EXPLORING THE FUTURE OF TECHNOLOGY EDUCATION IN CHINA

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CERTIFICATE OF ORIGINALITY

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where the acknowledgment has been made in the text.

___________________________ (Signed)

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For My Supervisor and Committed Educators

Kin Wai Michael SIU and Jian Jun GU

Abstract

More and more countries, including China, have taken technology education into the general education system as the key learning resource. Technology education has a rather short history when viewed from the perspective of the total history of education on the Chinese mainland. From informally to formally, technology education has developed over almost 60 years. Since the new technology curriculum was implemented, new secondary technology education has undergone approximately ten years of development. The technology curriculum is being experimented with in almost all provinces at present. A group of technology teachers is growing up among the new curriculum experiments. The technology curriculum is being expanded in the aspect of validated learning.

However, how to maintain this good momentum for the technology curriculum is a key problem and concern. While these developments imply some success with the curriculum, many problems and challenges remain. It is necessary now to ask ourselves how to strengthen the technology curriculum in the general education system. This is the key research question in this study.

The study is expected to alert the government and the public to the importance of technology education at secondary level. At the same time, it reveals some potential

problems during the current curriculum reform on the Chinese mainland. However, through a survey conducted in different provinces, this study attempts to find the existing problems and provide recommendations and strategies to resolve the problems and issues appearing in the process of implementation.

In theory, this study expects to establish a new perspective for the development of technology education. In practice, the study attempts to make suggestions and provide insights into how to solve the existing problems and meet the challenges. What this study actually does is to examine the current practice and then envisage the future. In this sense, this study plays a "guideline" role in the future of the development of technology education in the general education system.

The entire study was conducted through five major stages. Stage I is a general review of two major areas: (i) the current major issues and trends of technology education worldwide, and (ii) the development of technology education in China. Based on a review of these two areas, this study attempts to identify what has happened and what is happening in technology education in the world. In Stage II, questionnaires and interview questions were conducted in order to identify more practical issues so that the recommendations could be proposed. In Stage III, data were collected through face-to-face survey questionnaires and unstructured interview questions. Five versions of the questionnaires were designed to obtain feedback from key stakeholders, including education administrators, coordinators, school principals, technology teachers and senior secondary school students. In Stage IV, the analysis of a survey conducted in different provinces was carried out using a triangulation method, with closed-ended questionnaire

responses as the basis, supported by open-ended interview questions and seminars. Stage V is the final stage of the study. Based on the findings from Stage IV, the final part responds to the research question of the study: how to strengthen the new technology curriculum in the general education system.

Through the analysis of the collected data, common practice and effective experience in technology education have been summarized: (1) giving much attention to and overall planning an auxiliary system; (2) nurturing stable and professional technology teachers; (3) maximizing curriculum resources both online and offline; (4) designing and issuing local facility standards to guarantee workshop construction; (5) leveraging the leadership of academic research bodies; (6) implementing technical subjects in creative ways; and (7) brainstorming to develop a comprehensive curriculum evaluation system. Moreover, problems and obstacles have been found. It is concluded that the development of technology education needs the support of policy; faculty building needs sustainable teacher training; instruments and equipment depend on the full use of native resources; the establishment of the evaluation system needs to be based on Chinese traditional culture to promote the steady development of the curriculum. It is an arduous task to change education officials' ideas about education and eradicate their ignorance of technology education. To this end, five recommendations have been proposed: (1) exercising the power of policy to create a springboard for technical subjects; (2) establishing training mechanisms for technology teachers; (3) leveraging the leadership of school principals to facilitate curriculum development; (4) promoting academic research bodies as curriculum researchers, leaders and trainers; and (5) devising a fair and effective evaluation mechanism.

Publications Arising from the Thesis

<u>(A) Book Chapters</u>

Feng, W. W., Siu, K. W. M., & Gu, J. J. (2011). Exploring the position of technology education in China. In M. J. de Vries (Ed.), *Positioning technology education in the curriculum* (pp. 227-242). Rotterdam: Sense Publishers.

<u>(B)Refereed Journal Papers</u>

Chen, X. Y., **Feng, W. W.**, & Siu, K. W. M. (2011). The dilemma and experience of international technology education curriculum assessment and its inspiration. *Studies in Foreign Education, 38*(10), 58-62.

Feng, W. W., Siu, K. W. M., & Gu, J. J. (2011). The development and reform of technology education in general education in mainland China and Hong Kong. *Global Education, 40*(5), 91-96.

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Siu, K. W. M., Wong, Y. L, & **Feng, W. W.** (2010). Closing achievement gaps in design and technology education: Case study in mainland China and Hong Kong. *Journal of the*

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Table of Contents

List of Abbreviations

APT	Academic Proficiency Tests
CEE	College Entrance Examination
CS	Computer Studies
DAT	Design and Applied Technology
D&T	Design and Technology
EC	Education Commission
GT	General Technology
ICT	Information Communication Technology
IT	Information Technology
ISTE	International Society for Technology in Education
ITEA	International Technology Education Association
ITEEA	International Technology and Engineering Educators Association
KLA	Key Learning Area
NAENRCNA	National Academy of Engineering and National Research Council of the National Academies
NSF	National Science Foundation
PGDE	Postgraduate Diploma in Education
STEM	Science, Technology, Engineering and Mathematics

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Chapter 1: Introduction

1.1 Background of the Study

As Kellner (1998) observed, we are in the midst of one of the most dramatic technological revolutions which, centred on information technology, are often interpreted as the beginning of a knowledge society, and ascribe education a central role in every aspect of life. In a broad sense, technology is any modification of the natural world performed to fulfil human needs or desires (Committee on Assessing Technological Literacy, 2006).

Because of the pervasiveness of technology, an understanding of what technology is, how it works, how it is created, how it shapes society, and how society influences technological development is critical to informed citizenship (Committee on Assessing Technological Literacy, 2006). It makes sense to educate future citizens about this important aspect of our lives. Considering technology as a separate subject in school education has been attached great importance by an increasing number of educators (Petrina, 1998). Technology education has grown into a well-established field. Although it is still young, more and more technology educators are becoming dedicated the cause. Educators realize that technology education integrated into the general education system can play an important role in promoting students' technological literacy and students can comprehensively use knowledge of other disciplines to solve problems.

As Hansen & Froelich stated (1998a) that technology education is the only subject in schools that has ever followed an experiential pedagogical philosophy – one that is in harmony with the way people learn, with the natural and manufactured worlds, and with the way societies adapt to their environments.

When technology education begins in primary and secondary schools, students can acquire technological awareness from an early age. They acquire technological literacy and gain hands-on experience to enrich their knowledge in natural sciences, humanities, arts, design ability, creativity and problem-solving. Therefore, it is likely that more students, and probably the more able ones, will be motivated and prepared for enrolment in higher education studies within the technology-related field (Gu, 2004).

The importance of technology education in the general education system, especially at senior secondary level has been increasingly recognized by educational administration departments on the Chinese mainland. The technology curriculum has been integrated into the general education system. Technology education has developed apace in recent years.

In the past 30 years, technology as a subject in the general education system has emerged in many countries, such as the United Kingdom, the USA, Canada, Europe, South Africa, and New Zealand. It has been transformed from a traditional craft subject to a modern design-related subject. Design has brought in as a new part in some countries. Some high-tech elements such as robotics have become part of it in some countries.

Western countries, such as the United Kingdom and the United States tend to have better and more detailed technology education programmes for young students. These countries have made significant gains in educational practice through integrating design education into the technology curriculum.

As part of China, and owing to its political, economic and social history, Hong Kong is famous for finance and for hotel management, inter alia. Since the 1960s, Hong Kong has gone from an entrepôt trading post to a manufacturing-oriented economy, then to a combination of manufacturing and service industries, to becoming the international financial centre we know today (*The 2001 Policy Address*, 2001; Chan & So, 2002; *Hong Kong Annual Report*, 1986, 1990, 1996; Hong Kong Trade Development Council, 2000; Mo, 2006; Turner, 1989; Siu 2009). Because Hong Kong lacks natural resources and its manufacturing industry has declined, the government paying more attention to creative thinking and high-tech innovation (Innovation Technology Centre, 2004). Consequently, technology-related subjects have developed significantly. Since the late 1990s, hundreds of technology-related short courses have been offered both to students as extra-curricular activities and to working people as further study (Siu, 2009). At secondary level, Design and Technology (D&T; and, most recently Design and Applied Technology (DAT)), has been introduced from the United Kingdom. Owing to its special development of technology education (including D&T) and its close relationship with the Chinese mainland (i.e. as part of China), Hong Kong is treated as a supplementary case study in the review section of this thesis (Chapters 1 and 2) to provide references and insights for discussion of the future development of technology education in China.

It is not difficult to see, however, that technology education on the Chinese mainland and in Hong Kong faces many problems and challenges. In terms of improving technology literacy, the curriculum has not been implemented smoothly. On the Chinese mainland, although technology education is supported by the government, it also needs to compete with other subjects for class time. In Hong Kong, the situation is serious. Most secondary schools have cut back on the technology-related subjects for many reasons: for example, government policy, teacher education, public awareness.

In brief, the position of technology education in these two regions is being challenged. Therefore the issue of how to strengthen technology education in the school curriculum is a question frequently raised by educators and researchers in the field.

1.2 Statement of the Problem

Usually, the key task in the research process is to decide which aspects of a problem to investigate. The research problem is often stated as research questions. The research question format can serve as the focus of investigation (Wallen & Fraenkel, 2000).

In the present context, strengthening technology education at senior secondary level in China, the problem can be divided into three sub-questions as follows:

—what is the current position of technology education in the nationwide educational system of China?

—what are the key factors that influence the implementation of technology education policy and curriculum in China today?

—what are the issues and challenges of future technology education in China?

The above three sub-questions are an extension of the original problem and are correlated. On the Chinese mainland, although technology-related subjects at senior secondary level are classified into key learning areas, their actual implementation is not what we might have expected. We need to ask whether the present position of technology education at senior secondary level in the school curriculum system is appropriate or not?

For example, if it is appropriate, why are the subjects unavailable in most secondary schools in Hong Kong and offered only for a short time on the Chinese mainland? Is this caused by the implementation practice?

The second sub-question related to implementation derives from the first sub-question. The key factors influencing the development of technology education should be identified and analysed. Are the key factors on the Chinese mainland the same as or similar to those in other places?

After finding the key factors, this study aims to find solutions/insights as its final objective. It attempts to seek strategies to support the development of technology education. Of course, in practice it is impossible to reach the ideal status. On the basis of these strategies, the study aims to draw a blueprint for the future of technology education on the Chinese mainland.

1.3 Purpose of the Study

Technology education presently is in a period of transition and change with regard to the new curriculum structure of general senior secondary schools on the Chinese mainland. Therefore, this study aims to explore the future for technology education. In an ever-changing world, to meet the needs of society and education, we need to probe the nature, connotation and position of technology education. In the light of the current practice on the Chinese mainland, the study investigates and discusses the inherent factors which have caused the present predicament. These key inherent factors influence the implementation effect of technology education directly or indirectly. Based on a national investigation by a survey conducted in different provinces, the study identifies and analyses these key factors. The study is also intended to propose the solutions to several problems which occur or might occur in the process of developing of technology education.

