other interested parties.

(9) ***Similar research studies on other stakeholders.*** Listening to stakeholders can assist in identifying key components of successful programmes and barriers to change. Professionals should be concerned about how children will be affected by technology education programmes. School personnel can provide information on what instructional, management, and assessment strategies have been successful for them in ensuring meaningful implementation or integration of technology education into the school curriculum. Parents' voices need to be heard. School children are a vitally important yet neglected source of information about curriculum change. Others in the community, for example people in the private sector, can inform policy-makers about their expectations on technology education and assist in goal setting and re-setting. In this study only school principals and teachers in the field were involved because of time and resources constraints. It is recommended that in order to obtain a clearer picture of the whole situation, similar research studies which aim at investigating the perceptions and expectations of other potential stakeholders should be conducted in future.

9.6. Summary

This thesis is a status study of technology education in Hong Kong. Its main purpose was to investigate what and how technology education could contribute to the personal needs of Hong Kong students and that of Hong Kong's society. The study has added to the growing body of literature on technology education, teacher competences, technology teacher education, and curriculum change. The results of the study provide essential information about technology education in Hong Kong as regards to its historical development, status and processes of implementation in secondary schools.

The study has also identified a list of key factors that might facilitate and impede technology education reform and curriculum change. Outcomes of this study can inform policy-makers and curriculum developers about stakeholders' expectations on technology education and assist in goal setting, planning, resourcing, and professional development provisions for teachers and other key change agents. It is anticipated that some of the noted problems confronting the adaptation and implementation in Hong Kong would be useful for other education systems of similar social background or stage of economical development. Besides, the set of desirable characteristics for newly qualified teachers of technological subjects being identified will be useful as a guide for developing initial and in-service teacher education programmes and teacher competence framework.

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APPENDIX I

Survey Questionnaire (Chinese Version)

The Hong Kong Institute of Education
香港教育學院

香港科技教育及科技教師教育

調查

前 言

課程發展議會於二零零一年六月公布學校課程發展的最新路向。科技教育被列入八個學習領域其中之一。

本研究項目由香港教育學院撥款資助，旨在了解中學校長和科技科目教師對香港科技教育的觀點與期望，以及對師資培訓方面的意見，令學院的科技科目教師培訓課程，更能切合課程改革的需要。

完成整份問卷需時大約十五分鐘，請你依照各部分的指引填寫，並在所提供的空位內寫下你的意見或建議。即使你對近日香港的科技教育課程改革不太熟悉，亦煩請將問卷完成。你所提供的資料祇作此項研究之用，絕對保密。

我們衷心感謝你的合作。如對此研究項同或問卷調查有任何垂詢，請於辦公時間內致電聯絡冼凱敏小姐 (2948 7727) 或盧騰蛟先生 (2948 7711 或 9307 5334)。

盧騰蛟先生
研究項目負責人
香港教育學院

李家珍博士
資訊與應用科技系 系主任
香港教育學院

名詞釋義

- 「科技科目」是指初中、高中、中六各級程度，以獨立形式或綜合形式開授的科技科目，包括：膳食服務、汽車科技、基本設計、設計與科技、桌面出版、電子、電子與電學、圖象傳意、金工、基本科技、科技概論、工業繪圖、紡織。
- 「科技科目教師」是指現時任教上述任何一個科技科目的教師。
- 「新任科技科目合格教師」是指新近完成教師專業課程培訓，及獲得「合格教師資格」(QTS) 的科技科目教師。

香港科技教育和科技教師教育調查

這項調查旨在蒐集香港教育工作者對香港科技教育和科技教師教育的意見。

A 部　填表人相關基本資料

(此部分由校長 / 副校長填寫)

請就下列各項，圈選適合你的答案

A1	學校類別	1. 官立學校	2. 資助/津貼學校	3. 直接資助計劃學校	4. 私校	
A2	性別	1. 男	2. 女			
A3	年齡組別	1. 20 歲或以下	2. 21-30 歲	3. 31-40 歲	4. 41-50 歲	5. 51 歲或以上
A4	教學年資	1. 6-10 年	2. 11-20 年	3. 21 年 或以上		
A5	最高教育程度	3. 學士	4. 碩士	3. 博士	4. 其他: 請說明 ______	
A6	主修學科	1. 文科/人文 學科	2. 科學/數學	3. 科技/工程	4. 其他: 請說明 ______	
A7	職位	1. 校長	2. 副校長			
A8	在貴校任職校長 / 副校長年數	1. 2 年或以下	2. 3-5 年	3. 6-10 年	4. 11-20 年	5. 21 年或以上
A9	你對近日科技教育課程改革（例如：在「科技教育學習領域」及「科技教育課程架構」方面）的認識程度:	1. 知得很少或全不知道	2. 知道一些	3. 清楚	4. 非常清楚	
A10	貴校初中的科技科目是以什麼形式開設?	1. 獨立科目	2. 綜合科目	3. 沒有開授		
A11	貴校初中的科技科目是否男女生均可以修讀?	1. 男女均可修讀	2. 只供男生修讀	3. 只供女生修讀	4. 沒有 開授	
A12	貴校高中的科技科目是以什麼形式開設?	1. 獨立科目	2. 綜合科目	3. 沒有開授		
A13	貴校高中的科技科目是否男女生均可以修讀?	1. 男女均可修讀	2. 只供男生修讀	3. 只供女生修讀	4. 沒有開授	
A14	貴校開設的科技科目在不久之將來是否會有改變? 若是，請說明將會取消那些現有的科目，及/或將會開授那些新科目：______	1. 是	2. 否			

(此部分由科技科目老師 / 科主任填寫)

請就下列各項，圈選適合你的答案

		1.	2.	3.	4.	5.
A1	學校類別	官立學校	資助/津貼學校	直接資助計劃學校	私校	
A2	性別	男	女			
A3	年齡組別	20 歲或以下	21-30 歲	31-40 歲	41-50 歲	51 歲或以
A4	教學年資	2 年或以下	3-5 年	6-10 年	11-20 年	21 年或以上
A5	最高教育程度	教育証書	高級文憑	學士	碩士	其他: 請說明
A6	職位	科目老師	科主任			
A7	在現職學校工作年數	2 年或以下	3-5 年	6-10 年	11-20 年	21 年或以上
A8	在這學年裡，你用最多時間教授的科目是 (祇選一組)	A 組	B 組	C 組	D 組	

- A組　汽車科技、基本設計、設計與科技（另選課程）、桌面出版、圖象傳意、基本科技、科技概論
- B組　膳宿服務（中四至中五）、設計與科技、電子與電學、電子學、工程科學、時裝設計、工業繪圖、紡織
- C組　膳宿服務（中一至中三）、汽車修理、電工、時裝及成衣（中一至中三）、印刷、金工
- D組　包含科技科目元素的綜合科目，請說明：_______

		1.	2.	3.	4.
A9	你對近日科技教育課程改革的認識程度 (例如在「科技教育學習領域」及「科技教育課程架構」方面)：	知得很少或全不知道	知道一些	清楚	非常清楚
A10	你對在校內推行科技教育課程改革的準備程度:	需要他人幫助	需要一些幫助	有準備	有充分準備

B 部　科技教育

	請就下列各項有關香港中學科技教育的陳述句子，圈選你的同意程度。	同意程度 非常同意				非常不同意
B1	科技教育與教育科技相類似	5	4	3	2	1
B2	科技教育是電腦科的別稱	5	4	3	2	1
B3	科技教育爲學生提供發展資訊科技技能力的機會	5	4	3	2	1
B4	科技教育是手工藝科目的延伸	5	4	3	2	1
B5	科技教育爲學生提供發展創意思考的機會	5	4	3	2	1
B6	科技教育是一個獨立科目，有別於科學和數學	5	4	3	2	1
B7	科技教育爲學生提供發展智能的機會	5	4	3	2	1
B8	科技教育促進學生的科技素養，是學校課程的一個重要構成部分	5	4	3	2	1
B9	科技教育讓學生參與評估科技的影響	5	4	3	2	1
B10	科技教育對通才教育課程作出貢獻	5	4	3	2	1
B11	科技教育裝備學生去面對急速改變的科技社會	5	4	3	2	1
B12	科技教育不需要包括在學校課程之內，因其他學科已足夠促進學生的科技素養	5	4	3	2	1
B13	科技教育的發展應與工商業掛鈎	5	4	3	2	1
B14	科技教育可幫助學生發展解決問題和決策的能力	5	4	3	2	1
B15	科技教育鼓勵明智及理性地運用人力和自然資源	5	4	3	2	1
B16	科技教育爲學生提供基本專業技能和職業輔導資訊，有助學生選擇有意義的職業	5	4	3	2	1
B17	科技教育教導學生整合從其他學科所獲得的知識和技能，例如：語文、科學、數學、社會科	5	4	3	2	1
B18	科技教育發展和培養學生可轉移的技能	5	4	3	2	1
B19	科技教育培訓學生應用工業知識和技術	5	4	3	2	1
B20	科技教育爲學生在科技社會中終身學習作準備	5	4	3	2	1
B21	科技教育讓學生參與豐富的親身實踐活動	5	4	3	2	1
B22	科技教育爲學生未來的工作生活作準備	5	4	3	2	1
B23	不論是男生或女生，都應接受科技教育	5	4	3	2	1
B24	科技教育是爲能力稍遜的學生而設	5	4	3	2	1
B25	不論是修讀文/商科或理/工科的學生，都應接受科技教育	5	4	3	2	1
B26	科技教育應該屬於中學課程必修的一個部份	5	4	3	2	1

C 部　科技教育課程內容

	就下列各項課程範疇在香港中學科技教育課程之重要程度，圈選你的答案。	重要程度 *非常重要*				*非常不重要*
C1	基本電腦體系架構及電腦操作	5	4	3	2	1
C2	物料及物料處理	5	4	3	2	1
C3	物流管理	5	4	3	2	1
C4	人力資源管理	5	4	3	2	1
C5	食品包裝	5	4	3	2	1
C6	電腦及資訊系統	5	4	3	2	1
C7	生產的工具和機械	5	4	3	2	1
C8	產品分析及產品生命週期	5	4	3	2	1
C9	控制系統 - 電子、機械、油壓、氣動、電腦	5	4	3	2	1
C10	時裝設計	5	4	3	2	1
C11	生產設計	5	4	3	2	1
C12	電腦應用，包括文本處理、圖象處理、多媒體簡報和資料庫的運用	5	4	3	2	1
C13	結構系統	5	4	3	2	1
C14	生產管理	5	4	3	2	1
C15	決策、計劃和控制	5	4	3	2	1
C16	電腦傳訊和互聯網使用	5	4	3	2	1
C17	安全及健康	5	4	3	2	1
C18	能源的應用	5	4	3	2	1
C19	消費者教育	5	4	3	2	1
C20	算法及電腦程序編寫	5	4	3	2	1
C21	常見的工業生產程序	5	4	3	2	1

請在下面空位加上你認爲非常重要的**科技教育課程內容**:

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D 部　在香港中學推行科技教育的有利因素

請就下列在香港中學推行科技教育各項因素，圈選其有利程度。

		有利程度				
		非常有利				*少許有利*
D1	學校行政人員的支持	5	4	3	2	1
D2	同事的支持	5	4	3	2	1
D3	家長的支持	5	4	3	2	1
D4	社會的支持	5	4	3	2	1
D5	香港特區政府強制學生修讀科技教育	5	4	3	2	1
D6	科技科目教師對科技教育的正面態度	5	4	3	2	1
D7	學生對科技教育的正面態度	5	4	3	2	1
D8	有足夠財政支持	5	4	3	2	1
D9	獲額外撥款資助	5	4	3	2	1
D10	獲提供優質教材及教學資源	5	4	3	2	1
D11	獲提供所需的設備	5	4	3	2	1
D12	適切的教師專業發展課程	5	4	3	2	1
D13	科技科目有良好的形像	5	4	3	2	1
D14	修讀科技科目有助學生繼續進修或投考專上學院	5	4	3	2	1
D15	工藝取向的工業科目逐漸被淘汰	5	4	3	2	1
D16	科技科目越來越受到歡迎	5	4	3	2	1
D17	教師有足夠時間推行改革，包括備課	5	4	3	2	1
D18	本地期刊和雜誌刊登有更多有關科技教育的文章	5	4	3	2	1
D19	有更多科技教育方面的研究	5	4	3	2	1
D20	推行科技教育的網站	5	4	3	2	1
D21	參觀/觀摩其他學校的科技教育設施和學生作品的機會	5	4	3	2	1

請在下面空位，加上你認爲有利於在香港中學推行科技教育的其他因素：

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E 部　在香港中學推行科技教育的不利因素

請就下列在香港中學推行科技教育各項因素，圈選其不利程度。

		不利程度				
		非常不利				*少許不利*
E1	校內缺乏科技科目的領導人才	5	4	3	2	1
E2	校內沒有足夠數量的專科老師去教授有關學科	5	4	3	2	1
E3	缺乏受良好訓練和合資格的科技科目教師	5	4	3	2	1
E4	缺乏優質教材和教學資源	5	4	3	2	1
E5	教師不願意改變	5	4	3	2	1
E6	科技變革步伐急速，教師祇有很少時間去學習新科技知識，從而感受到的壓力	5	4	3	2	1
E7	學校行政人員對科技教育缺乏認識和了解	5	4	3	2	1
E8	缺乏有關設備和資源	5	4	3	2	1
E9	學生對科技教育持負面態度	5	4	3	2	1
E10	科技科目教師對科技教育持負面態度	5	4	3	2	1
E11	科技教育在學校課程被置於不利位置	5	4	3	2	1
E12	教師對課程改革缺乏理解	5	4	3	2	1
E13	學校行政人員視科技教育爲「垃圾傾倒場」	5	4	3	2	1
E14	科技科目形像欠佳	5	4	3	2	1
E15	對科技科目的傳統觀念（例如: 性別偏見）	5	4	3	2	1
E16	在緊迫的學校課程中缺乏時間空檔	5	4	3	2	1
E17	沒有足夠或合適的教師專業發展課程	5	4	3	2	1
E18	學生沒有足夠學習能力修讀科技科目	5	4	3	2	1
E19	科技教育沒有得到其他教師的支持	5	4	3	2	1
E20	家長對科技教育缺乏認識、興趣和支持	5	4	3	2	1
E21	學校結束或逐步刪除科技教育課程	5	4	3	2	1
E22	教師沒有足夠的學科訓練或專門知識	5	4	3	2	1
E23	各方面對科技教育課程內容缺乏共識	5	4	3	2	1
E24	祇有很短的準備時間去推行課程改革	5	4	3	2	1
E25	科技教育沒有公認的知識基礎	5	4	3	2	1
E26	科技教育常與電腦及教育科技混淆一起	5	4	3	2	1

請在下面空位，加上你認爲不利於在香港中學推行科技教育的其他因素：

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F 部. 科技科目教師能力

	請就下列新任科技科目合格教師的各項能力，圈選其重要程度 *科技科目的新任合格教師應能夠：*	重要程度 *非常重要*				*非常不重要*
F1	透過不同的評估方法，例如：設計作品集 (design portfolio)、專題研習，去評估學生科技學習活動的進度	5	4	3	2	1
F2	認識和了解課程發展議會所建議的「科技教育課程架構」	5	4	3	2	1
F3	根據「科技教育課程架構」及學校的課程政策，去計劃、執行和評估教學單元	5	4	3	2	1
F4	在設計科技教育課程時，邀請本地專上學院、工商界及社會人士提供意見，使課程更切合升學及社會的需要	5	4	3	2	1
F5	持續進修與科技或科技教育相關的、有認可資格的課程	5	4	3	2	1
F6	處理採購物料、儀器和工具的文書工作	5	4	3	2	1
F7	了解科技教育的本質及其在中學課程內擔當之角色	5	4	3	2	1
F8	參照近期科技教育教學法方面的研究，去計劃教學活動	5	4	3	2	1
F9	進行科技教育方面的研究	5	4	3	2	1
F10	保養科技工具和儀器	5	4	3	2	1
F11	適當地選取及安全地使用一系列的基本機械工具，去製造產品	5	4	3	2	1
F12	組織教學活動，提供機會讓學生參與工商業及社區工作	5	4	3	2	1
F13	了解科技教育如何能促進學生在概念、創意和實務方面的發展	5	4	3	2	1
F14	為學生訂定清晰、富挑戰性和可達致的期望	5	4	3	2	1
F15	閱讀與科技教育有關的專業期刊及文獻	5	4	3	2	1
F16	展示廣博的學科知識和技巧，足以教授中一至中六各級程度的科技科目	5	4	3	2	1
F17	計劃和佈置科技實驗室及教學活動空間	5	4	3	2	1
F18	適當地選取及安全地運用一系列電腦控制機械工具和裝置，去製造產品	5	4	3	2	1
F19	了解和應用科學及數學原理於科技解難方面	5	4	3	2	1
F20	有效地運用一系列切合學生年齡、能力、性別和個別需要的教學策略於科技學習活動之上	5	4	3	2	1
F21	透過成為科技教育專業團體的活躍會員，以跟上科技發展步閥	5	4	3	2	1
F22	認識和了解科技科目的考試課程綱要	5	4	3	2	1
F23	運用合適的科技詞彙，去促進學生的語文和溝通技巧	5	4	3	2	1
F24	透過適當途徑，去緊貼科技發展步閥	5	4	3	2	1
F25	對不同能力的學生訂立合適程度的要求和期望	5	4	3	2	1
F26	選用、製作及應用合適的資源，包括資訊科技，去輔助教與學	5	4	3	2	1
F27	撰寫與科技教育有關的文章或書本	5	4	3	2	1
F28	展示解決問題、批判性思考和決策的能力	5	4	3	2	1
F29	將教學活動與科技科目的近期教學理論相結合	5	4	3	2	1
F30	撰寫計劃書去申請資助（例如：優質教育基金）	5	4	3	2	1

F31	進行設計時考慮不同的價值取向（例如：技術、經濟、美學、社會、環境、道德）	5	4	3	2	1
F32	運用適當的策略，去配合資優學生、有特殊教育需要或有學習困難的學生的不同需要	5	4	3	2	1
F33	在科技教育會議 / 研討會上發表文章或演示教學活動	5	4	3	2	1
F34	適當地選取及安全地運用一系列科技材料和程序，去製造產品	5	4	3	2	1
F35	在計劃課程、施教及與學生一起工作時，提倡平等機會及避免把學生定型	5	4	3	2	1
F36	爲校本課程發展活動作出貢獻	5	4	3	2	1
F37	適當地選取及安全地使用一系列手工具，去製造器物產品	5	4	3	2	1
F38	組織教學活動，爲學生設計境況，鼓勵學生剖析個人及社會的價值觀	5	4	3	2	1
F39	透過網上 / 電郵參與科技教育電子討論區	5	4	3	2	1
F40	有效地管理校內的科技教育設備，包括：物料、工具及儀器的儲存	5	4	3	2	1
F41	遵照有關的健康及安全規則，自信地與學生一起工作	5	4	3	2	1
F42	根據適當的健康和安全標準，爲個人及他人作危險評估	5	4	3	2	1
F43	展示對「高科技」器材的知識（例如：激光和機械人）	5	4	3	2	1
F44	識別與科技活動和設備相關的環境和安全問題	5	4	3	2	1
F45	展示教授科技科目所需的英文口語和書寫能力	5	4	3	2	1
F46	展示教授科技科目所需的中文口語和書寫能力	5	4	3	2	1
F47	透過適當的健康和安全程序及教室常規，去維持一個安全的工作與學習環境	5	4	3	2	1
F48	應用不同種類的圖象傳意技巧，包括：繪圖、模塑、設計記錄	5	4	3	2	1
F49	應用資訊科技於傳意和數據處理方面	5	4	3	2	1
F50	應用資訊科技於模塑、控制和製造方面	5	4	3	2	1
F51	營造及維護一個能激勵思考及有意義的和有條理的學習環境，以去支援及促進學生學習	5	4	3	2	1
F52	評估個別工業使用科技的情況	5	4	3	2	1
F53	有效地計劃和管理個別學生的科技學習活動	5	4	3	2	1
F54	評估科技即時及長期的影響	5	4	3	2	1
F55	提倡跨學科的學習活動，使學生能融匯及轉移所學到的知識和技巧至其他學科	5	4	3	2	1
F56	有效地監察和支援學生的設計和製作活動	5	4	3	2	1

G 部　科技科目教師培訓課程

	請就下列各項有關科技教師培訓課程的陳述句子，圈選你的同意程度。	同意程度 *非常同意*				*非常不同意*
G1	科技科目教師培訓課程應著重提供全面性的學科基礎訓練	5	4	3	2	1
G2	科技科目教師培訓課程應集中於新科技的應用方面（例如：機械人及自動化生產）	5	4	3	2	1
G3	科技科目教師入職前必須經過師資培訓	5	4	3	2	1
G4	科技科目教的職前培訓，應包括相同比重的科技、學術及教育專業研習課程	5	4	3	2	1
G5	報讀科技科目教師培訓課程的學生，在中學階段必須曾修讀科技科目課程	5	4	3	2	1
G6	報讀科技科目教師培訓課程的學生，必須有相關的工作經驗					
G7	科技科目教師入職前必須持有相關大學學位	5	4	3	2	1
G8	「四年制教育學士學位課程」，是培訓科技科目教師最合適的課程	5	4	3	2	1
G9	爲跟上科技發展，所有科技科目教師須定期進修，以緊隨新科技的發展	5	4	3	2	1
G10	爲持有學士學位人士而設的「教師教育文憑課程」，是培訓科技科目教師最合適的課程	5	4	3	2	1

問卷完

多謝你的寶貴時間！

APPENDIX II

Survey Questionnaire (English Translation)

The Hong Kong Institute of Education
香港教育學院

Survey on Technology Education and Technology Teacher Education for Hong Kong

Forward

In June 2001, The Curriculum Development Council released the "Learning to Learn: the Way Forward in Curriculum Development Consultation Document". Technology Education has been positioned as one of the Key Learning Areas (KLAs).

This survey is supported by the Hong Kong Institute of Education. The purpose of this survey is to obtain views and expectations from secondary school principals and technological subject teachers on the future directions of Technology Education and Technology Teacher Education in Hong Kong.