The key objectives of the study are:

1. To determine the value and position of technology education ;

2. To explore the practicability and adaptability of technology education in the general education system within the framework of the technology curriculum in China.

1.4 Significance of the Study

Similarly to the Chinese mainland, the research in the field of technology education is limited, so the exploration is a keynote of this study.

The role of technology education is more important than one may imagine. Developing technology education in the general education system in an infiltration model and integrating technology education into the general education system is an effective and sensible approach. What students are taught in the technology curriculum is mainly procedural knowledge. This kind of knowledge is acquired by designing projects and problem-solving. In this sense developing technology education at primary and secondary levels brings “additional value” to Chinese education, while stressing the quality of education today.

On the one hand, the study is expected to alert the government and the public to the importance of technology education at primary and secondary levels. At the same time, it will reveal some of the potential problems of current curriculum reform on the Chinese mainland. On the other hand, through a national investigation, this study attempts to find the existing problems and seeks to recommend strategies to resolve difficulties in the process of implementation.

The study attempts to establish a new perspective on the development of technology education: how to solve existing problems and meet new challenges. What the study actually does is to examine the current practice and then envisage the future. In this sense, the study guides the future development of technology education in the general education system.

1.5 Definition of Key Terms

Technology

Technology is human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities. It is the innovation, change, or modification of the natural environment to satisfy perceived human needs and wants (International Technology Education Association, 2000a).

Technology Education

Technology education is a school subject designed to develop technological literacy (International Technology Education Association, 1996; Siu, 2009). It is a comprehensive, action-based educational programme concerned with technical means, their evolution, utilization, and significance in industry, organizations, personnel, systems, techniques, resources, and products, and their social/cultural impacts (International Technology Education Association, 1985). The scope and nature of technology education varies from one country to another. In this study, technology education is classified as general education. It aims to cultivate students' technological literacy (International Technology Education Association, 1996; Ministry of Education of the People's Republic of China, 2001, 2003). It helps students to achieve appropriate levels of technological knowledge and capability (Ministry of Education of the People's Republic of China, 2001, 2003; Siu, 2007, 2009). Its scope ranges from primary to secondary levels. In this study, the research focus is on the senior secondary level.

There is a grey area even for educators between technology education and educational technology (Dugger & Naik, 2001). International Technology and Engineering Educators Association (ITEEA, formerly ITEA) and the International Society for Technology in Education (ISTE) try, however, to override such differences despite many overlaps in content, ideology, and standards (Petrina, 2003). Educational technology is the "application of technological process and tools which can be used to solve problems of instruction and learning" (Seels & Richey, 1994, p.4). It is associated with information technology (IT), information communication technology (ICT), computer studies (CS) and others.

Another term related to technology education is "engineering education". Technology education is broader than engineering education because it also considers what users need to know and are able to do. Moreover technology education covers the human and social aspects of technology, whereas engineering education mainly deals with the "hard" aspects of technology. In engineering education, students are still primarily trained to become engineers; in technology education, students are prepared to become citizens, irrespective of their future career (de Vries, 2011).

There is another term, "vocational education", which can easily cause confusion about the nature of technology education. Vocational education prepares students for a specific profession. In contrast, technology education offers an introduction to technology as a component of both our professional life and our life as a consumer and citizen.

In brief, technology education is a form of generic education, whereas engineering education and vocational education are forms of specialized education.

Technological Literacy

This term is used to indicate an important aim of technology education, namely to provide students with the type of literacy that is important for the technological society in which we live. It is related to the ability to use, manage, understand and assess technology (ITEA, 2000). A technologically literate person, is one who understands—with increasing sophistication—what technology is, how it is created, how it shapes society, and how in turn it is shaped by society (Ministry of Education of the People's Republic of China, 2001, 2003).

STEM

"STEM" is a relatively recent innovation (Cavanagh & Trotter, 2008). Until 2001, the common shorthand was SMET, science, mathematics, engineering, and technology. The National Science Foundation (NSF) was the first to begin referring to this collection of subjects (science, mathematics, engineering, and technology) as STEM formally (National Academy of Engineering and National Research Council of the National Academies, 2009). The STEM acronym has since become familiar to the public. These four subjects represent a well-connected system of learning.

1.6 Scope of the Study

There is no doubt about the importance of technology education at primary and secondary levels. Despite the development of technology education in some Western countries, owing to the special environment in China, some of these successful practices are not suitable. With regard to the present implementation practice in China, in-depth research on this topic is important and necessary. Thus, the study does not aim to be a large-scale review of the topic. Instead, it offers an in-depth study designed to generate discussions, issues and strategies that will be useful in further practice.

As indicated in previous sections, this study focuses on the senior secondary level of technology education in China, although various levels of technology education exist in different way in some schools. Another reason for the scope of this study is that the regular and formal curricula of technology at this level of study are relatively more mature and are formally recognized by the Chinese government, such as the Ministry of Education of the People's Republic of China (Siu, 2007).

For the past ten years, the Chinese mainland and Hong Kong have both been undergoing general education reform. The key stakeholders such as the government, educators, education researchers and the public have different interests in and attitudes to technology education at primary and secondary levels in these two regions, which has led to the different development of technology education in each. This thesis does not, however, intend to provide a direct comparative study between the Chinese mainland and Hong Kong. Instead, it focuses on presenting issues related to technology education at senior secondary level.

In addition, the author of this thesis once followed Prof. Gu Jianjun, the leader of the expert group on High-Middle school technology curriculum standards of the National Ministry of Education in China, and her present supervisor Prof. Kin Wai Michael Siu is also an experienced researcher in this field in Hong Kong. For the past eight years, the author has built close associations with many regional technology organizations and accumulated a large amount of academic resources and information. For this study, she contacted technology education coordinators in more than 20 provinces in China. Her experience and networks made it possible to conduct a large-scale survey in different provinces. Four key education research organizations provided direct help (see Appendix A):

1. Education Research Training Institute of Hainan Province;
2. Teaching Research Office of the City of Nanjing;

3. General Education Research Office of the City of Qingdao;
4. Education Research Office of the City of Shenzhen.

These organizations helped to contact hundreds of secondary schools and recruit the students and teachers who participated in the investigations. The samplings will be described in Chapter Four. The organizations helped to distribute questionnaires and contact the experts and teachers to be interviewed. In addition, the author organized several national teacher training sessions which facilitated a face-to-face dialogue platform with core technology teachers. Collection of first-hand data at senior secondary was convenient and effective.

Through this broad investigation and analysis, this thesis presents a comprehensive picture of the current situation of technology education in China.

Chapter 2: Review of Related Literature: Development of Technology Education Worldwide

2.1 Brief Introduction to Technology Education Development

Increasingly, more countries, including China, are classifying technology education in the general education system as the key learning area. Different countries use different terms to describe technology education, including technology, technical education, design and technology, and technological education (Rasinen, 2003; Siu, 2002a, 2009). Instead of arguing over the meaning of the terms, this chapter focuses more on the nature and objectives of technology education itself and thus treats these expressions as synonymous.

"Technology" is described as a new curriculum of the general education system, but there are historical antecedents which are important in terms of understanding the current state of technology education at senior secondary level.

In most countries, technology education can be traced back to craft-oriented education, which is still evident in current practice. To a large extent, craft-oriented education meant making work pieces. Subjects are related to work with materials, for example woodwork, metalwork, home economics, carving. In these early subjects, students were mainly required to acquire skills and experience in preparation for earning a living (Siu, 1997a) in accordance with the economic and social situation of the time.

In the 1960s, it was clear that, the tide of recognition for the craft-oriented subjects was turning (Eggleston, 1976). There were multiple reasons for this. The advancement of society and the innovations in technology meant much of what had been taught became obsolete.

As Eggleston (1976) observes, the mathematics curriculum had to be reviewed to take account of the computer age; developments in nuclear physics transformed the content of even junior science; work in written and spoken English had to take heed of the unprecedented development of new media of communication. Similarly, the making of food, clothing, wood, and metal by hand has declined in craft-oriented subjects. The teaching task of craft teachers was translated into helping students to acquire the capacity to adapt, to initiate, to modify, to solve problems and to make decisions to enable them to live in a modern society. *Living* in this context means more than surviving (de Vries, 2002).

With the emphasis on problem-solving, people started to realize that the technology curriculum was a good approach to cultivating students' comprehensive abilities. As Eggleston (1976) says, technology education is concerned with the identification and solution of problems in the use of materials that occur in the social systems in which our students will become adults. In this sense the birth of new technology education is necessary and also timely.

What exactly is technology education? What should we teach in technology classes? Technology has its own distinctive knowledge, understanding and skills, but students are also required to apply the skills, knowledge and understanding from other subjects, including mathematic, physics and science (Rutland, 2002). It might be that the nature and content of technology education are more complex than we image.

2.2 Major Trends and Issues in Technology Education Worldwide

Technology education as a field of study was widely recognized by the end of the 1980s although the debate on including it in the school curriculum started much earlier. It is only in the past two or three decades that it has been developed on a worldwide scale (de Vries, 2000, 2006). By the end of the 1980s, education coupled with market reforms held sway in government policy. Education has been seen as the response to technological change. A close association between education and the economy meant technology education was an important area of discussion in many reports undertaken by educational authorities in different countries (Wright, Washer, Watkins & Scott, 2008). Changes in educational policy and different practical courses in the school curriculum were the background to the inclusion of technology education in the curriculum of comprehensive schools internationally (Pavlova, 2006b).

Technology education has suffered some turbulence over the last twenty years. That makes it even more difficult to draw conclusions from it, but a retrospective view on the past two decades of technology education may be a useful exercise. It can tell us how we got where we are now. As Layton (1995) stated, understanding the current situation can be enriched by insights into how technology education has become what we know it as now. Moreover, it may help to determine future actions, but there is no simple one-to-one relationship between what is current and what will happen in the future.

In the development of a school subject or learning area, a period of twenty years is relatively short. Most school subjects have developed over a much longer course. In some countries, technology education was a craft-oriented school subject twenty years ago and it still is. Some of the Scandinavian countries are in that category, are Switzerland and Austria. In other countries the situation regarding technology education looks very much the same as it did twenty years ago, but rather than stability there was a circular movement: changes have been made and undone in the same twenty-year period. Malta, and in some respects Scotland, are examples of that. It can be very frustrating to be involved in such a shift. In some other countries, however, real and lasting progress has been made. Country size does not seem to play a vital part in that, because the USA, a large country, and New Zealand, a much smaller country, are both examples of such progress. Remaining countries can be categorised as those in which developments in the past twenty years have led to a point of decision (de Vries, 2006). Certain fundamental changes have been made in technology education in schools, and now politicians want to see results. In fact, it is difficult to know what kind of results they see as valuable. Politicians want to harvest benefits now. For example, in France and the Netherlands, officials in education departments push for decisions: to keep technology education as a distinct entity in the curriculum, to integrate it with better-established entities such as science education, or to get rid of it altogether. Because there is no concrete evidence of success, the fate of technology education is in the balance in several countries. Hong Kong is a good example.

In different countries with different economic and social situations, different approaches to technology education have emerged (Pannabecker, 1995). It is impossible to describe them all, but one way to conclude is to find the common trend and current issues.

2.2.1 Major Trends of Technology Education Worldwide

Contents of Technology Education

1. "Design"— New Component of Technology

"Design" does not exist as an independent curriculum but is integrated into the technology curriculum system at senior secondary levels on the Chinese mainland and in Hong Kong. This phenomenon also exists in any other countries, which is worldwide trend (Lewis, 2005b; Siu, 2009; Williams, 2000). In the Standards for Technological Literacy (ITEA, 2009), there are 20 standards. Standard No. 8 is about design (Table 2.1).
In this context, the problems of design-related subjects are also those of technology education. Technology and design-related subjects are relatively new subjects, so there is currently no school subject around which there is so much debate as there is around them (de Vries, 2002). The changes which have happened in these subjects are fundamental, and some generic issues (i.e. problems) are inevitable.

Table 2.1 Design—Standards for Technological Literacy (ITEA, 2000b)

Standard 8: Students will develop an understanding of the attributes of design	
Students in grades K-2	Students in grades 3-5
A. Everyone can design solutions to a problem B. Design is a creative process	A. The design process is a purposeful method for planning practical solutions to problems. B. Requirements for a design include such factors as the desired elements and features of a product or system or the limitations that are placed on the design
Students in grades 6-8	Students in grades 9-12
E. Design is a creative planning process that leads to useful products and systems. F. There is one perfect design. G. Requirements for a design are made up of criteria and constraints.	H. The design process includes defining a problem ,brainstorming ,researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities for a design proposal, making it, and communicating processes and results I. Design problems are seldom presented in a clearly defined form J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other

2. “Engineering”— STEM Approach

In the past 15 years a consensus has emerged about the need to improve K—12 education, particularly in science, technology, engineering, and mathematics, the so-called STEM subjects. Engineering has been brought into the mix with a number of **s**cience, **t**echnology, **e**ngineering and **m**aths (STEM) projects being developed, most significantly, in terms of numbers and influence, in the UK and USA (Sanders, 2009; Williams, 2011). Each curriculum has its own personality, and no two are completely alike in terms of mission, content, format, or pedagogy. To deal with this complexity, Prof. Welty developed the "beads-and-threads" model (Figure 2.1) that enables us to analyse the curricula in a systematic way using a manageable set of key variables.

Allied with the STEM approach is technology education revisionary movement toward engineering in schools, particularly in the USA. Technology educators who promote this approach do so out of frustration at the lack of general recognition of Technology Education after many years of advocacy (Gattie & Wicklein, 2007). The fact that William Wulf, the President of the National Academy of Engineering wrote the foreword to the Standards for Technological Literacy (International Technology Education Association, 2000) is heralded as a "significant benediction" (Lewis, 2005a) on the shift from technology education to engineering (Rogers, 2006).

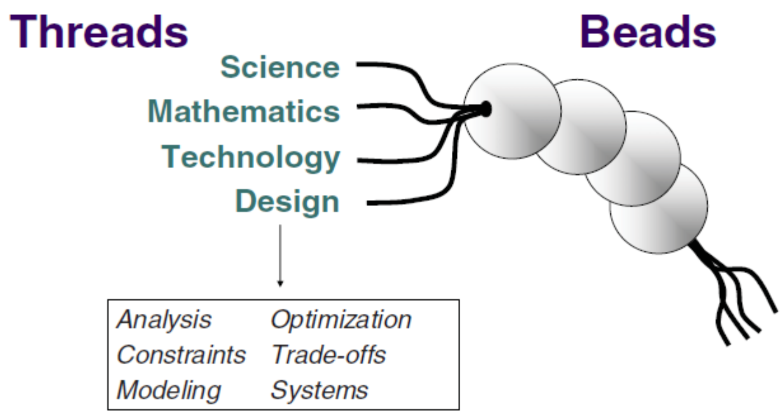


Figure 2.1 Beads-and-Threads Model of K-12 Engineering Curricula (NAENRCNA, 2009, pp.77).

Knowledge of Technology Education

Technological knowledge is seen as having clear boundaries in the USA and Russia, and without clear boundaries in the UK and Australia. In the UK, the emphasis is on technical knowledge, although values are considered as playing an important role in technology education. In Russia, technical knowledge is seen as important for achieving the aims of technology education and is described in content modules. In the USA, the philosophical aspects of the relationship between technology and society are seen as important.

Table 2.2 Knowledge of Technology Education in Curriculum Documents of Four Countries (Pavlova, 2006a, pp.24)

	Australia	**UK**	**USA**	**Russia**
Definition of knowledge	Non-explicit: information is knowledge-generated and used in everyday life	Not stated	Knowledge is interpreted information that can be put to use	Not stated
Source of knowledge for technology education	Not clear, Knowledge is not explicitly stated, the required activities are specified	Terms of Reference state knowledge which students need to have to achieve technological capability	Place and nature of knowledge in technology	Non-justified selection of knowledge—what students have to learn to achieve the aims of the subject
What knowledge is stated?	Technical knowledge about information, systems, materials and process of designing, making, appraising+ value judgments connected with those issues	Technical knowledge about materials, systems structures, products, etc.	Technological knowledge; emphasis on the relationship between technology and society and vice versa	Technical knowledge or particular knowledge (legislation, for example)
Relationship knowledge/ understanding	Not stated	Not stated	Understanding is knowledge synthesized into new insights	Not stated
Structure	Boundaries are not clear	Boundaries are not clear	It is possible to set up boundaries	Boundaries are clear
Is the selected approach justified?	No	Several assumptions have been made, no theoretical justification	Yes	No theoretical justification

In Australia and the UK, the main emphasis is on lower levels of generalization (artisan skills and technical maxims). In Russia and the USA the higher level of knowledge are also involved (technological theories and descriptive laws). Knowledge about technology (as a general phenomenon) was included in the USA Standards and to a very limited extent in the Australian Statement (Pavlova, 2006a).

2.2.2 Current Practical Issues of Technology Education Worldwide

In this part, the practical issues that influence the implementation effect of technology education in the school curriculum are considered. The future of technology education will largely depend on the extent to which we are able to gain a more in-depth insight into the mechanisms. There might be many practical issues need to be taken into account when technology education is discussed. Among them, curriculum time, gender issue, Facilities in the Workshops, teacher education, academic research and assessment are frequently considered and discussed (Hansen, 1995; Wicklein, 1993; Zuga, 1994, 1995).

Curriculum Time

In most Western countries, technology and design related subjects are compulsory subjects (Siu, 2009). Yet they still need to compete with other subjects, such as science chemistry or physics for teaching time. On the Chinese mainland, although the government drives the curriculum, subjects have not been made part of the college entrance examination in some provinces. Some schools offer these subjects for a short period merely to satisfy government inspectors. In Hong Kong, they are only "recommended", and 2.4 to 3.6 hours per week are “suggested” (Siu, 2002b). Most schools, however, do not offer these subjects for all students.

Gender Issue

Technology-related subjects have always been the most strongly gendered of all curriculum areas (Harding, 2002). In the past these subjects were mainly offer exclusively to boys (Volk & Yip, 1999). Not until recent years has the gender issue been discussed and educators have attempted to eliminate this phenomenon (Silverman, 1996).

In Hong Kong, in the past few years, owing to the physical limitations of the classroom environment, D&T was offered almost exclusively to boys (Siu, 2002b). Few girls had a chance to take D&T, and most of them were only allowed to take Home Economics. This practice reflects and prolongs gender discrimination and stereotyping (Equal Opportunities Commission, 1999). Although in recent years this situation has improved somewhat, girls still have fewer the opportunities to attend technology classes (Siu, 2002b, 2009).

Facilities in the Workshops

There are two opposite extremes. In some schools, teachers face difficulties in purchasing new facilities. Some standard equipment is only suitable for the older syllabus. Lack of money to purchase new equipment means teachers cannot switch to the new teaching contents, and students cannot obtain more valuable practical experience with new technology. In other schools, special facilities for CAD, CAM, robotics, etc, are provided by the government. Sometimes these facilities are not utilized efficiently. Some can often be found covered in plastic sheets and an accumulation of dust, or are used by other disciplines.

Teacher Education

Technology and design-related subjects are highly comprehensive and stress synthetic utilization of the knowledge from other disciplines, which requires that technology teachers should have a common grounding in the scientific fields of mathematics, physics, and chemistry, as well as the fields of literature, and the humanities (Barnes, 2005). In most countries teachers of other subjects undergo in-service retraining to become technology teachers (sometimes they take no retraining at all). Their philosophy remains the same as before. In their view, the current technology subjects are the same as before, but were just packaged differently: modules are used instead of unit shops; computers and robots replace the metalworking and woodworking. These teachers usually do not have much more than a basic knowledge which is sufficient to teach them adequately (de Vries, 2002; Williams, 1996).

Teacher shortage is also s serious problem in China. There are two main reasons for this: low entry and high leaving rates. At present, in both these regions, there is no special institution for technology teachers, which causes the low entry rate. (Note: The only technology teacher education programme in Hong Kong was terminated several years ago owing to the shortage of students.) On the other hand, there are many factors which cause teachers to leave the teaching profession: restricted promotion opportunities, the burden of other duties such as coordinating and handling general and maintenance matters in schools, lack of professional development and lack of administrative support (Steinke & Putnam, 2007).

Academic Research

Differently from other school subjects, there is no directly equivalent discipline in the academic world to support further development of technology education. Policy-making, curriculum implementation, even teaching and learning, all need sustainable academic research to provide useful references and resources. It is desirable that an international agenda for educational research in this field is established (Jenkins, 1992).

Assessment

Assessing students' performance in the field of design education needs appropriate methods and tools (Kimbell, 2002; Leung, 1998). The content of technology and design-related activities is to provide some opportunities for students to find problems in daily life and carry out investigation to put forward solution (Siu, 2002a). This refers to a series of complex cognitive processes including thinking, feedback and experiment. Therefore what needs to be assessed is not only what students know but also how students employ their knowledge to solve problems. This includes emotional attitudes, values and thinking modes and so on. In the past decades, many researches about assessment in this field have emerged. The assessment of students' technological literacy including design literacy and how to make use of assessment to promote the implementation of technology and design-related subjects is always an issue for educators and educational researchers.

The assessment method on the Chinese mainland is mainly paper-based tests. Some provinces are still in the wait-and-see stage, as they have not yet drawn up the specifications for an assessment method, methodology and so on. It is notable that at present, especially in the social environment of China, college entrance examinations have their own special status and social significance. There needs to be a just, fair and open way of assessing students’ technological literacy. Whether the most authoritative entrance examination is the best choice needs further study but it is clear that the final choice should control and guide the teaching and learning activities towards predetermined goals (Gu, 2005). In Hong Kong there have been some improvements in assessing technology subjects in the past few years. Instead of the emphasis being on the assessment of technological knowledge and skills, more attention has been paid to students' analytic skills and creative thinking. They are still insufficient, however (Siu, 1997b, 2002a, 2009).