It will take about 15 minutes to complete the questionnaire. Please follow the instructions provided in filling out the questionnaire, and feel free to make further comments or suggestions in the space provided. Please complete this survey even if you are not acquainted with recent technology education curriculum reform in Hong Kong.

Your cooperation will be greatly appreciated. For enquiry about this survey, please call during office hours Miss Cherise Sin at 2948 7727 or Mr. Albert Lo at 2948 7711 or 9307 5334.

Mr. LO Ting Kau
Principal Investigator
The Hong Kong Institute of Education

Dr. LEE Kar Tin
Head, Department of Information and Applied Technology
The Hong Kong Institute of Education

DEFINITIONS OF TERMS

In this survey:

- Technological Subject refers to *discrete* or *integrated subject* at the Junior Secondary, Senior Secondary, or Sixth Form level, in the areas of Accommodation & Catering Services, Automobile Technology, Design Fundamentals, Design & Technology, Desktop Publishing, Electronics, Electronics & Electricity, Graphical Communications, Metalwork, Technology Fundamentals, Technological Studies, Technical Drawing, and Textiles.
- Technological Subject Teacher refers to a teacher currently teaching any of the technological subjects specified at above.
- Newly Qualified Teacher of Technological Subject refers to a technological subject teacher who has recently completed a professional training programme and has obtained the Qualified Teacher Status (QTS).

Survey on Technology Education and Technology Teacher Education for Hong Kong

The purpose of this survey is to obtain information about the perceived characteristics of Technology Education and Technology Teacher Education in Hong Kong.

Section A. Demographic Data

(To be completed by School Principal / Vice Principal)

Please indicate your response to each of the following statements by circling the appropriate answer.

A1	School Type	1. Government School	2. Subsidised/ Aided School	3. Direct Subsidy Scheme School	4. Private School	
A2	Gender	1. Male	2. Female			
A3	Age Range	1. 20 years or less	2. 21-30 years	3. 31-40 years	4. 41-50 year	5. 51 years or more
A4	Teaching Experience	1. 6-10 years	2. 11-20 years	3. 21 yers or more		
A5	Highest level of education achieved	3. Bachelor Degree	4. Master 's Degree	3. Doctoral Degree	4. Other: Please Specify	
A6	Your academic subject discipline	1. Arts / Humanity	2. Science / Maths	3. Technology / Engineering	4. Other: Please Specify	
A7	Position held	1. School Principal	2. Vice Principal			
A8	Number of years in present position in this school as School Principal / Vice Principal	1. 2 years or less	2. 3-5 years	3. 6-10 years	4. 11-20 years	5. 21 years or more
A9	Do you consider yourself knowledgeable about recent Technology Education curriculum reform (e.g., Technology Education Key Learning Area and Technology Education Curriculum Framework)?	1. Have little or no knowledge	2. Have some knowledge	3. Have good knowledge	4. Have very good knowledge	
A10	How is/are Technological Subject(s) offered in your school at Junior Secondary level?	1. Discrete Subject	2. Integrated Subject	3. Not offered		
A11	Do/does Technological Subject(s) offered to both boys and girls in your school at Junior Secondary level?	1. For both boys and girls	2. For boys only	3. For girls only	4. Not offered	
A12	How is/are Technological Subject(s) offered in your school at Senior Secondary level?	1. Discrete Subject	2. Integrated Subject	3. Not offered		
A13	Do/does Technological Subject(s) offered to both boys and girls in your school at Senior Secondary level?	1. For both boys and girls	2. For boys only	3. For girls only	4. Not offered	
A14	Will there be any changes in the list of Technological Subjects offered in your school in the near future? If yes, please specify below existing subject(s) to be phased out, and new subject(s) to be adopted:	1. Yes	2 No			

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(To be completed by Subject Teachers / Panel Chairpersons)

Please indicate your response to each of the following statements by circling the appropriate answer.

A1	School Type	1. Government School	2. Subsidized/ Aided School	3. Direct Subsidy Scheme School	4. Private School	
A2	Gender	1. Male	2. Female			
A3	Age Range	1. 20 years or less	2. 21-30 years	3. 31-40 years	4. 41-50 years	5. 51 years or more
A4	Teaching Experience	1. 2 years or less	2. 3-5 years	3. 6-10 years	4. 11-20 years	5. 21 years or more
A5	Highest level of education achieved	1. Teacher's Cert	2. Higher Diploma	3. Bachelor Degree	4. Master Degree	5. Other: Please Specify
A6	Position held	1. Subject Teacher	2. Subject Panel Chair-person			
A7	Number of years in present position in this school	1. 2 years or less	2. 3-5 years	3. 6-10 years	4. 11-20 years	5. 21 years or more
A8	Technological subject(s) that you spend most of the time teaching in this academic year (Select from only one group of subject below):	1. Group A	2. Group B	3. Group C	4. Group D	

- Group A - Automobile Technology, Design Fundamentals, Design & Technology (Alt. Syll.), Desktop Publishing, Graphical Communication, Technology Fundamentals, and Technological Studies.
- Group B - Accommodation & Catering Services (S4-5), Design & Technology (incl. ASL), Electronics & Electricity, Electronics, Engineering Science, Fashion Design, Technical Drawing, and Textiles.
- Group C - Accommodation & Catering Services (S1-3), Auto Repairs, Electrical Studies, Fashion & Clothing (S1-3), Printing, and Metalwork.
- Group D - Integrated subjects with technological elements incorporated. Please specify:

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A9	Do you consider yourself knowledgeable about recent Technology Education curriculum reform (e.g., Technology Education Key Learning Area and Technology Education Curriculum Framework)?	1. Have little or no knowledge	2. Have some knowledge	3. Have good knowledge	4. Have very good knowledge
A10	How well are you prepared for the implementation of recent Technology Education curriculum change in your school?	1. Need help	2. Need some help	3. Prepared	4. Well prepared

Section B. Technology Education

	Please indicate the extent you agree or disagree with each of the following statements about Technology Education for Hong Kong secondary schools by circling the appropriate answer.	Level of Agreement *Strongly Agree*				*Strongly Disagree*
B1	TE is something similar to Educational Technology	5	4	3	2	1
B2	TE is computer studies with a different name	5	4	3	2	1
B3	TE provides an opportunity for students to develop Information Technology skills	5	4	3	2	1
B4	Technology Education is an extension of craft-based subjects	5	4	3	2	1
B5	TE provides an opportunity for students to develop creative thinking	5	4	3	2	1
B6	TE is a stand alone subject, separated from Science and Mathematics	5	4	3	2	1
B7	TE provides an opportunity for students to develop intellectual capabilities	5	4	3	2	1
B8	TE is an essential part of the school curriculum that promotes technological literacy	5	4	3	2	1
B9	TE involves students in assessing and evaluating the effects of technology	5	4	3	2	1
B10	Technology Education contributes to the general education curriculum	5	4	3	2	1
B11	TE prepares students to deal with the rapidly changing technological society	5	4	3	2	1
B12	TE is not needed in the school curriculum because other subjects adequately promote technological literacy	5	4	3	2	1
B13	TE's development should be linked up with the business / industry sectors	5	4	3	2	1
B14	TE can assist in the development of students' problem-solving and decision making skills	5	4	3	2	1
B15	TE encourage the wise and rational use of human and natural resources	5	4	3	2	1
B16	TE serves to provide students with basic technical skills and occupational guidance information to contribute to meaningful occupational choice	5	4	3	2	1
B17	TE serves to teach students to integrate knowledge and skills acquired from other subject disciplines such as languages, science, mathematics, and social studies	5	4	3	2	1
B18	TE develops and nurtures students' transferable skills	5	4	3	2	1
B19	TE prepares students to apply knowledge and skills of industry	5	4	3	2	1
B20	TE prepares students for lifelong learning in a technological society	5	4	3	2	1
B21	TE engages student in rich hands-on activities	5	4	3	2	1
B22	TE prepares students for future working life	5	4	3	2	1
B23	TE should be provided for both boys and girls	5	4	3	2	1
B24	TE is for the low achievers	5	4	3	2	1
B25	TE should be provided for both arts/humanity and science/technology students	5	4	3	2	1
B26	TE should be a compulsory part of the secondary school curriculum	5	4	3	2	1

Section C. Technology Curriculum Content

	Please rate the level of importance of each content area in the Technology Education Curriculum for Hong Kong secondary schools by circling the appropriate answer.	**Level of Importance** *Most Important*				*Least Important*
C1	Basic computer architecture and computer operation	5	4	3	2	1
C2	Materials and material processing	5	4	3	2	1
C3	Logistics management	5	4	3	2	1
C4	Human resource management	5	4	3	2	1
C5	Food packaging	5	4	3	2	1
C6	Computers and information systems	5	4	3	2	1
C7	Tools and machinery for production	5	4	3	2	1
C8	Product analysis and product life cycles	5	4	3	2	1
C9	Control systems - electronics, mechanical, hydraulic, pneumatics, and computers	5	4	3	2	1
C10	Fashion design	5	4	3	2	1
C11	Design for manufacturing	5	4	3	2	1
C12	Computer applications, including text processing, graphic handling, multimedia presentation, and using databases	5	4	3	2	1
C13	Structure system	5	4	3	2	1
C14	Production management	5	4	3	2	1
C15	Decision making, planning and control	5	4	3	2	1
C16	Computer communications and Internet access	5	4	3	2	1
C17	Safety and health	5	4	3	2	1
C18	Application of energy	5	4	3	2	1
C19	Consumer education	5	4	3	2	1
C20	Algorithm and computer programming	5	4	3	2	1
C21	Common industrial processes	5	4	3	2	1

Please add any other Technology Education Curriculum content area(s) that you consider is /are very important:

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Section D. Facilitating Factors for Implementing Technology Education in Hong Kong Secondary Schools

	Please indicate the facilitating level of each of the following factors that you think would facilitate the implementation of technology education in Hong Kong secondary schools by circling the appropriate answer.	**Facilitating Level** *Most Facilitating*				*Least Facilitating*
D1	Support from school administrators	5	4	3	2	1
D2	Support from peers	5	4	3	2	1
D3	Support from parents	5	4	3	2	1
D4	Support from the community at large	5	4	3	2	1
D5	The HKSAR Government mandates students to take TE	5	4	3	2	1
D6	Positive attitudes of technological subject teachers towards TE	5	4	3	2	1
D7	Positive attitudes of students towards TE	5	4	3	2	1
D8	Adequate financial support	5	4	3	2	1
D9	Availability of extra grant funding	5	4	3	2	1
D10	Availability of quality instructional materials and teaching resources	5	4	3	2	1
D11	Availability of necessary facility	5	4	3	2	1
D12	Appropriate professional development programme for teachers	5	4	3	2	1
D13	Good subject image for technological subjects	5	4	3	2	1
D14	Studying technological subjects is useful for students' further study or admission to tertiary institutions	5	4	3	2	1
D15	Phasing out of craft-oriented technical subjects	5	4	3	2	1
D16	Technological subjects are growing in popularity	5	4	3	2	1
D17	Teachers have ample time to cope with change, including adequate time for lesson preparation	5	4	3	2	1
D18	More articles on TE in local journals & magazines	5	4	3	2	1
D19	More research in TE	5	4	3	2	1
D20	A website for promoting TE	5	4	3	2	1
D21	Opportunity of visiting / observing TE facilities and outcome of students in other schools	5	4	3	2	1