2.3 The Development of Technology Education in China

China’s post-1978 reforms, such as the opening up policy, have had far-reaching economic and social effects. Over the past several decades, China has been introducing more and more flexibility into its governance. The establishment of special administrative and economic regions such as Hong Kong, Macao, Shenzhen and Zhuhai is a good example of this effective and flexible governance. As government leaders have indicated, however, maintaining rapid and stable economic development and social transformation in a country with a population as large as 1.4 billion requires a comprehensive and sound education system (Borthwick, 1983; Ministry of Education of the People's Republic of China, 2008). Accordingly, the government has been implementing a series of educational policy and management reforms to match the changing social and economic environment.

Education in China is administrated by the Ministry of Education. The current nine-year system of compulsory education from the primary to the junior secondary level was first introduced in 1986. Since 1996, the Ministry has been servicing the largest population in the world, and all races and national minorities, women and the disabled are expected to have an equal right to education. This aim of education for all has almost been reached.

Although several special administrative and economic regions in China have achieved significant economic growth in recent years, the Chinese mainland considers itself and is widely recognised to be, a developing country. A number of areas need to be improved before China reaches the standard of developed countries (Hewett, 2008; Yeh, 2006; Yuen, 2010). Thus, the government has focused its attention on the modernization of industry, agriculture, science, technology and defence. In this regard, all of these areas will benefit from the development of new technologies. Therefore, understanding, mastering and applying technology have become important issues in China. In fact, there were no formal educational curricula relating to technological concepts before the foundation of the People's Republic of China. Although some technical subjects were introduced in the following years, the subjects focused on basic artisanal production skills and mostly served political needs. In addition, the general education system paid little attention to all-round development. To a large extent, education was exam-oriented and aimed to train students to achieve high scores (Gu, 2005; Hall & Lewis, 2008). As a consequence students ended up with limited abilities in other areas. Moreover, many students pursued academic subjects, rather than seeking knowledge applicable to the problems of the real world. Accordingly, many modern educators in China are calling for “additional values” to be introduced into education, while others are stressing the need for “quality education” (Borthwick, 1983; Hall & Lewis, 2008; Hewitt, 2008; Price, 1979; Siu, 2009). Although technology should not be thought of as the panacea for all educational problems, technology education does have the potential to provide a new direction for further educational reforms (Feng & Siu, 2010). The integration of technology education into the general education system is an irreversible trend. Therefore, it is necessary to consider how technology should be integrated into the current curricula and what kinds of implementation models are suitable for a country such as China. It is also necessary to consider whether the current technology education is positioned correctly. In the light of these practical problems, the direction of development must be continually rectified, especially given the size of the population and the correspondingly large number of students in China.

In addition to the development and situation of technology education on the Chinese mainland, the situation in Hong Kong (as part of China) is also discussed in later sections as a special case. This case is designed to supplement the discussion on technology education development on the Chinese mainland.

The general education systems across the Chinese mainland and Hong Kong vary in terms of objectives, content and implementation. Since the beginning of the twenty-first century, these two regions have been undergoing basic education reform on a large scale to meet new social and educational needs. In the recent education reform, technology education has emerged as an essential part of basic education for all students (Gu, 2004; Lewis, 1995b). Curricular systems of the primary and secondary schools in these two regions are in the process of being rebuilt; and both regions claim this will "develop students' technological literacy" (Curriculum Development Committee, 2000; Ministry of Education of the People's Republic of China, 2003). In these two regions, design is integrated into the technology curriculum without exception.

2.3.1 The Progression of Technology Education on the Chinese Mainland

Technology education has a rather short history on the Chinese mainland when viewed from the perspective of the history of education. From informal apprenticeships to formal school education, technology education has gone through almost 60 years of development (Siu, Wong & Feng, 2010a). The following section reviews and discusses this transition in relation to the structure and characteristics of the curriculum, educational facilities, teacher education and assessment.

The Transition Process of the Curriculum

In the 1950s, technology education in the People's Republic of China was influenced by the Soviet model of polytechnic education (Jiang, 1996). This conception of the polytechnic, which grew out of Marxism-Leninism, made a tremendous impact on education in China. Politically, polytechnic education was designed to serve the political needs of the proletarian class. Economically, from the 1950s to the 1970s, teachers and students were also considered to be members of the class of productive labourers: that is, workers who satisfied basic life needs (Fouts & Chan, 1997). On the basis of these two major historical precedents, labour-technical education began to emerge in the early 1980s.

Labour-technical education is different from other traditional school subjects, as its teaching content is much wider and less clear (Gu, 2004; Liu, 2005). The subject mainly consists of the two areas of labour education and technical education. Labour education is intended to instil in students an appropriate attitude towards labour; technical education teaches the technological skills related to agriculture and industrial manufacturing. Although labour-technical education meets political and economic needs, its development has reached an end-point for three main reasons: assessment, a shortage of labour-technical teachers and few formal or official textbooks. Thus, labour-technical education has little attraction for students, their parents and teachers (Bao, 1997; Siu, Wong & Feng, 2010a). Despite these problems, labour-technical education has undergone significant changes over the past two decades (Xu, 2002, 2004). Importantly, more emphasis has been placed on the technological dimensions of labour-technical education, especially in Shanghai, which is the largest modern metropolitan city in China. In this respect, the curricular goals focus on “hands-on activities” and developing the “technological skills” for manufacturing products used in daily life (Shanghai Municipal Education Commission, 2004).

In the late 1990s, a wave of educational reforms was introduced nationwide. One result of these reforms was that technology was made one of the eight key learning fields in general education, especially at senior secondary level (Ministry of Education, 2003). In April 2003, the Ministry of Education issued “The Standards of Technology Curriculum in Senior Secondary Schools (Experimental)”, which showed that technology had become an independent subject at the senior secondary level (Gu, 2004). This national curriculum document is the first indication of how the discipline is emerging through the implementation of curriculum standards. At primary and junior secondary levels, however, technology education is still integrated into comprehensive practical activities, rather than existing as an independent subject. Furthermore, technology education co-exists with other technically related programmes at the primary, secondary and higher education levels.

The core content of the new curriculum is design (not fine arts or art), which provides opportunities to cultivate students’ initiative, creativity, problem-solving skills and practical design competence (Siu, Wong & Feng, 2010a, 2010b). Another objective is to strengthen information technology learning (Gu, 2004; Ministry of Education of the People’s Republic of China, 2003). This approach encourages students to use information technology in their learning and to solve any problems they may encounter. It is hoped that every student will strive to obtain a wealth of practical experience through observation, investigation, design, production, experimentation and other similar activities. As a result, students are expected to develop emotional and social skills, as well as technical ability (Ministry of Education of the People’s Republic of China, 2003).

Curriculum Structure

The technological education curriculum is divided into two parts: Information Technology and General Technology (Gu, 2004; Ministry of Education of the People's Republic of China, 2003). Information technology consists of six modules, one compulsory and five elective, whereas General Technology comprises nine modules, two compulsory and seven elective. Each module is worth two academic credits (Table 2.3).

The inclusion of elective and compulsory courses is designed to cater for the different needs of students (Gu, 2004; Ministry of Education of the People's Republic of China, 2003). The compulsory content, which covers the basic development of students' technological literacy, reflects the progressive nature of technology education in China and provides the necessary foundation for students' future work and life. Additionally, the electives provide individual topics which extend the compulsory modules into specific technology fields. Students are required to take one elective module in addition to the compulsory course to obtain the four credits necessary to complete the IT component. As students also need to obtain at least four credits in General Technology, they are free to choose any elective module, or none, after finishing the two compulsory modules. As they are offered a variety of opportunities for technological practice, the students are able to enrich their technological proficiency and improve their ability to put theory into practice. Overall, this approach to technology education is extensively applicable, widely suitable and flexible to implement.

Table 2.3 Structure of Technology Education in Senior Secondary Schools on the Chinese mainland

Subject	Module	Remark
Information Technology	Information Technology Foundation	Compulsory
	Algorithms and Programming	Elective
	The Application of Multimedia Technology	
	The Application of Network Technology	
	Data Management Technology	
	Introduction to Artificial Intelligence	
General Technology	Technology & Design 1	Compulsory
	Technology & Design 2	
	Electronic Control Technology	Elective
	Architecture and Architectural Design	
	The Construction of Simple Robots	
	Modern Agricultural Technology	
	Home Economics & Life Technology	
	Garments and Garment Design	
	Automobile Driving and Maintenance	

Curriculum Characteristics

From an educational perspective, the aim of the curriculum is to deepen "quality education" to foster the lifelong development of secondary school students (Gu, 2004;

Ministry of Education of the People's Republic of China, 2008). The major goal is to improve students' technology literacy. On the one hand, efforts are directed toward helping students understand technological concepts, theories and methods, as well as operating procedures and techniques, and to promote their analytic and decision-making skills. On the other hand, emphasis is also placed on enhancing students' understanding of the humanistic value of technology and leading students to develop positive attitudes and values when they probe, test and create during their technological learning to counter the biased assumption that technology only relates to skill. Furthermore, technical design is regarded as pivotal to organizing students' technological learning content. Fully exploring the educational function of technical design can help students learn how to make thorough investigations, how to think effectively, how to create and how to make sound judgments. In this regard, design represents an important vehicle for improving students' technological literacy.

The technology curriculum is also intended to help students learn about methods of experimenting with and probing technology, thereby enabling them to convert their knowledge into practical skills in terms of finding and solving problems (Lewis, 2005b; Siu, 2002b). In addition, fully aware of the interdependence between science and technology, theory and practice, and designing and producing, the current curriculum tries to unify these aspects in an organic whole.

The contents of the technology curriculum are designed to follow students' social development and closely match students' real-life needs. For instance, "Modern Agricultural Technology", which is one of the seven general technology electives, includes several optional special topics that reflect the fact that the needs of students from rural areas are different from those of students from urban centres. This curriculum can be easily adapted and applied to different regions. Accordingly, this structure effectively resolves the problem of unifying the core and targeted needs of the technology curriculum.

In the light of the unbalanced distribution of resources on the Chinese mainland, schools in different areas can select their own content for inclusion in the technology curriculum. Schools are also encouraged to share curriculum resources (Xie & Ma, 2008). For example, senior schools, local vocational schools and technical schools can share teachers, equipment, apparatus and laboratories. Students can gain the same credits at vocational schools, technical schools, technological educational bases or scientific and technological venues.

At present, officials are exploring a technological certificate system for senior school students. The idea is that after completing the compulsory modules, students in rural areas will receive a “green certificate” and other technical training to gain “double certificates” in technology education (Zhou, Yang & Ni, 2004). Alternatively, students in urban areas gain corresponding course certificates after taking occupational technology curriculum or other technical training. This structure can help to balance the differences between urban and rural schools, and to strengthen the ties between general technology education and vocational technology education.

Educational Facilities

Over the past twenty years, the development of the facilities for labor-technical education has gone through three stages:

1. The 1980s – A Lack of Well-established Standards

At this stage, there were no educational standards or related requirements for facilities. Neither the educational departments nor the schools had any definite schemes for what should be provided or how to map it. Moreover, there were no professional manufacturers (or well-monitored or recognized manufacturers) to supply facilities. The teaching aids and learning kits were mainly made or bought by teachers themselves. This scattered and disorderly situation had the added effect of hindering regular teaching.

2. The 1990s – The Toolbox Standard

In 1989, the Ministry of Education issued the standards for teaching equipment for secondary labour-technical education (Bao, 1997; Xu, 2002, 2004). The equipment was classified into categories according to the type of activity. In each category, the corresponding equipment was divided into three levels adaptable to different regions. In accordance with the standards, some manufacturers produced several different sets of toolbox equipment: for example, manual kits, wood-work kits, metal-work kits and bench-work kits. These diverse types and specifications made management inconvenient, however.

3. From the Late of 1990s to the Present – The Workshop Style

After being equipped with the toolboxes mentioned above, schools found that they needed to provide special work spaces for students to complete their projects. This led to the birth of “special workshops” in each school for students to carry out projects related to all the compulsory modules. Although the workshops solved many problems, after three to five years of implementation new shortages and limitations began to emerge. For example, the work spaces are used for different kinds of projects. After home economics teaching, students also use the spaces for metalwork projects, which may damage the instruments. Moreover, as too many students use the work spaces at the same time this tends to reduce the hands-on opportunities for each student.

Given these three stages of development, it is obvious that there are no definite standards for facilities. Teachers are left to purchase or design their own equipment. Moreover, with the rapid developments in information technology, education department officials and a number of secondary school principals have begun to shift the conventional technology curriculum towards information technology subjects. One of the major reasons for this is that information technology enables students to master basic programming and to make simple robots. Often these learning outputs bring opportunities for students to participate in various international competitions. A student can gain a great sense of achievement by winning a prize. The schools, the school head and teachers can also gain a good reputation. In fact, over the past decade, the mass media have reported on the achievements of schools and individual teachers. In view of this added value, secondary schools, as well as a number of primary schools have invested a lot of money in purchasing high-powered computers and other related teaching aids. Furthermore, many schools have even allocated additional special classrooms or converted conventional classrooms specifically for the teaching of information technology. This overemphasis on information technology has led to the subject appearing in the teaching timetables of nearly all of the senior secondary schools on the Chinese mainland. By the end of 2001, 12,000, or 92% of all senior secondary schools offered information technology courses (Liu, Gu & Yu, 2005). This extreme focus on information technology has caused the design and development of facilities for traditional hands-on technology activities to stagnate. Similarly, the curriculum goals of the new senior secondary technology curriculum have changed to "promoting technological literacy for each student" (Ministry of Education, 2003). Therefore, the existing facilities for the original "Integrated Curriculum of Practical Activities" may not be suitable for the new technology curriculum, especially the "general technology" component.

Furthermore, although a number of best practices for facility layout have been developed in Western countries, these practices cannot be applied in the mainland Chinese context without modification, owing to the different economic and cultural environment and the different curriculum contents (Meng, 2005). In addition, there is a slight overlap between labour-technical education and general technology education. Thus, it is necessary and appropriate to have facility standards for technology education that are specific to the social, cultural and educational characteristics of the Chinese mainland (Feng & Siu, 2010). Officials and educators have begun to devote time to designing the necessary facility standards, and several local facility standards have been issued. New facilities for secondary technology education on the Chinese mainland have been developed from scratch in a workshop style based on an industrial centre model (Xie & Ma, 2008). This development is a big step in the history of technology education in China, especially with regard to the birth of regional facility standards. Owing to the varying levels of economic development and stages of curriculum implementation, a final universal standard is needed that has different grades that can be adapted to different regions. In sum, considering the wide scope of technology education and the rapidly changing curriculum content, the workshops must be designed in different styles conforming to the different modules. In addition, industrial centres should be established to facilitate the sharing of facilities, especially expensive facilities in more deprived regions. In view of the current overemphasis on information technology, cooperation between enterprises and the design of projects that combine information technology and general technology should be the ultimate aim of the Chinese mainland.

Teacher Education

The curricula for technology education at the senior secondary level are highly comprehensive and stress synthesizing knowledge from other disciplines (Kozak , 1992; Ritz, 2009; Wicklein, 1997). Accordingly, technology teachers are required to have a comprehensive grounding in the scientific fields of mathematics, physics and chemistry, as well as in the arts and humanities. This is a basic requirement for normal teaching and self-learning (Ministry of Education, 2003). Because the most recent technology education curriculum is completely new, there is not yet any formal education programme at the tertiary level to nurture technology teachers. At present, the majority of teachers are from other disciplines, such as science, physics, chemistry and labour and technology education, and have not received systematic pre-service training. Most, however, have gained experience in technology education through in-service retraining or, in some cases, even without it. As a result, they tend to retain the thinking associated with their original subject areas. In their view, the current technology subjects are the same as before, but are just packaged differently: modules are used instead of unit shops and computers and robots replace metalworking and woodworking. Furthermore, the teachers usually do not have much more than the basic knowledge necessary to teach. As de Vries (2002) mentioned, most teachers of technology education lack the wherewithal necessary to create a new approach to these subjects in their schools.

To implement the new curriculum smoothly, the Ministry of Education has invested large amounts of human and financial resources in in-service teacher education (Liu, et al., 2005). Presently, some regional- and provincial-scale face-to-face training of core teachers has been carried out. The technology teachers are trained in dialogue, collaboration, technical exploration and technical practice. Some technology teachers have also made individual bulletins which they have stuck on the back wall of the classroom to share their experiences and training notes with other teachers. After training, technology teachers are required to submit a self-summary and a teaching project for assessment. Experts from the national curriculum standard group and scholars from each technology field give lectures to enhance the teachers' knowledge and background information, and to raise their awareness of the importance of technology education (see Appendix B).

On-line learning for technology teachers started in the summer of 2007 after the Ministry of Education set up a special website for long-distance training. Several areas are represented on the site, including curriculum arrangement, video source downloads, curriculum bulletins and on-line discussion. Unlike face-to-face training, on-line training enables technology teachers, not just core teachers, to start self-learning. They use their own username to logon to the website and the system keeps a record of their learning. After the teachers' submit a learning report of their on-line training, the Ministry of Education assesses whether they should be awarded the teaching certificate. Moreover, on-line discussions (live chat) are popular among teachers, as they can share their opinions and experiences with others across the country, even with curriculum experts. Curriculum experts and education department officials are able to give feedback directly and instantly.

The Ministry of Education has also invested vast amounts of financial, material and human resources into technology teacher training to advance the curriculum implementation. Unfortunately, many problems and challenges still exist (Feng & Siu, 2010). On the one hand, although technology is part of the government-driven curriculum, the relevant subjects have not been made part of the college entrance examination in some provinces. Some schools only offer these subjects for a short period solely for government inspection. In reaction to official pressure, some schools dispatch teachers from other disciplines to participate in face-to-face training. Once trained, however, these teachers have no opportunity to teach technology subjects. This is ultimately a waste of training resources. On the other hand, the extent of the technology curriculum implementation varies widely in different provinces because of numerous factors, including school support, family attitude and financial support. Therefore, it is impossible to design one style of training scheme capable of meeting these different needs. The technology curriculum has been implemented very well in some provinces and teachers in these schools urgently need new information and more training. Quick update of the training contents and design of new projects is difficult to achieve, however.

Assessment

Assessing students' performance in the field of technology education requires appropriate methods and tools (Assessment & Performance Unit, 1994; Eggleston, 2001; Feng & Siu, 2010; Kimbell, 2002; Kimbell et al., 1991; Leung, 1998; Nicholson, 1989; Scott, 1990; Stables, 2002; Tufnell, 2000). The contents of technology and design-related activities are to provide opportunities for students to investigate and find solutions to problems in daily life. This requires a series of complex cognitive processes including thinking, gaining feedback and experimenting. Therefore, the assessment of students' work involves not only what students know, but also how they employ their knowledge in solving problems (Assessment & Performance Unit, 1994; Eggleston, 2001; Siu, 1997, 2002a). This is also the case with emotional attitude, values and modes of thinking. In the past decade, a great deal of research on assessment has emerged (e.g. Atkinson, 1999; Eggleston, 2000). Nonetheless, how to assess students' technological literacy, including design literacy, and how to use assessment to promote technology and design-related subjects are issues that are of continual concern to educators and educational researchers.

To date, assessment on the Chinese mainland has mainly been based on written tests (Gu, 2005). Some provinces are still at the wait-and-see stage with regard to introducing new assessment methods. It is notable that, especially in relation to the social environment in China, college entrance examinations currently have their own special status and social significance. There needs to be a just, fair and open way of assessing students' technological literacy. Whether the most authoritative entrance examination is the best needs further study. What is certain, however, is that the final method chosen should control and guide teaching and learning activities towards predetermined goals (Gu, 2005).

In 1999 on the Chinese mainland, the Ministry of Education began to design the new general education curriculum system for the twenty-first century (Ministry of Education of the People's Republic of China, 2008). This educational reform has gained worldwide attention.

In April 2003, the Ministry of Education issued "The Standards of Technology Curriculum in Senior Secondary Schools (Experimental)", denoting that technology has become an independent curriculum at the senior secondary level (Gu, 2004). It is the first national curriculum document that indicates how the discipline is emerging through the implementation of curriculum standards. At primary and junior secondary levels, technology education is integrated into comprehensive practical activities instead of existing as an independent curriculum.

Technology education at primary and secondary levels started fairly late, but it has been developing fast. To date, almost all provinces have entered into curriculum reform, and will start the teaching of Technology Education at senior secondary level

2.3.2 Hong Kong — Technology Education in a Special Administrative Region

The teaching of formal technical subjects in educational institutions and schools in Hong Kong can be traced back to the 1920s (Siu, 2009). Technology education was formally offered only at the secondary and tertiary, or post-primary levels in Hong Kong (Fung, 1997; Siu, 2002a, 2009). As implied by the technical subjects offered, students (sometimes called apprentices) were mainly required to acquire skills and practical experience in preparation for earning a living (Leung, 1998; Siu, 1997; 2009). As a former British colony, Hong Kong was influenced by the UK education system. With respect to curricula, most of the craft and technical subjects were adopted directly from the early curricula for British schools, and were not revised for many years (Sweeting, 2004).

In the mid-1970s, a Design & Technology (D&T) course was introduced in an attempt to move beyond the traditional craft-based and skill-oriented subjects, such as woodwork and metalwork (Fung, 1997). At that time, many of the workshop facilities, including machines, hand tools and furniture, were imported from the United Kingdom and, accordingly, were designed for the British curricula (Fung, 1997; Siu, 1997, 2009). D&T is also expected (Curriculum Development Council, 2000) to enable students to achieve design and technological literacy through the development of:

- Design and technological knowledge and understanding;
- Communication and problem-solving capabilities;
- Design and technological capability, and
- An understanding and awareness of the relationship between design/technology and society.

D&T offers a new direction in learning, and an environment in which students can have more opportunities to practise their problem-solving skills (Leung, 1998). The programme focuses on the processes of thinking and design more than before and is implemented concurrently with conventional technical subjects (Table 2.4). Today, about half of the secondary schools in Hong Kong offer D&T in secondary years one to three, though fewer than 40 schools offer the subject at senior level (Siu, 2009).