Please add any other factor(s) that you consider would facilitate the implementation of technology education in Hong Kong secondary schools:

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Section E. Impeding Factors for Implementing Technology Education in Hong Kong Secondary Schools

Please indicate the level of impedance of each of the following factors that you think would hinder the implementation of technology education in Hong Kong secondary schools by circling the appropriate answer.		**Level of Impedance**				
		Most Impeding				*Least Impeding*
E1	Lack of leadership in technological subject(s) in school	5	4	3	2	1
E2	Insufficient number of subject specialist in school for teaching	5	4	3	2	1
E3	Shortage of well-trained and qualified technological subject teachers	5	4	3	2	1
E4	Lack of quality instructional materials and teaching resources	5	4	3	2	1
E5	Reluctance of teachers to change	5	4	3	2	1
E6	Teacher's stress associated with short learning time of technological knowledge due to rapid pace of technological change	5	4	3	2	1
E7	Lack of knowledge and understanding of TE from school administration	5	4	3	2	1
E8	Lack of appropriate facilities and resources	5	4	3	2	1
E9	Negative attitudes of students towards technology education	5	4	3	2	1
E10	Negative attitudes of technological subject teachers towards TE	5	4	3	2	1
E11	Unfavourable positioning of TE in the school curriculum	5	4	3	2	1
E12	Teachers' lack of understanding of the curricula reform(s)	5	4	3	2	1
E13	School administrators using TE as a dumping ground	5	4	3	2	1
E14	Poor subject image of technological subjects	5	4	3	2	1
E15	Subject traditions of technological subjects (e.g., gender biased)	5	4	3	2	1
E16	Lack of timeslot in the congested curriculum	5	4	3	2	1
E17	Inadequate or lack of appropriate professional development programmes for teachers	5	4	3	2	1
E18	Students' lack of academic abilities in studying technological subjects	5	4	3	2	1
E19	Lack of other teachers' support of TE	5	4	3	2	1
E20	Lack of parents' understanding, interest and support of TE	5	4	3	2	1
E21	Closing or elimination of TE programmes in schools	5	4	3	2	1
E22	Teachers have inadequate training or expertise in the subject area	5	4	3	2	1
E23	Lack of consensus of curriculum content for TE	5	4	3	2	1
E24	Short time frame to prepare for and implement curricular change	5	4	3	2	1
E25	Lack of a recognised knowledge base in TE	5	4	3	2	1
E26	Confusion of TE with computers and educational technology	5	4	3	2	1

Please add any factor(s) that you consider would impede the implementation of technology education in Hong Kong secondary schools:

Section F. Technological Subject Teacher Competence

	Please rate the level of importance of each competence for newly qualified technological subject teachers by circling the appropriate answer.	**Level of Importance** *Most Important*				*Least Important*
	Newly qualified technological subject teachers should be able to:					
F1	Assess students' progress in technology learning activities using a variety of assessment methods such as design portfolios, and project work	5	4	3	2	1
F2	Demonstrate knowledge and understanding of the TE Curriculum Framework as recommended by the Curriculum Development Council	5	4	3	2	1
F3	Plan, manage and evaluate units of work and lessons taking account of the TE Curriculum Framework and the school's curriculum policy	5	4	3	2	1
F4	Involve local tertiary institutions, industry and the community to enhance the relevance of the curriculum in TE	5	4	3	2	1
F5	Further attend a qualification awarding programme related to technology or TE	5	4	3	2	1
F6	Prepare materials, equipment and tool purchases requests	5	4	3	2	1
F7	Demonstrate an understanding of the nature of technology education and its role within the whole secondary school curriculum	5	4	3	2	1
F8	Plan their teaching on the basis of recent, relevant pedagogical research in technology education	5	4	3	2	1
F9	Conduct a research related to TE	5	4	3	2	1
F10	Maintain technological tools and equipment	5	4	3	2	1
F11	Select and use a range of basic machine tools properly and safely for making artefacts	5	4	3	2	1
F12	Structure teaching and learning activities to provide students with opportunities to work with industry, commerce, and the local community	5	4	3	2	1
F13	Demonstrate an understanding of how TE enhances students' conceptual, creative and practical developments	5	4	3	2	1
F14	Set expectations for students that are clear, challenging and achievable	5	4	3	2	1
F15	Read professional journals and other literature related to TE	5	4	3	2	1
F16	Demonstrate a breadth of subject knowledge and skills sufficient to teach technological subjects at S1 to S6 levels	5	4	3	2	1
F17	Plan and layout technology laboratories and instructional areas	5	4	3	2	1
F18	Select and use a range of computer controlled machine tools and devices properly and safely for making artefacts	5	4	3	2	1
F19	Understand and apply scientific and mathematical principles to technological problem solving	5	4	3	2	1
F20	Effectively use a suitable range of teaching and learning strategies for technology learning activities which match students' age, ability, gender, and individual needs	5	4	3	2	1
F21	Keep current through active membership in professional organisations in technology education	5	4	3	2	1
F22	Demonstrate a knowledge and understanding of examination syllabuses of technological subjects	5	4	3	2	1
F23	Contribute to the development of students' language and communication skills through the clear use and promotion of technological vocabulary	5	4	3	2	1
F24	Employ mechanisms to stay current in technology	5	4	3	2	1

F25	Set appropriately demanding and progressive expectations for individual students of all abilities	5	4	3	2	1
F26	Select, produce and use appropriate resources, including information technology, to support teaching and learning	5	4	3	2	1
F27	Write an article or book for publication relating to TE	5	4	3	2	1
F28	Demonstrate an ability to solve problems, think critically, and make decisions	5	4	3	2	1
F29	Relate teaching and learning activities to current theories of teaching and learning technological subjects	5	4	3	2	1
F30	Write a proposal for applying a grant (e.g. Quality Education Fund)	5	4	3	2	1
F31	Consider different values (technical, economic, aesthetic, social, environmental and moral) when designing	5	4	3	2	1
F32	Employ appropriate strategies to meet the needs of gifted students and those with special educational needs or learning difficulties	5	4	3	2	1
F33	Present a paper or teaching and learning activity at a TE meeting / conference	5	4	3	2	1
F34	Select and use a range of technological materials and processes properly and safely for making artefacts	5	4	3	2	1
F35	Promote equality of opportunity and the avoidance of stereotype in curriculum planning, teaching, and working with students	5	4	3	2	1
F36	Contribute to school-based curriculum development activities	5	4	3	2	1
F37	Select and use a range of hand tools properly and safely for making artefacts	5	4	3	2	1
F38	Structure teaching and students' learning to provide context within which students can be encouraged to clarify their own values and examine those of society	5	4	3	2	1
F39	Participate in TE electronic panel discussions on the web / via e-mail	5	4	3	2	1
F40	Manage effectively TE provisions in schools including the storage of materials, tools and equipment	5	4	3	2	1
F41	Work confidently with students in accordance with the appropriate health and safety regulations	5	4	3	2	1
F42	Apply appropriate health and safety measures to make risk assessments for themselves and others	5	4	3	2	1
F43	Demonstrate knowledge on "Hi-Tech" equipment such as laser and robotics	5	4	3	2	1
F44	Identify environmental and safety concerns related to technological activities and facilities	5	4	3	2	1
F45	Demonstrate oral and written English language skills for teaching technological subjects	5	4	3	2	1
F46	Demonstrate oral and written Chinese language skills for teaching technological subjects	5	4	3	2	1
F47	Maintain a safe working and learning environment through appropriate health and safety procedures and students' routines	5	4	3	2	1
F48	Use a variety of graphical communication techniques including sketching, modelling, and recording design decisions	5	4	3	2	1
F49	Use information technology for communicating and data handling	5	4	3	2	1
F50	Use information technology for modelling, controlling and manufacturing	5	4	3	2	1

F51	Create and maintain stimulating, purposeful and orderly learning environments that supports and enhances students' learning	5	4	3	2	1
F52	Assess the use of technology in selected industries	5	4	3	2	1
F53	Effectively plan and manage individual students' technology learning activities	5	4	3	2	1
F54	Assess the immediate impacts and long-term effects of technology	5	4	3	2	1
F55	Promote interdisciplinary learning activities that enable students to integrate and transfer knowledge and skills to other subject disciplines	5	4	3	2	1
F56	Effectively monitor and support students' design and making activities	5	4	3	2	1

G. Technology Teacher Education Programme

	Please indicate the extent you agree or disagree with each of the following statements about technology teacher education programme by circling the appropriate answer.	**Level of Agreement** *Strongly Agree*				*Strongly Disagree*
G1	Training programmes for technological subject teachers should emphasize the provision of a thorough foundation in subject matter	5	4	3	2	1
G2	Training programmes for technological subject teachers should focus on the use of new technologies (e.g., Robotics and factory automation)	5	4	3	2	1
G3	Technological subject teachers need to be professionally trained before entering the teaching profession	5	4	3	2	1
G4	Pre-service technology teacher education should consist of equal studies in technology, academic, and professional courses	5	4	3	2	1
G5	Completion of a secondary school TE course should be a major criterion in selecting students for technology teacher education programme	5	4	3	2	1
G6	Relevant working experience should be a major criterion in selecting students for technology teacher education programme					
G7	Technological subject teachers need to possess a relevant bachelor degree before entering the teaching profession	5	4	3	2	1
G8	A four-year Bachelor in Education programme is an appropriate programme of study for training competent technological subject teachers	5	4	3	2	1
G9	All technological subject teachers should be required, at specific periods, to attend courses to update themselves	5	4	3	2	1
G10	A Postgraduate Diploma in Education programme for degree holders in a relevant field is an appropriate programme of study for training competent technological subject teachers	5	4	3	2	1

End of Questionnaire.

Thank you for taking time for completing the survey.

APPENDIX III

Schedule for Interviews

for

Curriculum Experts, Teachers and School Principals

1. Opening

1.1 Thank you for accepting our invitation and spending your valuable time to attend this interview. It will take you about one hour.

1.2 (For Curriculum Experts) You have been identified as an individual in the field of technology education who served in a position of educational leadership and most knowledgeable about recent developments in technology education in Hong Kong.

(For Teachers and School Principals) You have been identified as an individual in the field of technology education who are knowledgeable about recent developments in technology education in Hong Kong.

1.3 This interview is related to a research supported by the Internal Research Grant of the Hong Kong Institute of Education (HKIEd), which aimed at studying school principals and technology teachers' perceptions and expectations on technology education for Hong Kong.

2. Background and Purpose of the Research

2.1 Just recently, the Curriculum Development Council (CDC) proposed a technology education curriculum framework which portrays the vision of technology education to be pursued for preparing Hong Kong school children for living and working in a rapidly changing technological society and meeting challenges of the 21st century.

2.2 The purpose of the study is to assess school principals and technology teachers' perceptions and expectations on technology education for Hong Kong in the new century. This study attempts to address the following key issues and problems:

- What are the expectations of secondary school principals and technology teachers on technology education in Hong Kong and technology teacher education programmes provided by the HKIEd? And will there be any differences or inconsistencies among these key stakeholders' expectations?