Until September 2000 these technical subjects continued to adopt an outdated syllabus, teaching approach and facilities. The situation changed after the Education Commission (EC) submitted the "Reform Proposal for the Education System in Hong Kong" to the government. The Commission proposed that all subjects should be reorganized and categorized into Key Learning Areas (KLAs), with Technology Education being one such KLA (Curriculum Development Committee, 2002a). D&T (design and applied Technology (DAT) at the senior secondary level) and other technical subjects are not compulsory (or "recommended") subjects in Hong Kong, however. Teacher experience and the facilities in the labs ("workshops") also influence the teaching of technical subjects. Teachers have relative freedom to follow either the older 1983 syllabus or the new syllabus introduced in 2000. At present, the general system is being restructured in that the senior secondary level is being adjusted to a three-year schooling period. Furthermore, the syllabi for technology-related subjects are still under review and further modifications are planned.

The latest junior secondary school syllabus for technology education was established in 2000 to “develop the technological awareness, literacy, capability and lifelong learning patterns” of students (Curriculum Development Committee, 2007). Students have to study four areas of learning: “the nature and impact of technology for yesterday, today and tomorrow”, “design and communication”, “the tools and machines of technology” and “resources of technology”. The latest senior secondary school technology education curriculum was established in 2007 and implemented in 2009. The senior levels cover more advanced areas of technology, such as electronics and automation. Students are required to study three core subjects (technological principles, design and innovation, and value and impact) and another two of five elective modules (electronics, automation, creative digital media, visualization and CAD modelling, and design implementation and material processes) (Curriculum Development Committee, 2000b). The two core concepts underlying the curriculum are innovation and entrepreneurship.

Secondary schooling in Hong Kong is currently being restructured to a three-year schooling model and the changes are to be implemented in 2010. Up to now, however, D&T (or DAT) and other technical subjects have not been compulsory subjects in Hong Kong. Today, around half of the secondary schools in Hong Kong offer D&T in secondary years one to three, and fewer than 40 schools offer DAT at the senior level

(Siu, 2009). Technology programmes in some secondary schools have been cut back or closed, which has led to declining enrolments in technology-related teaching majors.

Over the past thirty years, technology education in Hong Kong has been seen unprecedented changes. A few decades ago, technical schools were very popular among primary school graduates (Fung, 1997) and craft-based technology education was attractive to students and parents. This was largely because, from the 1950s to the 1980s, a formal educational system was established to cultivate technology teachers. Students at the Hong Kong Institute of Education received four years of education before becoming technology teachers (Volk, 1993, 1997).

Owing, however, to the rapid decline of students enrolled in technology courses, technology teacher training programmes have faded out since 2004. The two full-time technology education teacher training programmes (the four-year full-time BEd (Sec) and the three-year mixed-mode BEd (Sec)) at the Hong Kong Institute of Education (the only formal technology education programme in Hong Kong) ceased in 2003/04 and 2005/06, respectively. Furthermore, the Institute officially phased out the Postgraduate Diploma in Education (PGDE) programme for technology teachers in 2007/08, though in reality no students were admitted to either the one-year full-time PGDE (Sec) in 2005/06 or two-year part-time PGDE (Sec) programme in 2004/05.

Table 2.4 Technology Education at Secondary Level in Hong Kong (Curriculum Development Committee, 2002, 2007)

Junior Secondary	Automobile technology Catering services Design & technology Design fundamentals Electronics & tlectricity Graphical communication Retail merchandising Textiles Business fundamentals Computer literacy Design & technology (Alternative Syllabus) Desktop publishing Fashion design Home economics Technology fundamentals
Senior Secondary (Implemented in September 2009)	Design and Applied Technology Technology and living Information and Communication Technology Health Management and Social Care Business, Accounting and Financial Studies

Nevertheless, the syllabi for technology-related subjects in Hong Kong are still under review and further modifications are planned. As became clear in interviews with officers from the Curriculum Development Council and the Hong Kong Examinations and Assessment Authority there is still a long way for technology education to go in terms of technology education (see also Siu, 2009). Opportunities for achieving a better situation for teacher education remain and the realization of these opportunities depends on the direction of the new DAT curriculum and further curriculum development in the coming years.

Technology education on the Chinese mainland and DAT in Hong Kong have the same curricular objective of "developing students' technological literacy" (Ministry of Education of the People's Republic of China, 2003; Curriculum Development Council, 2002). It is obvious that technology is becoming one of the key learning fields in these two regions. The difference is, however, that technology subjects are not compulsory in Hong Kong. Technology education, which could be formally offered as an independent curriculum at the secondary level, has not become a complete system that can cultivate students' technological literacy step by step. Another typical characteristic of technology education is that it has changed from traditional craft and technical subjects to design and technology-related subjects (Fung, 1997). Design is an important part, which provides more opportunity to cultivate student's initiative, creativity, problem-solving skills and practical design competence.

Because this is a new curriculum on the Chinese mainland, there is no formal education system at tertiary level to nurture technology teachers. At present, the majority of the teachers are from other disciplines, such as science, physics, and chemistry. They have not received systematic pre-service training. To implement the new curriculum smoothly, the Ministry of Education has invested a large amount of human and financial resources in in-service teacher education (Feng & Siu, 2009). Unfortunately, many problems and challenges still exist. On the one hand, although technology is in the government-driven curriculum, subjects have not been made part of the college entrance examination in some provinces. Some schools offer these subjects only for a short period just for the government's inspection. Under official pressure, some schools dispatch teachers from other disciplines to participate in the face-to-face training. After training, these teachers have no opportunity to teach technology subjects. This wastes the training resources.

In Hong Kong, technology education has developed to a high level in the past 30 years (Volk, 2003b). There is a good foundation, and facilities and experience necessary to train technology teachers and benefit their professional development. Owing, however, to changes in the schooling system and educational policy, technology education is in a "tortuous" situation. D&T (or DAT at senior secondary level) and other technical subjects were not "compulsory" or "recommended" subjects in Hong Kong. This produced a knock-on effect on the enrolment of technology teachers. Consequently, the technology teacher education programme was discontinued. The workshop and laboratory facilities were left unused, which is a waste of resources (Figure 2.2 & 2.3).

Figure 2.2 Workshops for Training Technology Teachers in Hong Kong

Figure 2.3 Facilities in Workshops for Training Technology Teachers in Hong Kong

With the strong support of government, it developed very quickly, especially at senior secondary level, although it started fairly late. In Hong Kong, from the late 1970s, when the subject of D&T was introduced, technology education has achieved a high level. As discussed in previous paragraphs, however, development of technology education is beset by problems in both regions.

2.4 Summary

This chapter reviewed the related literature on the development of technology education. Although special administrative regions have their own particular policy considerations and backgrounds in educational development, developing and implementing a better organized technology curriculum, with a clear vision, mission and objectives, over all of the country's regions is an important and urgent task (Gu, 2004).

From the late 1970s, when the subject of D&T was introduced in Hong Kong (a special administrative region of China) schools, technology education achieved high levels of enrolment (Fung, 1997). This established a good foundation, with the necessary facilities and experience, to train technology teachers and to benefit their professional development. However, due to changes in the schooling system and in educational policy, technology education has sunk to the depressed situation. D&T (or DAT at senior secondary level) and other technical subjects are not "compulsory" or "recommended" subjects in Hong Kong. This has produced a knock-on effect on the enrolment of technology teachers. Consequently, technology teacher education programmes have been discontinued and the workshop and laboratory facilities are left unused, which is a waste of resources.

The curricular objectives for technology education in both the Chinese mainland and Hong Kong aim to develop students' technological literacy. It is obvious that technology is becoming one of the key learning areas in these two regions. However, the difference is that technology education is not a compulsory subject in secondary schools in Hong Kong. Technology education, which could be formally offered as an independent curriculum at secondary level, is not yet a complete system capable of progressively cultivating students' technological literacy (Volk, Yip & Lo, 2003a). Another typical characteristic of technology education is that it has changed from the traditional craft and technical subjects to the current design and technology-related subjects. Design has become the core content, which provides opportunities to cultivate students' initiative, creativity, problem-solving skills and practical design competence.

There are many reasons behind the current situation in Hong Kong. In recent years, curriculum planners and teachers have tried to develop technology education specific to the needs of Hong Kong students, as industry does not need large amounts of technologically well-skilled people and has shifted to a knowledge-based and management-based economy. However, from a different point of view, the current crisis presents an opportunity for curriculum planners, teachers and other educational researchers to review the development of technology education in Hong Kong. The reasons for the decline in technology education in Hong Kong might not only be associated with the industrial decline during the 1990s. Other internal factors relating to current technology education and beliefs held by Hong Kong people may also have contributed. For example, some school administrators may not understand the educational value of technology education, while others may still perceive it to be a skills-based discipline. Although Hong Kong is only a small part of China and the world, the success and failure of technology education experienced in Hong Kong can provide some hints for technology educators in other places who wish to optimize technology education. More important in this regard is how educators and researchers should intervene in the process and relaunch, redevelop, or rekindle technology courses in secondary schools. Action must be taken to develop a better system of technology education, so that students can enjoy the true benefits of the curriculum.

As discussed earlier, the development of, and problems with, technology education coexist on the Chinese mainland and in Hong Kong. Technology education is currently in a period of transition within the implementation of the new curriculum structure for general senior secondary schools on the Chinese mainland. Hong Kong is currently confronted with greater challenges in technology education than ever before. Although technology education is classified as a key learning area on the Chinese mainland and in Hong Kong, the actual implementation situation is not as expected (Siu, 2009). It is now necessary to ask whether the present position of technology education in the school curriculum system is suitable or not. Taking Hong Kong as an example, if the position of technology education is currently suitable, why are these subjects now closed in most secondary schools? Are the issues of successes and problems in Hong Kong similar to those experienced on the Chinese mainland or in other countries? Can the situations on the Chinese mainland and in Hong Kong serve as references or mirrors for each other? All of these questions need to be continually asked during the implementation process to correct or revise policies and curricula.

The current situation indicates that the development of technology education needs the support of policy and that the instruments and equipment required depend on making full use of local resources. The evaluation system needs to be based on the specific needs of Chinese culture to promote the steady development of the curriculum. Changing people's ideas about education is an arduous task, as is overcoming their ignorance of technology education. Overall, the reform of the technology curriculum in China has had a great impact in improving students' innovative spirit, practical competence and adaptability in a technology-based society, and more importantly their overall well-being and lifelong development (Ding, 2009; Gu, 2004). The reforms also have a profound historical significance in that they are enhancing technology literacy all over China. It is necessary to establish a strong leadership position to ensure that technology education remains a significant part of the mainstream public education curriculum. Technology education is still a new area, particularly in Asian regions such as China. It is thus necessary for curriculum planners and teachers to realize that the reform of technology education does not require a perfect final solution in curriculum development. Instead, reform should be considered as a series of continuous cycles of research, implementation, evaluation and further research. It is only through such a continuous cycle of action and reflection that technology education can be made to fit the ongoing social and educational changes within society.

Chapter 3: Research Design and Methods

3.1 Introduction

This study focuses both on theoretical and practical issues. The purpose of the study is to identify the existing problems and challenges and to explore recommendations for the future of the development of technology education on the Chinese mainland and in Hong Kong. In this context, national investigation is to be used to find current existing and potential problems. Because of the special background of the Chinese mainland and Hong Kong, some practices in other Western countries cannot be adapted to well. So there is no definite guideline as to where technology education should go. Based on the findings of the national investigation, the researcher discusses the issues behind the findings and attempts to put forward recommendations for the special issues. This chapter describes the research structure and framework, the stages of the study, samples, instruments and the data collection procedures.

3.2 Combined Research Approach

According to Herman and Egri (2002), quantitative research can help to explain what is happening, while qualitative research can enable us to understand the reasons for it. To achieve these two aims, this combined approach is taken by the researcher.

In order to achieve a full picture of technology education in China, a large-scale survey was utilized in this study to gather the necessary data. This requires both detailed qualitative information from open-ended interviews, and quantitative information from questionnaires (Hoepfl, 1997). Checking data obtained by a variety of methods is one way of contributing to trustworthiness (Ely, 1991). The use of questionnaires and face-to-face open-ended interviews provides sources for the triangulation of information. This reduces the risk that the conclusions of the study will reflect only the systematic biases or limitations of a specific method, and it allows you to gain a better assessment of the validity and generality of the explanations developed (Maxwell, 1996; Jick, 1983). In this study, "between-method triangulation" was utilized, which consists of a questionnaire survey and interviews conducted to collect data. As Diesing (1971) concluded, the variety of combinations is so great that survey research and fieldwork are better viewed as two ends of a continuum rather than as two distinct kinds of methods. In this research, methodological triangulation informed our decision to gather data through both questionnaire surveys and qualitative interviews, and then to analyse the data by content analysis and statistical procedures.

A questionnaire survey was conducted to supply the data necessary to achieve basic knowledge about the situation of technology education at senior secondary level such as background information, curriculum offering situation, curriculum resources and faculty status. Qualitative interviews played a dominant role in the study to find the existing and potential problems behind the current situation.

Quantitative sampling was selected as broadly as possible because of the research objective of describing the overall current technology education situation in China. It is comprised of technology teachers, local technology education coordinators, school principals and officers/administrators and students. In order to obtain qualitative data regarding the in-depth questions, the researcher purposefully selected informants who would best answer the research questions.

3.3 Research Structure and Framework

This study aims at more practical issues so that the recommendations can be proposed in the last chapter of this thesis.

In order to maintain the good momentum of the development of the technology curriculum on the Chinese mainland, the large-scale survey focuses on the issues related to problems and obstacles in the implementation process.

The main issues for national investigation are as follows：

- The attitude towards technology education;
- The situation of offering the new technology curriculum;
- Curriculum resources;
- Academic research activities;
- Pre-service and in-service teacher training;

- Evaluation mechanism.

According to the above issues, the questionnaire items are designed and in-depth questions of the interview are derived.

The entire study was conducted through five major stages (Figure 3.1). These stages are not independently separated but linked together. Each stage of the research work is especially planned to generate information relevant to the following stage of research work. From Stage III to Stage IV of the research, the work flow is not a one-way process. This process takes several recirculation corrections.

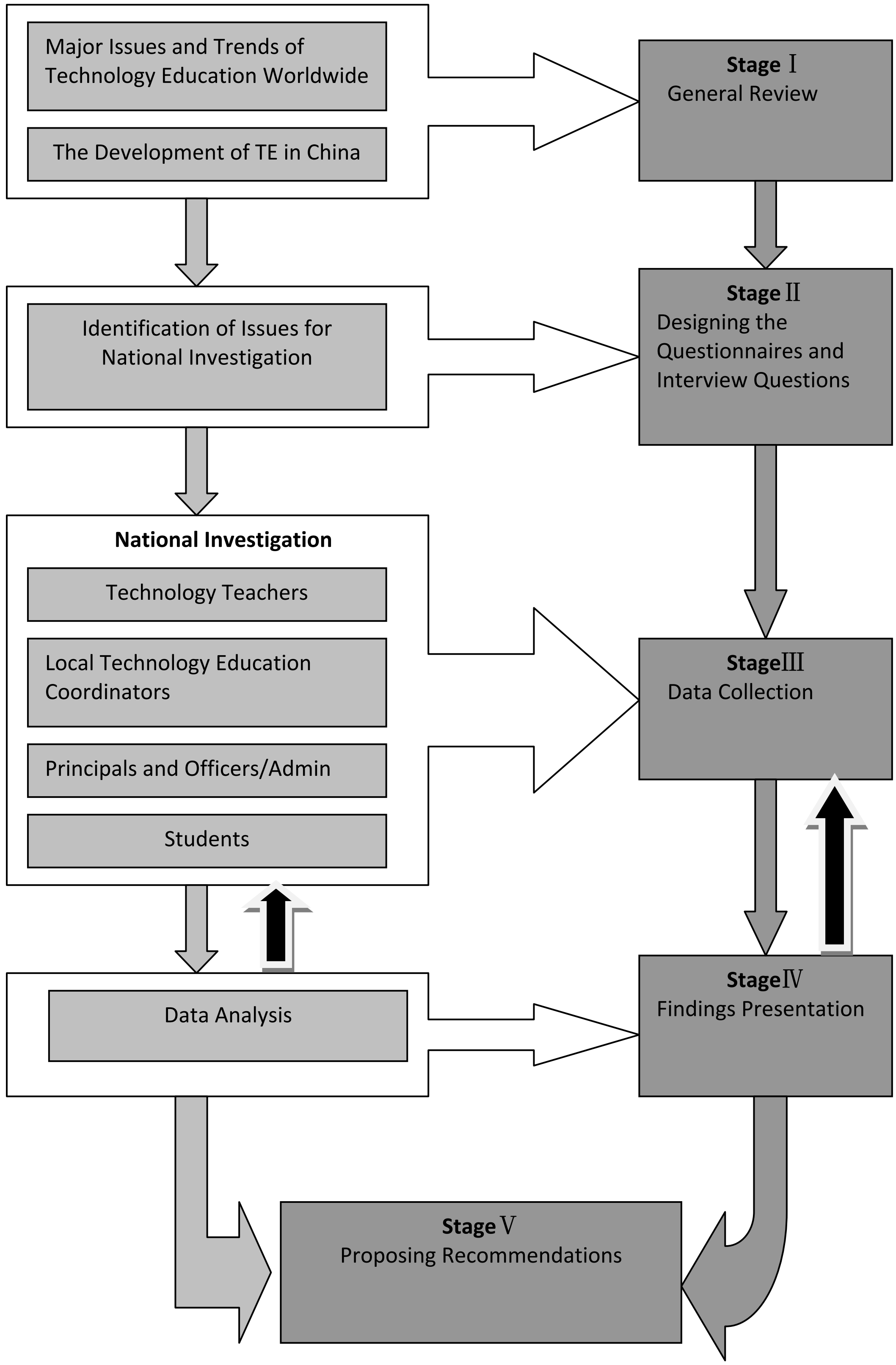


Figure 3.1 Research Framework

3.4 Stages of the Study

Stage I

Stage I (also the logical beginning of the entire study) is a general review of two major areas:

- Major issues and trends of technology education worldwide;
- The development of technology education in China.

Both these review areas are expected to provide a good foundation and a clear direction for both the survey and also the preparation of the thesis. This stage also serves as a guide for the whole study. The literature reviews (Chapter 2) serve as a basis for the development of the national investigation. As explained in Chapter 1, the scope of this study is confined to the senior secondary level. Thus, the emphasis of the review on technology education and the development of technology education is on this level.

Regarding the review of major issues and trends of technology education worldwide, the study attempts to discover what has happened and what is happening in technology education across the world. The review of the recent development of technology education is important, since it provides a base and direction for analysis and discussion related to current and future issues (Siu, 2000a).

As the focus of the study is confined to the Chinese mainland, the background to technology education and its development on the Chinese mainland is very important. This background provides information on both historical change and the transformation of technology education systems. Hong Kong is a special case for discussion, and the results from it are considered as a whole in the analysis phase. However, the review does not provide a direct comparative study between the Chinese mainland and Hong Kong. Instead, it presents some issues related to technology education at senior secondary level as a reference for the following research on the Chinese mainland.

Stage II

Compared to the general review across the world, the review in China is more in-depth and particular in nature. After these review areas, the directions for the investigation were confirmed. The questionnaires and interview questions were designed based on the research questions stated in Chapter 1.

Questionnaire

Questionnaires were conducted to offer basic and brief information about technology education in China. Five set questionnaires were designed to collect data. The questionnaire for technology teachers contains four categories: background information; the availability of the new technology curriculum; faculty status; and experiences, difficulties, and suggestions for curriculum implementation (Appendix E). The questionnaire for technology education coordinators contains three categories: background information; the context of the technology curriculum; and academic research activities (Appendix F). The questionnaire for education administrators and principals contains two categories: background information; and the situation of the new technology curriculum (Appendix G). The questionnaire for students contains two categories: background information; and the learning situation of technology subjects (Appendix I).

Though questionnaires are considered to be a quantitative research method, their data can be divided into two types: quantitative and qualitative. Since the survey aims to collect first-hand information of the current situation of technology education in China, the questionnaire consists of one-choice and multiple-choice questions, subjective items so that respondents can give explicit information in most cases. After the survey participants were confirmed, the questionnaires were sent out. Beside on-site responses, email was utilized as a complementary method to achieve efficient feedback.

Interview

Interviews are one of the most important sources of qualitative information (Yin, 1994). They are a highly efficient way to gather rich, empirical data (Eisenhardt *et al*., 2007). They allow researchers "control" over the line of questioning (Merriam, 1988; Bogdan & Biklen, 1992; Creswell, 2003).

In this study, in-depth open-ended face-to-face interviews were conducted not only for a detailed description of existing problems of technology education in China, but also for exploring the recommendations for these problems. A basic question list was designed for the interviews. In this study, two kinds of interview were used: individual and group.

A digital recorder was used to record the individual and group interviews. The interview recordings were transcribed as soon as possible which is beneficial for reviewing and following up on crucial issues.

Stage III

After designing five sets of questionnaires and interview questions, the survey started. The survey activities included:

- Delivering questionnaires to and collecting them from principals (secondary schools), as well as interviewing them;
- Delivering questionnaires to and collecting them from technology teachers (secondary school teachers), as well as interviewing them;
- Delivering questionnaires to and collecting them from education administrators, as well as interviewing them;
- Delivering questionnaires to and collecting them from local technology education coordinators, as well as interviewing them;
- Delivering questionnaires to and collecting them from senior secondary school students, as well as interviewing them.

Five versions of the questionnaires were designed to obtain feedback from key stakeholders, including education administrators, coordinators, school principals, technology teachers and senior secondary school students. Data were collected through the face-to-face survey questionnaires and the unstructured interview questions. All of the interviews were semi-structured. The questions were predominately closed-ended, supplemented by open-ended questions. This type of interviewing permits the author to ask follow-up questions constructed in the process, depending on how the person interviewed gave a specific response to an initial question (Babbie, 2004; Cohen, Manion & Morrison, 2007; Siu, 2009; Wolcott, 2001; Yin, 1994). At this stage, the interview is supplementary to the questionnaire. This step is so important because the author can gather more in-depth information for further survey.

Because Chinese is more direct and effective for collecting data, the questionnaires and interview questions were designed in Chinese. Meanwhile the English versions are translated copies attached in appendices.