- What are the implications of these key stakeholder groups' expectations for recent technology education curricula reform in general, and technology teacher education programmes provided by the HKIEd in particular?

3. Purpose of the interview

3.1 Given your educational leadership / knowledge / immerse involvements in curriculum development in technology education in Hong Kong, we would like to have your valuable professional inputs on your views on technology education and technology teacher education for Hong Kong.

3.2 We are interested in your opinion on these areas. Please feel free to express your ideas, feelings, and concerns.

3.3 (For Curriculum Experts) The information gathered will be used to refine the instruments being designed for this research study, including questionnaires for school principals and teachers in technology education. A draft of the instruments will be sent to you for comments once ready.

4. Research Ethnics and Confidentiality

4.1 All your responses will remain confidential.

4.2 All information will be reported in aggregate, with no individual or affiliated organization being identified.

4.3 All raw data, including tapes and field notes will be destroyed after the period of the research.

5. Profile of the Interviewee

Name: ______________________________

Organisation: ______________________________

Post held: ______________________________

- Experience in the field: ______________________________
- Experience / involvement in curriculum development and recent educational and curricula reforms: ______________________________
- Have conducted research / published work related to technology education ______________________________
- Serve in a position of educational leadership: ______________________________
- Other: (Please specify) ______________________________

Code:	
Date:	
Venue:	
Time start:	
Time end:	

6. Interview Questions

(1) Have you read any consultation documents, reports, etc., on recent educational and curriculum reforms in Hong Kong, in particular those relating to technology education? For example,

- *Learning to Learn: Key Learning Area - Technology Education (Consultation Document)* (CDC, 2000) *(b)*
- *Learning to Learn: Life-long Learning and Whole-person Development* (CDC, 2001a)

(2) The *Learning to Learn* documents proposed to group the four subject areas, namely Business Studies, Computer Education, Home Economics, and Technological Subjects under the Technology Education Key Learning Area (TEKLA) within the new School Curriculum Framework. Do you have any comments on this arrangement?

(3) In the light of recent reforms, what specific changes you would like to see in the development of technology education in Hong Kong secondary schools?

(4) In your opinion, what are the major factors that would facilitate the development of technology education in Hong Kong secondary schools?

(5) In your opinion, what are the major factors that would impede the development of technology education in Hong Kong secondary schools?

(6) In your opinion, what type of knowledge, skills and competencies are required for Newly Qualified Teachers in technology education in order to meet the redefined aims of education for the 21st century?

(7) In your opinion, what elements should be added or strengthened in the technology teacher education programmes in Hong Kong because of recent technology education curricula reform?

(8) In your opinion, which type of programmes (PGDE or B.Ed.) would be attractive to potential students and welcomed by school principals for teaching technological subjects in Hong Kong secondary schools?

(9) Do you have any other issues that you would like to bring out or share with us in relation to technology education and technology teacher education in Hong Kong?

APPENDIX IV

Tables of Statistical Analysis Results

Table A - 1

Questionnaire Return Rate by School Type (Curriculum)

Questionnaire Return Rate	School Type (Curriculum)			
	Technical School	Prevocational School	Grammar School	Total
No. of targeted school	16	27	247	290
No. of schools returned the completed questionnaires	16	20	134	170
Return rate	100%	74%	54%	59%

Table A - 2

Background of Respondents according to School Type (Curriculum)

Respondent Group	School Type (Curriculum)			
	Technical School	Prevocational School	Grammar School	Total
Administrator	14	19	108	141 (19.5%)
Teacher	89	192	302	583 (80.5%)
Total	103 (14.2%)	211 (29.1%)	410 (56.6%)	724 (100%)

Table A - 3

Administrator Respondents' Education Level

Position	Education Level N (% in total)				
	Teacher Certificate	Bachelor Degree	Master's Degree	Doctoral Degree	Total
School Principal	-	11 (7.9%)	28 (20%)	3 (2.1%)	42 (30%)
Vice Principal	1(0.7%)	55 (39.3%)	42 (30%)	-	98 (70.0%)
Total	1 (0.7%)	66 (47.1%)	70 (50%)	3 (2.1%)	140 (100%)

Remark: 1 missing case for "Position" and "Educational Level" not included.

Table A - 4

Administrator Respondents' Subject Major

Subject Major	N	%
Arts / Humanity	58	41.4
Science / Mathematics	65	46.4
Technology / Engineering	14	10.0
Other	3	2.1
Total	140	100

Table A - 5

Teacher Respondents' Education Level

Position	Education Level N (% in total)					
	Teacher Certificate	Higher Diploma	Bachelor Degree	Master's Degree	Doctoral Degree	Total
Panel Chairperson	91 (16.6%)	23 (4.2%)	149 (27.2%)	49 (8.9%)	4 (0.7%)	316 (57.7%)
Subject Teacher	77 (14.1%)	12 (2.2%)	111(20.3%)	30 (5.5%)	2 (0.4%)	232 (42.3%)
Total	168 (30.7%)	35 (6.4%)	260 (47.4%)	79 (14.4%)	6 (1.1%)	548 (100%)

Remark: 15 missing cases for "Position" and 20 missing cases for "Educational Level" not included.

Table A - 6

Teacher Respondents' Teaching Experience and Major Subject Taught

Teaching Experience	Major Subject Taught N (% of total)				
	New Subjects	Existing Subjects	Phasing-out Subjects	Integrated Subjects	Total
2 or below	20 (3.6%)	5 (0.9%)	2 (0.4%)	9 (1.6%)	36 (6.4%)
3 - 5	28 (5.0%)	10 (1.8%)	4 (0.7%)	13 (2.3%)	55 (9.8%)
6 - 10	45 (8.0%)	28 (5.0%)	12 (2.1%)	40 (7.1%)	125 (22.2%)
11 - 20	97 (17.3%)	75 (13.3%)	17 (3.0%)	35 (6.2%)	224 (39.9%)
21 or above	61(10.9%)	51 (9.1%)	3 (0.5%)	7 (1.2%)	122 (21.7%)
Sub-total (% of total)	251 (44.7%)	169 (30.1%)	38 (6.8%)	104 (18.5%)	562 (100%)

Table A - 7

Mode of Offering Technological Subjects in the Junior Secondary Curriculum

School Type (Curriculum)	TS in the Junior Secondary Curriculum (Mode of Offering) N (% of total)		
	Discrete Subject	Integrated Subject	Total
Technical School	14 (10.3%)		14 (10.3%)
Prevocational School	16 (11.8%)	3 (2.2%)	19 (14%)
Grammar School	92 (67.6%)	11 (8.1%)	105 (75.7%)
Sub-total (% of total)	122 (89.7%)	14 (10.3%)	136 (100%)

Remark: 5 missing cases not included.

Table A - 8

Technological Subjects Offered in the Junior Secondary Curriculum (by Gender)

School Type (Curriculum)	TS in the Junior Secondary Curriculum (Gender) N (% of total)			
	Both Boys and Girls	Boys Only	Girls Only	Total
Technical School	8 (5.9%)	6 (4.4%)	-	14 (10.4%)
Prevocational School	18 (13.3%)	1 (0.7%)	-	19 (14.1%)
Grammar School	89 (65.9%)	13 (9.6%)	-	102 (75.6%)
Sub-total (% of total)	115 (85.2%)	20 (14.8%)	-	135 (100%)

Remark: 6 missing cases not included.

Table A - 9

Mode of Offering Technological Subjects in the Senior Secondary Curriculum

School Type (Curriculum)	TS in the Senior Secondary Curriculum (Mode of Offering) N (% of total)			
	Discrete Subject	Integrated Subject	Not offer	Total
Technical School	13 (9.2%)	-	1 (0.7%)	14 (9.9%)
Prevocational School	18 (12.8%)	1 (0.7%)	-	19 (13.5%)
Grammar School	35 (24.8%)	1 (0.7%)	72 (51.1%)	108 (76.6%)
Sub-total (% of total)	66 (46.8%)	2 (1.4%)	73 (51.8%)	141 (100%)

Table A - 10

Technological Subjects in the Senior Secondary Curriculum (by Gender)

School Type (Curriculum)	TS in the Senior Secondary Curriculum (Gender) N (% of total)			
	Both Boys and Girls	Boys Only	Not offer	Total
Technical School	5 (3.6%)	8 (42%)	1 (0.7%)	14 (10.1%)
Prevocational School	14 (10.1%)	5 (3.6%)	-	19 (13.8%)
Grammar School	31 (22.5%)	6 (4.3%)	68 (49.3%)	105 (76.6%)
Sub-total (% of total)	50 (36.2%)	19 (13.8%)	69 (50.0%)	138 (100%)

Remark: 3 missing cases not included.

Table A - 11

Any Change in the Near Future

School Type (Curriculum)	Any Change in the Near Future N (% in total)		
	Yes	No	Total
Technical School	2 (1.5%)	12 (8.8%)	14 (10.2%)
Prevocational School	10 (7.3%)	8 (5.8%)	18 (13.1%)
Grammar School	13 (9.5%)	92 (67.2%)	105 (76.6%)
Total (5 in total)	25 (18.2%)	112 (81.8%)	137 (100%)

Table A - 12

Administrator Respondents' Familiarity with Recent TE Reforms

Position	Familiarity with Recent TE Reform N (% of total)				
	Little or no knowledge	Some knowledge	Good knowledge	Very good knowledge	Total
School Principal	4 (2.9%)	17 (12.3%)	18 (13.0%)	2 (1.4%)	41 (29.7%)
Vice Principal	7 (5.1%)	54 (39.1%)	33 (23.9%)	3 (2.2%)	97 (70.3%)
Total (% in total)	11 (8.0%)	71 (51.4%)	51 (37.0%)	5 (3.6%)	138 (100%)

Table A - 13

Teacher Respondents' Familiarity with Recent TE Reforms

Position	Familiarity with Recent TE Reform N (% of total)				
	Little or no knowledge	Some knowledge	Good knowledge	Very good knowledge	Total
Subject Teacher	65 (11.5%)	124 (21.9%)	46 (8.1%)	6 (1.1%)	241 (42.7%)
Panel Chairperson	43 (7.6%)	166 (29.4%)	112 (19.8%)	3 (0.5%)	324 (57.3%)
Total (% in total)	108 (19.1%)	290 (51.3%)	158 (28.0%)	9 (1.6%)	565 (100%)

Table A - 14

Teacher Respondents' Preparedness for TE Reforms (by Position)

Position	Familiarity with Recent TE Reform N (% of total)				
	Need help	Need some help	Prepared	Well prepared	Total
Subject Teacher	41 (7.2%)	102 (18.0%)	93 (16.4%)	6 (1.1%)	242 (42.8%)
Panel Chairperson	47 (8.3%)	136 (24.0%)	131 (23.1%)	10 (1.8%)	324 (57.2%)
Total (% in total)	88 (15.5%)	238 (42.0%)	224 (39.6%)	16 (2.8%)	566 (100%)

Note: 17 missing cases not included

Table A - 15

Teacher Respondents' Preparedness for TE Reforms (by Major Subject Taught)

Major Subject Taught	Familiarity with Recent TE Reform N (% of total)				
	Need help	Need some help	Prepared	Well-prepared	Total
New Subject	24 (4.2%)	90 (15.8%)	127 (22.3%)	11 (1.9%)	252 (44.2%)
Existing Subject	24 (4.2%)	89 (15.6%)	56 (9.8%)	3 (0.5%)	172 (30.2%)
Phasing-out Subjects	13 (2.3%)	19 (3.3%)	9 (1.6%)	-	41 (7.2%)
Integrated Subjects	25 (4.4%)	42 (7.4%)	36 (6.3%)	2 (0.4%)	105 (18.4%)
Total (% in total)	86 (15.1%)	240 (42.1%)	228 (40.0%)	16 (2.8%)	570 (100%)

Table A - 16

Correlation between the Teacher Respondents' Responses on Their Familiarity with and Preparedness for TE Reforms

Variables		Familiarity with Recent TE Reforms	Preparedness for TE Reforms
Familiarity with Recent TE Reforms	Correlation Coefficient	1.00	
	Sig. (2-tailed)	-	
Preparedness for TE Reforms	Correlation Coefficient	.49**	1.00
	Sig. (2-tailed)	.00	-

** Correlation is significant at the .01 level (2-tailed).

Table A - 17

Statistical Analysis Results on TE as a Subject in the School Curriculum

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
B1	TE is something similar to Educational Technology	Admin.	141	1.91	0.82	-4.207	.000*
		Teacher	580	2.24	0.92		
B2	TE is computer studies with a different name	Admin.	141	1.60	0.71	-1.085	.278
		Teacher	580	1.68	0.80		
B4	TE is an extension of craft-based subjects	Admin.	140	2.47	1.06	-2.185	.029
		Teacher	576	2.69	1.07		
B6	TE is a stand alone subject, separated from Science and Mathematics	Admin.	140	3.85	0.86	1.839	.067
		Teacher	578	3.69	1.04		
B8	TE is an essential part of the school curriculum that promotes technological literacy	Admin.	141	3.91	0.68	-1.965	.050
		Teacher	578	4.04	0.71		
B10	TE contributes to the general education curriculum	Admin.	141	3.91	0.72	.063	.950
		Teacher	581	3.91	0.75		
B17	TE serves to teach students to integrate knowledge and skills acquired from other subject disciplines such as languages, science, mathematics, and social studies	Admin.	141	3.43	0.86	-3.251	.001*
		Teacher	581	3.68	0.82		

Remarks:

Equal variances not assumed for Items B1 and B6.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 18

Cross-checking Items B8 and B12 for Trustworthiness Using Pearson Correlation

	Correlations	B8	B12
B8	Pearson Correlation	1	.318**
	Sig. (2-tailed)	-	.000
	N	719	716
B12	Pearson Correlation	.318**	1
	Sig. (2-tailed)	.000	-
	N	716	719

** Correlation is significant at the 0.01 level (2-tailed).

Table A - 19

Statistical Analysis Results on the Contribution of TE towards Developing Students' Generic Skills

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
B3	TE provides an opportunity for students to develop Information Technology skills	Admin.	140	3.23	1.05	-1.171	.242
		Teacher	578	3.33	0.93		
B5	TE provides an opportunity for students to develop creative thinking	Admin.	141	4.09	0.70	.520	.603
		Teacher	578	4.05	0.76		
B14	TE can assist in the development of students' problem-solving and decision making skills	Admin.	141	3.91	0.60	-1.418	.157
		Teacher	580	3.99	0.80		
B18	TE develops and nurtures students' transferable skills	Admin.	141	3.75	0.66	-.662	.508
		Teacher	581	3.80	0.71		
B20	TE prepares students for lifelong learning in a technological society	Admin.	141	3.91	0.64	-0.150	.881
		Teacher	580	3.92	0.77		

Remarks:

Equal variances not assumed for Items B14 and B20.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 20

Statistical Analysis Results on the Importance of TE for Students of Diverse Abilities and Backgrounds

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
B23	TE should be provided for both boys and girls	Admin.	141	4.27	0.66	-1.240	.216
		Teacher	580	4.35	0.73		
B24	TE is for the low achievers	Admin.	140	1.94	0.97	2.461	.014
		Teacher	580	1.73	0.88		
B25	TE should be provided for both arts/humanity and science/technology students	Admin.	141	3.80	0.82	-3.998	.000*
		Teacher	581	4.10	0.81		
B26	TE should be a compulsory part of the secondary school curriculum	Admin.	141	3.72	0.79	-5.208	.000*
		Teacher	582	4.13	0.84		

Remarks:

Equal variances not assumed for Item B23.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 21

Statistical Analysis Results on the Importance of TE for Students' Future Career Preparation

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
B16	TE serves to provide students with basic technical skills and occupational guidance information to contribute to meaningful occupational choice	Admin.	141	3.51	0.77	-.084	.933
		Teacher	580	3.52	0.85		
B19	TE prepares students to apply knowledge and skills of industry	Admin.	141	3.55	0.77	-2.170	.030
		Teacher	580	3.70	0.74		
B22	TE prepares students for future working life	Admin.	141	3.47	0.75	-1.387	.166
		Teacher	579	3.58	0.85		

Remarks:

Equal variances assumed for all Items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 22

Statistical Analysis Results on the Information and Communication Technology Content Area

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
C1	Basic computer architecture and computer operation	Admin.	139	3.97	0.79	1.072	.284
		Teacher	579	3.89	0.81		
C6	Computers and information systems	Admin.	138	4.04	0.74	.930	.353
		Teacher	576	3.98	0.68		
C12	Computer applications, including text processing, graphic handling, multimedia presentation, and using databases	Admin.	139	4.14	0.78	.102	.919
		Teacher	578	4.14	0.74		
C16	Computer communications and Internet access	Admin.	140	4.14	0.73	1.641	.101
		Teacher	577	4.02	0.73		
C20	Algorithm and computer programming	Admin.	139	3.12	0.91	-.391	.696
		Teacher	579	3.15	0.90		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 23

Statistical Analysis Results on the Materials & Structures Content Area

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
C2	Materials and material processing	Admin.	139	3.42	0.84	-1.643	.101
		Teacher	580	3.54	0.80		
C7	Tools and machinery for production	Admin.	139	3.32	0.87	-4.015	.000*
		Teacher	577	3.62	0.77		
C13	Structure system	Admin.	139	3.35	0.82	-2.290	.022
		Teacher	576	3.52	0.79		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 24

Statistical Analysis Results on the Operations & Manufacturing Content Area

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
C3	Logistics management	Admin.	140	3.36	0.87	3.299	.001*
		Teacher	579	3.10	0.81		
C8	Product analysis and product life cycles	Admin.	139	3.28	0.84	-3.047	.000*
		Teacher	572	3.52	0.84		
C11	Design for manufacturing	Admin.	138	3.38	0.87	-3.772	.000*
		Teacher	577	3.68	0.75		
C14	Production management	Admin.	139	3.33	0.83	1.013	.311
		Teacher	577	3.25	0.79		
C17	Safety and health	Admin.	140	3.99	0.82	.851	.395
		Teacher	581	3.92	0.83		
C21	Algorithm and computer programming	Admin.	140	3.34	0.80	-2.350	.019
		Teacher	578	3.51	0.76		

Remarks:

Equal variances not assumed for Items C3 and C11.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 25

Statistical Analysis Results on the Strategies & Management Content Area

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
C4	Human resource management	Admin.	139	3.29	0.84	1.336	.182
		Teacher	578	3.18	0.82		
C15	Decision making, planning and control	Admin.	139	3.54	0.89	-0.516	.606
		Teacher	579	3.58	0.87		

Remarks:

Equal variances assumed for both listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 26

Statistical Analysis Results on the Systems & Control Content Area

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
C9	Control systems - electronics, mechanical, hydraulic, pneumatics, and computers	Admin.	140	3.38	0.88	-4.965	.000*
		Teacher	578	3.77	0.82		
C18	Application of energy	Admin.	139	3.73	0.81	-.336	.737
		Teacher	577	3.75	0.80		

Remarks:

Equal variances assumed for both listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 27

Statistical Analysis Results on the Technology & Living Content Area

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
C5	Food packaging	Admin.	140	2.82	0.79	-1.305	0.192
		Teacher	577	2.93	0.86		
C10	Fashion design	Admin.	140	3.13	0.91	-0.219	.827
		Teacher	581	3.15	0.85		
C19	Consumer education	Admin.	140	3.62	0.79	1.712	.087
		Teacher	581	3.48	0.90		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 28

Comparisons of the Administrator and Teacher Respondent Groups' Mean Scores for the Six TE Curriculum Content Areas

Category	Respondent Group	N	Mean	SD	*t*	*p*
Information and Communication Technology (ICT)	Admin.	140	3.88	0.56	.907	.365
	Teacher	581	3.84	0.55		
Materials & Structures (M&S)	Admin.	140	3.36	0.65	-3.428	.001*
	Teacher	582	3.56	0.62		
Operations & Manufacturing (O&M)	Admin.	140	3.45	0.57	-1.022	.307
	Teacher	581	3.50	0.55		
Strategies & Management (S&M)	Admin.	140	3.41	0.70	.488	.626
	Teacher	580	3.38	0.73		
Systems & Control (S&C)	Admin.	140	3.56	0.66	-3.229	.001*
	Teacher	580	3.76	0.67		
Technology & Living (T&L)	Admin.	140	3.19	0.62	.071	.944
	Teacher	583	3.19	0.67		

Remarks:
* $p < .05$ with Bonferroni adjustment applied (i.e., .05/6 = .008).

Table A - 29

Statistical Analysis Results on Facilitating Factor (Subject Image and Value)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
D13	Good subject image for technological subjects	Admin.	139	3.83	1.01	-3.45	.001*
		Teacher	580	4.13	0.88		
D14	Studying technological subjects is useful for students' further study or admission to tertiary institutions	Admin.	139	3.94	0.99	-3.25	.001*
		Teacher	579	4.22	0.87		
D15	Phasing out of craft-based technical subjects	Admin.	138	3.22	1.02	0.00	.997
		Teacher	576	3.22	0.97		
D16	Technological subjects are growing in popularity	Admin.	139	3.6	0.89	-3.78	.000*
		Teacher	576	3.91	0.84		

Remarks:

Equal variances not assumed for Item D16.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 30

Statistical Analysis Results on Facilitating Factor (Change Characteristic - Time)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	p
D17	Teachers have adequate time for lesson preparation	Admin.	139	3.70	1.05	-3.87	0.000*
		Teacher	579	4.01	0.82		

Remarks:

Equal variance assumed for the item.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 31

Statistical Analysis Results on Facilitating Factor (Supports from Others)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
D1	Support from school administrators	Admin.	139	3.91	1.00	-3.67	.000*
		Teacher	580	4.21	0.83		
D2	Support from peers	Admin.	139	3.76	0.98	-2.69	.008
		Teacher	580	4.01	0.82		
D3	Support from parents	Admin.	139	3.73	1.05	-2.97	.003
		Teacher	580	4.01	0.85		
D4	Support from the community at large	Admin.	139	3.95	0.94	-2.77	.006
		Teacher	580	4.17	0.81		
D5	The HKSAR Government mandates students to take TE	Admin.	139	3.50	1.09	-4.55	.000*
		Teacher	578	3.95	0.92		

Remarks:

Equal variances not assumed for Items D2, D3 and D5

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002)

Table A - 32

Statistical Analysis Results on Facilitating Factor (Resources and Professional Development)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
D8	Adequate financial support	Admin.	139	4.04	0.94	-3.22	.001*
		Teacher	580	4.31	0.84		
D9	Availability of extra grant funding	Admin.	139	4.03	0.92	-2.56	.011
		Teacher	578	4.25	0.86		
D10	Availability of quality instructional materials and teaching resources	Admin.	139	4.07	1.00	-2.47	.014
		Teacher	580	4.28	0.87		
D11	Availability of necessary facility	Admin.	139	4.17	0.87	-2.55	.011
		Teacher	580	4.36	0.79		
D12	Appropriate professional development programme for teachers	Admin.	139	4.05	0.95	-2.79	.005
		Teacher	580	4.29	0.88		

Remarks:

Equal variances not assumed for Item D9.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 33

Statistical Analysis Results on Facilitating Factor (Other Professional Supports)

Item No.	Statement	Respondent Group	N	Mean	SD	t	p
D18	More articles on TE in local journals & magazines	Admin.	139	3.51	0.94	-3.53	.000*
		Teacher	578	3.81	0.88		
D19	More research in TE	Admin.	139	3.63	0.94	-3.12	.002*
		Teacher	578	3.89	0.86		
D20	A website for promoting TE	Admin.	139	3.65	0.97	-3.37	.001*
		Teacher	578	3.95	0.86		
D21	Opportunity of visiting / observing TE facilities and outcome of students in other school	Admin.	139	3.68	0.90	-2.98	.003*
		Teacher	578	3.93	0.85		

Remarks:

Equal variances not assumed for Items D20 and D21

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002)

Table A - 34

Statistical Analysis Results on Facilitating Factor (Students' Attitudes towards TE)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
D7	Positive attitudes of students towards technology education	Admin.	139	3.93	0.88	-2.98	0.003
		Teacher	580	4.16	0.81		

Remarks:

Equal variance assumed for the item.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/21 = .002).

Table A - 35

Statistical Analysis Results on Impeding Factor (Subject Image and Value)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E11	Unfavourable positioning of TE in the school curriculum	Admin.	138	3.75	0.92	-2.29	.022
		Teacher	579	3.96	1.01		
E13	School administrators using TE as a dumping ground	Admin.	136	3.74	1.10	-2.88	.004
		Teacher	579	4.03	1.02		
E14	Poor subject image of technological subjects	Admin.	137	3.67	0.97	-0.77	.442
		Teacher	577	3.74	0.99		
E15	Subject traditions of technological subjects (e.g., gender biased)	Admin.	138	3.33	1.05	-1.02	.309
		Teacher	578	3.42	1.00		
E16	Lack of timeslot in the congested curriculum	Admin.	138	3.85	0.92	0.33	.739
		Teacher	575	3.82	0.98		
E21	Closing or elimination of TE programmes in schools	Admin.	137	3.68	0.96	-3.36	.001*
		Teacher	579	4.01	1.04		

Remarks:

Equal variances not assumed for Item E13.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 36

Statistical Analysis Results on Impeding Factor (Change Characteristic - Time Frame)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E24	Short time frame to prepare for and implement curricular change	Admin.	138	3.90	0.89	-.439	.661
		Teacher	577	3.94	0.95		

Remarks:

Equal variances assumed for the item.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 37

Statistical Analysis Results on Impeding Factor (Supports from Others)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E7	Lack of knowledge and understanding of TE from school administration	Admin.	139	3.82	0.85	-1.70	.090
		Teacher	579	3.97	0.97		
E19	Lack of other teachers' support of TE	Admin.	138	3.33	0.91	-2.18	.030
		Teacher	578	3.53	1.00		
E20	Lack of parents' understanding, interest and support of TE	Admin.	136	3.59	1.01	-0.67	.502
		Teacher	578	3.65	1.00		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 38

Statistical Analysis Results on Impeding Factor (Teacher Factors)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E5	Reluctance of teachers to change	Admin.	139	3.86	0.93	-.216	.814
		Teacher	580	3.88	1.06		
E6	Teacher's stress associated with short learning time of technological knowledge due to rapid pace of technological change	Admin.	139	3.86	0.99	-.616	.538
		Teacher	580	3.92	0.98		
E10	Negative attitudes of technological subject teachers towards technology education	Admin.	139	3.68	1.02	-2.000	.046
		Teacher	578	3.87	1.04		
E12	Teachers' lack of understanding of the curricula reform(s)	Admin.	138	3.65	0.88	-1.123	.262
		Teacher	578	3.75	0.90		
E22	Teachers have inadequate training or expertise in the subject area	Admin.	138	3.81	0.92	-.260	.795
		Teacher	576	3.84	0.96		

Remarks:

Equal variances not assumed for Item E5.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 39

Statistical Analysis Results on Impeding Factor (Resources & Professional Development)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E4	Lack of quality instructional materials and teaching resources	Admin.	139	3.78	1.00	-1.287	.199
		Teacher	578	3.91	1.03		
E8	Lack of appropriate facilities and resources	Admin.	138	3.91	0.96	-1.018	.309
		Teacher	579	4.00	0.98		
E17	Inadequate or lack of appropriate professional development programmes for teachers	Admin.	138	3.88	0.87	.170	.865
		Teacher	578	3.86	0.96		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 40

Statistical Analysis Results on Impeding Factor (Characteristics of TE)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E23	Lack of consensus of curriculum content for TE	Admin.	138	3.80	0.84	.403	.687
		Teacher	575	3.77	0.90		
E25	Lack of a recognised knowledge base in TE	Admin.	138	3.58	0.93	-1.764	.078
		Teacher	577	3.73	0.91		
E26	Confusion of TE with computers and educational technology	Admin.	138	3.34	0.98	-2.98	.003*
		Teacher	578	3.63	1.03		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 41

Statistical Analysis Results on Impeding Factor (Student Factors)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E9	Negative attitudes of students towards TE	Admin.	139	3.59	0.99	-1.004	.316
		Teacher	577	3.69	1.07		
E18	Students' lack of academic abilities in studying technological subjects	Admin.	139	3.68	1.02	-1.998	.046
		Teacher	578	3.87	1.04		

Remarks:

Equal variances assumed for both listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 42

Statistical Analysis Results on Impeding Factor (Shortage of Subject Expertise and Leadership)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
E1	Lack of leadership in technological subject(s) in school	Admin.	139	3.88	1.01	.006	.995
		Teacher	579	3.88	1.01		
E2	Insufficient number of subject specialist in school for teaching technological subject(s)	Admin.	139	4.02	0.94	2.069	.040
		Teacher	579	3.83	1.02		
E3	Shortage of well-trained and qualified technological subject teachers	Admin.	139	3.92	0.91	.597	.551
		Teacher	577	3.87	1.02		

Remarks:

Equal variances not assumed for Items E2 and E3.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/26 = .002).

Table A - 43

Statistical Analysis Results on the Four Teacher Competence Categories

Category	Respondent Group	N	Mean	SD	*t*	*p*
General Pedagogical Knowledge Competences (GPKC)	Admin.	138	3.91	0.49	1.984	.048
	Teacher	580	3.81	0.54		
Subject Matter Knowledge Competences (SMKC)	Admin.	138	3.59	0.49	-.910	.363
	Teacher	580	3.64	0.52		
Pedagogical Content Knowledge Competences (PCKC)	Admin.	138	3.89	0.44	1.664	.097
	Teacher	581	3.81	0.52		
Continuing Professional Development Competences (CPDC)	Admin.	138	3.30	0.51	-2.489	.013
	Teacher	581	3.43	0.55		

Remarks:

Equal variances not assumed for Category PCK.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/4 = .0125).

Table A - 44

Statistical Analysis Results on Perceived General Pedagogical Knowledge Competences (Reform Related)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F26	Select, produce and use appropriate resources, including information technology, to support teaching and learning	Admin.	138	4.05	0.64	2.025	.043
		Teacher	580	3.92	0.69		
F35	Promote equality of opportunity and the avoidance of stereotype in curriculum planning, teaching, and working with students	Admin.	138	3.67	0.77	-0.922	.358
		Teacher	579	3.73	0.79		
F36	Contribute to school-based curriculum development activities	Admin.	137	3.71	0.73	2.807	.005*
		Teacher	580	3.50	0.79		
F55	Promote interdisciplinary learning activities that enable students to integrate and transfer knowledge and skills to other subject disciplines	Admin.	138	4.04	0.69	3.210	.001*
		Teacher	580	3.81	0.75		

Remarks: Equal variances not assumed for Item F35.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/4 = .0125).

Table A - 45

Statistical Analysis Results on Perceived General Pedagogical Knowledge Competences (Generic)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F14	Set expectations for students that are clear, challenging and achievable	Admin.	138	4.07	0.69	.729	.466
		Teacher	580	4.02	0.73		
F25	Set appropriately demanding and progressive expectations for individual students of all abilities	Admin.	138	3.90	0.77	-.016	.987
		Teacher	578	3.90	0.73		
F32	Employ appropriate strategies to meet the needs of gifted students and those with special educational needs or learning difficulties	Admin.	138	3.85	0.67	1.353	.176
		Teacher	580	3.76	0.72		
F38	Structure teaching and students' learning to provide context within which students can be encouraged to clarify their own values and examine those of society	Admin.	138	3.76	0.74	1.125	.261
		Teacher	580	3.68	0.79		
F51	Create and maintain stimulating, purposeful and orderly learning environments that supports and enhances students' learning	Admin.	138	4.12	0.71	2.450	.015
		Teacher	578	3.95	0.74		

Remarks: Equal variances assumed for all Items; * $p < .05$ with Bonferroni adjustment applied (i.e., .05/5 = .01).

Table A - 46

Statistical Analysis Results on Subject Matter Knowledge Competences (Conventional)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F6	Prepare materials, equipment and tool purchases requests	Admin.	138	3.07	0.92	-2.034	0.042
		Teacher	579	3.25	0.93		
F10	Maintain technological tools and equipment	Admin.	138	3.12	0.97	-1.007	0.314
		Teacher	579	3.21	0.93		
F11	Select and use a range of basic machine tools properly and safely for making artefacts	Admin.	138	3.59	0.88	-1.539	0.124
		Teacher	578	3.72	0.84		
F18	Select and use a range of computer controlled machine tools and devices properly and safely for making artefacts	Admin.	138	3.68	0.70	-0.344	0.731
		Teacher	580	3.71	0.81		
F34	Select and use a range of technological materials and processes properly and safely for making artefacts	Admin.	138	3.62	0.82	-0.905	0.366
		Teacher	578	3.69	0.85		
F37	Select and use a range of hand tools properly and safely for making artefacts	Admin.	137	3.69	0.78	-0.808	0.419
		Teacher	579	3.76	0.83		

Remarks:

Equal variances assumed for all Items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/6 = .008).

Table A - 47

Statistical Analysis Results on Subject Matter Knowledge Competences (Renewed)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F19	Understand and apply scientific and mathematical principles to technological problem solving	Admin.	138	3.68	0.73	-.074	.941
		Teacher	577	3.69	0.73		
F28	Demonstrate an ability to solve problems, think critically, and make decisions	Admin.	138	3.88	0.76	-.049	.961
		Teacher	578	3.89	0.74		
F43	Demonstrate knowledge on "Hi-Tech" equipment such as laser and robotics	Admin.	138	3.45	0.82	.204	.838
		Teacher	580	3.43	0.86		
F48	Use a variety of graphical communication techniques including sketching, modelling, and recording design decisions	Admin.	138	3.89	0.65	.056	.955
		Teacher	579	3.89	0.75		
F49	Use information technology for communicating and data handling	Admin.	138	3.94	0.64	2.280	.024
		Teacher	578	3.80	0.72		
F50	Use information technology for modelling, controlling and manufacturing	Admin.	137	3.65	0.68	.012	.991
		Teacher	578	3.65	0.78		

Remarks:

Equal variances not assumed for Items F48 and F49.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/6 = .008).

Table A - 48

Statistical Analysis Results on Subject Matter Knowledge Competences (Design, Technology and Society)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F31	Consider different values (technical, economic, aesthetic, social, environmental and moral) when designing	Admin.	138	3.67	0.76	-.929	.353
		Teacher	578	3.74	0.73		
F52	Assess the use of technology in selected industries	Admin.	138	3.29	0.77	-1.231	.219
		Teacher	578	3.38	0.78		
F54	Assess the immediate impacts and long-term effects of technology	Admin.	138	3.52	0.74	-.678	.498
		Teacher	580	3.57	0.77		

Remarks:

Equal variances assumed for all listed Items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/6 = .008).

Table A - 49

Statistical Analysis Results on Subject Matter Knowledge Competences (School Subject Knowledge)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F16	Demonstrate a breadth of subject knowledge and skills sufficient to teach technological subjects at S1 to S6 levels	Admin.	138	3.71	0.76	-1.623	0.105
		Teacher	580	3.83	0.78		

Remarks:

Equal variances assumed for the Item.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/6 = .008).

Table A - 50

Statistical Analysis Results on Pedagogical Content Knowledge Competences (Curricular Knowledge)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F2	Demonstrate knowledge and understanding of the TE Curriculum Framework as recommended by the CDC	Admin.	138	4.02	0.79	2.207	.028
		Teacher	580	3.86	0.76		
F7	Demonstrate an understanding of the nature of TE and its role within the whole secondary school curriculum	Admin.	138	3.93	0.78	.216	.829
		Teacher	580	3.92	0.77		
F22	Demonstrate a knowledge and understanding of examination syllabuses of Technological Subjects	Admin.	138	3.83	0.73	-.940	.348
		Teacher	579	3.89	0.75		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/3 = .017).

Table A - 51

Statistical Analysis Results on Pedagogical Content Knowledge Competences (Curriculum and Instruction Planning)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F4	Plan, manage and evaluate units of work and lessons taking account of the Technology Education Curriculum Framework and the school's curriculum policy	Admin.	138	3.70	0.80	-.866	.387
		Teacher	580	3.77	0.86		
F8	Plan their teaching on the basis of recent, relevant pedagogical research in technology education	Admin.	138	3.85	0.60	1.633	.104
		Teacher	579	3.75	0.76		
F29	Relate teaching and learning activities to current theories of teaching and learning technological subjects	Admin.	138	3.57	0.70	-.252	.801
		Teacher	579	3.58	0.79		

Remarks:

Equal variances not assumed for Item F8.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/3 = .017).

Table A - 52

Statistical Analysis Results on Pedagogical Content Knowledge Competences (Workshop-related and Health & Safety)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F17	Plan and layout technology laboratories and instructional areas	Admin.	138	3.76	0.72	.915	.361
		Teacher	580	3.70	0.83		
F40	Manage effectively TE provisions in schools including the storage of materials, tools and equipment	Admin.	137	3.72	0.78	1.100	.271
		Teacher	578	3.63	0.85		
F41	Work confidently with students in accordance with the appropriate health and safety regulations	Admin.	138	4.10	0.72	2.179	.030
		Teacher	580	3.94	0.79		
F42	Apply appropriate health and safety measures to make risk assessments for themselves and others	Admin.	138	4.05	0.74	2.372	.019
		Teacher	580	3.88	0.82		
F44	Identify environmental and safety concerns related to technological activities and facilities	Admin.	138	3.92	0.72	1.717	.087
		Teacher	579	3.80	0.79		
F47	Maintain a safe working and learning environment through appropriate health and safety procedures and students' routines	Admin.	136	4.06	0.73	.690	.490
		Teacher	580	4.01	0.77		

Remarks:

Equal variances not assumed for Items F17, F42 and F44.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/6 = .008).

Table A - 53

Statistical Analysis Results on Pedagogical Content Knowledge Competences (Support Student Learning)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F12	Structure teaching and learning activities to provide students with opportunities to work with industry, commerce, and the local community	Admin.	137	3.86	0.76	1.945	0.052
		Teacher	579	3.72	0.74		
F13	Demonstrate an understanding of how TE enhances students' conceptual, creative and practical developments	Admin.	138	4.08	0.69	1.060	0.290
		Teacher	580	4.01	0.71		
F20	Effectively use a suitable range of teaching and learning strategies for technology learning activities which match students' age, ability, gender, and individual needs	Admin.	138	3.99	0.70	0.164	0.870
		Teacher	578	3.97	0.75		
F23	Contribute to the development of students' language and communication skills through the clear use and promotion of technological vocabulary	Admin.	138	3.75	0.72	0.605	0.545
		Teacher	579	3.71	0.77		
F53	Effectively plan and manage individual students' technology learning activities	Admin.	138	3.93	0.73	1.052	0.293
		Teacher	576	3.86	0.72		
F56	Effectively monitor and support students' design and making activities	Admin.	138	4.01	0.66	0.345	0.730
		Teacher	577	3.98	0.71		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/6 = .008).

Table A - 54

Statistical Analysis Results on Pedagogical Content Knowledge Competences (Language Skills)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F45	Demonstrate oral and written English language skills for teaching technological subjects	Admin.	138	3.46	0.83	.78	.44
		Teacher	579	3.40	0.83		
F46	Demonstrate oral and written Chinese language skills for teaching technological subjects	Admin.	138	3.68	0.79	.88	.38
		Teacher	580	3.61	0.81		

Remarks:

Equal variances assumed for both listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/2 = .025).

Table A - 55

Statistical Analysis Results on Continuing Professional Development Competences (Updating and Enhancing Professional Knowledge and Skills)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F5	Further attend a qualification awarding programme related to technology or TE	Admin.	138	4.01	0.64	-1.31	.19
		Teacher	581	4.09	0.73		
F9	Conduct a research related to TE	Admin.	138	3.32	0.91	-1.21	.23
		Teacher	580	3.42	0.88		
F15	Read professional journals and other literature related to technology education	Admin.	138	3.66	0.75	0.59	.56
		Teacher	580	3.62	0.82		
F21	Keep current through active membership in professional organisations in TE	Admin.	138	3.36	0.82	-2.07	.04
		Teacher	579	3.51	0.78		
F24	Employ mechanisms to stay current in technology	Admin.	138	3.79	0.64	-0.86	.39
		Teacher	579	3.85	0.73		

Remarks:

Equal variances not assumed for Item F5.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/5= .01).

Table A - 56

Statistical Analysis Results on Continuing Professional Development Competences (Sharing and Other Aspects)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
F27	Write an article or book for publication relating to TE	Admin.	138	2.82	1.00	-2.07	.039
		Teacher	577	3.01	0.98		
F30	Write a proposal for applying a grant (e.g. Quality Education Fund)	Admin.	138	2.81	0.96	-2.33	.020
		Teacher	579	3.02	0.94		
F33	Present a paper or teaching and learning activity at a TE meeting / conference	Admin.	138	2.77	0.93	-2.49	.014
		Teacher	580	2.98	0.86		
F39	Participate in TE electronic panel discussions on the web / via e-mail	Admin.	138	3.17	0.79	-1.90	.060
		Teacher	577	3.32	0.82		

Remarks:

Equal variances not assumed for Item F33.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/4= .0125).

Table A - 57

Focus of Initial Teacher Education Programme for Technological Subject Teachers

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
G1	Training programmes for technological subject teachers should emphasise the provision of a thorough foundation in subject matter	Admin.	138	4.10	0.78	-.969	.333
		Teacher	579	4.17	0.75		
G2	Training programmes for technological subject teachers should focus on the use of new technologies (e.g., Robotics and automation)	Admin.	138	3.57	0.78	-.007	.995
		Teacher	578	3.57	0.95		
G4	Pre-service technology teacher education should consist of equal studies in technology, academic, and professional courses	Admin.	138	4.31	0.75	-.846	.398
		Teacher	579	4.18	0.81		

Remarks:

Equal variances not assumed for Item G2.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/3= .017).

Table A - 58

Entry Qualification of Technological Subject Teachers

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
G3	Technological subject teachers need to be professionally trained before entering the teaching profession	Admin.	138	4.31	0.75	1.719	.086
		Teacher	579	4.18	0.81		
G7	Technological subject teachers need to possess a relevant bachelor degree before entering the teaching profession	Admin.	137	3.37	0.92	-.087	.931
		Teacher	578	3.38	1.04		

Remarks:

Equal variances assumed for all listed items.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/2= .025).

Table A - 59

Initial Teacher Training Mode (BEd vs. PGDE)

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
G8	A four-year BEd programme is an appropriate programme of study for training competent technological subject teachers	Admin.	138	3.44	0.93	.279	.780
		Teacher	578	3.42	0.95		
G10	A PGDE programme for degree holders in a relevant field is an appropriate programme of study for training competent technological subject teachers	Admin.	138	3.36	0.78	-1.307	.192
		Teacher	576	3.46	0.95		

Remarks:

Equal variances not assumed for Item G10.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/2= .025).

Table A - 60

ANOVA for Initial Teacher Training Mode (BEd vs. PGDE) according to Administrator Respondents' Subject Major

		Sum of Squares	df	Mean Square	F	Sig.
G8	Between Groups	4.230	3	1.410	1.651	.181
	Within Groups	113.609	133	.854		
	Total	117.839	136			
G10	Between Groups	1.375	3	.458	.740	.530
	Within Groups	82.377	133	.619		
	Total	83.752	136			

Remark:

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/2= .025).

Table A - 61

Previous Education and Working Experience as Pre-requisites for Entry to Technology Teacher Education Programmes

Item No.	Statement	Respondent Group	N	Mean	SD	*t*	*p*
G5	Completion of a secondary school TE course should be a major criterion in selecting students for technology teacher education programme	Admin.	138	3.17	0.98	-5.26	0.00*
		Teacher	579	3.68	1.02		
G6	Relevant working experience should be a major criterion in selecting students for technology teacher education programme	Admin.	137	3.18	0.83	-4.91	0.00*
		Teacher	577	3.57	0.89		

Remarks:

Equal variances not assumed for Item G6.

* $p < .05$ with Bonferroni adjustment applied (i.e., .05/2= .025).