Stage IV

The aim of data analysis is to deepen the understanding of various transcripts and materials collected and to enable the researcher to elicit meaning from the data.

> Data analysis is the process of systematically searching and arranging the interview transcriptions, fields notes, and other materials that you accumulate to increase your own understanding of them and to enable you to present what you have discovered to others (Bogdan & Biklen, 1992).

In the analysis of the questionnaires, the responses to each item were subjected to an item analysis. Descriptive and statistical data analyses were utilized to describe synthesize and interpret the data that had been collected. The researcher found the percentage of responses for each item.

In the analysis of the open-ended interview questions, an ad hoc approach was utilized. Ad hoc data analysis can include words, figures, and numbers. Using this approach, the researcher firstly transcript the interviews to get an overall impression (Kvale, 1996). The researcher then categorized and interpreted the responses.

The work flow is not a one-way process. It is made up of a series of recirculation corrections, e.g., revisions of the questionnaires and the interview questions. In the final analysis process, more questions have been checked again and asked. So the researcher jumped back in the field study again for a very specific purpose. All these can guarantee to generate the necessary, effective and trustworthy data. Checking data obtained by a variety of methods is one way of contributing to trustworthiness.

Stage V

Stage V is the final stage of the study. Based on the findings from Stage IV, the final part of this thesis responded to the research question of the study: how to strengthen the new technology curriculum in the general education system. Through the analysis of the collected data, this study identified common practice and successful experience on the

Chinese mainland for in-depth discussion and proposed recommendations for the further development of technology education.

Chapter 4: Analysis and Findings

4.1 Introduction

The technology curriculum was introduced as standalone subjects in the senior secondary schools of the Chinese mainland in 2004 (Gu, 2004). By 2009, 24 provinces, cities and autonomous regions had joined the pilot scheme. Up until, almost all the provinces, cities and autonomous regions have offered this new curriculum for senior secondary school students (Appendix C). A large-scale survey was conducted to assess progress thus far, to identify successful practices and existing problems, and to formulate recommendations for wider implementation. The survey was conducted over three months, and data were collected through questionnaires, field trips and seminars.

Taking into consideration variations in geography, locations and schools, the survey identified a sample of 11 provinces and 25 cities, including Jilin, Heilongjiang, Zhejiang, Anhui, Jiangsu, Shandong, Henan, Hainan, Ningxia and Shanxi. Five versions of the questionnaires were designed to obtain feedback from key stakeholders, including education administrators, coordinators, school principals, technology teachers and senior secondary school students. The questions are predominately closed-ended, supplemented by open-ended questions. A total of 25 valid questionnaires were collected from education administrators, 75 from coordinators, 141 from school principals, 596 from teachers and a total of 3,532 valid and 183 invalid questionnaires were collected from senior secondary school students. The data were processed by SPSS.

Field studies were also conducted in Beijing, Jilin, Zhejiang, Anhui, Jiangsu, Hainan and Ningxia. Each province was represented by two locations that differed in terms of their implementation of the technology curriculum. Each location was represented by two or three schools categorized in different tiers. Seminars were organized in each location to engage the key stakeholders: education administrators, coordinators, school principals, teachers and senior secondary school students. The interview questions were used to guide the discussion. Both the questionnaires and the interviews were completed during the seminar, which was audio-recorded as primary data.

4.2 Background Analysis of Sample

4.2.1 Background Analysis of Participating Technology Teachers

The survey captured information on the teachers' gender, age, location of school, college degrees obtained, type of school, college major, years of teaching experience, years of teaching technology subjects experience, and associated academic research bodies.

In terms of gender distribution, there were 453 male (76%) and 143 female (24%) teachers. In terms of age, 77.7% were under 40, and only 4.5% were over 50. Those with less than 10 years of teaching experience made up 61.1% of the sample, and 86.2% of the sample had less than three years of experience in teaching technical subjects. This figure illustrates how young the teaching staff is; not just those teaching technical subjects, but teachers in general. In terms of the teachers' academic associated research fields, 30.2% belonged to technical disciplines, 28.7% to general technical disciplines and 40.1% to other disciplines.

Table 4.1 Background Analysis of Participating Technology Teachers

Demographic Criteria	Option	n	%
Gender	Male	453	76.0
	Female	143	24.0
Age	21-30	238	39.9
	31-40	225	37.8
	41-50	106	17.8
	51-60	27	4.5
Location of School	City	149	25.0
	District	351	58.9
	Town	96	16.1
Type of School	Provincial Key	218	36.6
	City Key	126	21.1
	District Key	142	23.8
	General	109	18.3
Highest Qualification Obtained	Master	7	1.2
	B.Sc./B.A.	570	95.6
	Junior College	18	3.0
	Other	1	0.2
College Major	Educational Technology	181	30.4
	Physics	222	37.2
	Chemistry, Biology or Geography	88	14.8
	Engineering	45	7.6
	other	60	10.1
Years of Teaching Experience	Less Than 5 Years	168	28.2
	5-10 Years	196	32.9
	11-16 Years	110	18.5
	16-20 Years	45	7.6
	More Than 20 Years	77	12.9
Years of Teaching Technical Subjects Experience	1 Year	204	34.2
	2 Years	206	34.6
	3 Years	104	17.4
	4 Years	50	8.4
	5 Years	29	4.9
Associated Academic Research Body	Technology	180	30.2
	General Technology	171	28.7
	Information Technology	76	12.8
	Comprehensive Practical Activities	27	4.5
	Other	136	22.8

4.2.2 Background Analysis of Participating Senior Secondary School Students

The questionnaire captured information on students' gender and grades.

In terms of gender, 53.7% were male and 46.3% were female. In terms of grades, 52.6% were in senior grade 1, 42.4% in grade 2, and 5% in grade 3. This shows a reasonably balanced gender and grade distribution.

Table 4.2 Background Analysis of Participating Senior Secondary School Students

Demographic Criteria	Option	n	%
Gender	Male	1833	53.7
	Female	1635	46.3
Grade	Senior Grade 1	1843	52.6
	Senior Grade 2	1499	42.4
	Senior Grade 3	175	5.0

4.2.3 Background Analysis of Participating School Principals

The questionnaire captured information on the principals' age, college degrees obtained, college major, location of school, tier of school and nature of school.

The vast majority (78.7%) were aged from 41 to50. Those with Bachelor's degrees or higher made up 95.7% of the sample, indicating a relatively strong educational background. Most schools were at both the provincial (83%) and city (63.8%) levels. Almost all of the schools (95.7%) were public schools.

Table 4.3 Background Analysis of Participating School Principals

Demographic Criteria	**Option**	**n**	**%**
Age	21-30	3	2.1
	31-40	15	10.6
	41-50	111	78.7
	51-60	12	8.5
Highest Qualification Obtained	Master	27	19.1
	B.Sc./B.A.	108	76.6
	Junior College	6	4.3
	Other	0	0
College Major	Educational Technology	6	4.3
	Physics	33	23.4
	Chemistry, Biology, or Geography	24	17
	Other	78	55.3
Location of School	City	117	83
	District	15	10.6
	Town	9	6.4
Type of School	Provincial Key	90	63.8
	City Key	21	14.9
	District Key	0	0
	General	30	21.3
Primary Source of Funding for School	Public	135	95.7
	Private	6	4.3

4.2.4 Background Analysis of Participating Education Administrators

The questionnaire captured information on the education administrators' age, years of experience in education administration, educational background and degree of understanding of the technology curriculum.

In terms of age, 56% were in their 40s. Forty-four percent had worked in education administration departments for 10-15 years. A majority (72%) majored in science and engineering. It was apparent that their degree of understanding of the technology curriculum directly affected course implementation: only one respondent claimed to be very familiar with the subject, whereas 36% said they were either unfamiliar or completely ignorant.

Table 4.4 Background Analysis of Participating Education Administrators

Demographic Criteria	**Option**	**n**	**%**
Age	21-30	0	0
	31-40	7	28
	41-50	14	56
	51-60	4	16
Years of Experience in Education Administration	Less Than 5 Years	2	8
	5-10 Years	1	4
	11-15 Years	11	44
	15-20 Years	4	16
	More Than 20 Years	7	28
College Major	Arts	7	28
	Science	15	60
	Engineering	3	12
	Other	0	0
Degree of Understanding of the Technology Curriculum	Very Familiar	1	4
	Quite Familiar	15	60
	Unfamiliar	8	32
	Ignorant	1	4

4.2.5 Background Analysis of Participating Coordinators

The questionnaire captured information on the coordinators' gender, age, college degrees obtained, college major, and years of experience in academic research and training.

The findings show that the profession is dominated by men (82.8%). Those aged 41 to 50 made up the majority (43.8%) of the sample, a similar proportion to that of education administrators. The vast majority (95.3%) held Bachelor's degrees, with 40.6% majoring in physics. According to the findings from the field visit, the majority of technology education coordinators had a background in physics due to the close links between the two subjects. The training proved satisfactory, with all technology education coordinators having completed relevant programmes, seven at the state level and 57 at the provincial level. In terms of turnover, the group was very unstable, with 48.4% working across subjects and 7.8% working temporarily in technical subjects. Similarly, during the field visits, principals and teachers reported few academic research activities, not to mention the "leadership" generally expected of technology education coordinators. This also resulted in schools assigning non-specialists to teach technical subjects.

Table 4.5 Background Analysis of Participating Coordinators

Demographic Criteria	Option	n	%
Gender	Male	53	82.8
	Female	11	17.2
Age	21-30	1	1.6
	31-40	21	32.8
	41-50	28	43.8
	51-60	14	21.9
Highest Qualification Obtained	Master	1	1.6
	B.Sc./B.A.	61	95.3
	Junior College	2	3.1
	Other	0	0
Years of Experience in Academic Research and Training	1 Year	13	20.3
	2 Years	24	37.5
	3 Years	13	20.3
	More Than 4 Years	14	21.9
College Major	Educational Technology	15	23.4
	Engineering	5	7.8
	Physics	26	40.6
	Chemistry, Biology, or Geography	10	15.6
	Other	8	12.5
Training Level	State Level	7	10.9
	Provincial Level	57	89.1
	Municipal Level	45	70.3
	County Level	0	0
Post Classification	Full-time Coordinator	14	21.9
	Full-time Technology Education Coordinator	10	15.6
	Full-time General Technology Education Coordinator	4	6.3
	Part-time General Technology Education Coordinator	31	48.4
	Temporary General Technology Education Coordinator	5	7.8

4.3 Presentation of Findings

The analysis of the large-scale survey was carried out using a triangulation method, with closed-ended questionnaire responses as the basis, supported by open-ended questions and seminars.

Eight items of findings are presented. These eight items are summarized based on the five main issues of national investigation. The linkage is as follows:

- Curriculum offering situation, curriculum guarantee mechanisms, curriculum evaluation, and implementation effects of the technology curriculum are related to the situation of offering the new technology curriculum;
- Faculty Status is related to pre-service and in-service teacher training;
- Curriculum identification is related to the attitude towards technology education;
- Academic research activities is related to academic research activities;
- Curriculum resources is related to curriculum resources.

4.3.1 Curriculum Identification

The implementation effects of the technology curriculum are dependent on them being recognized by the main implementers of the new senior secondary school curriculum: educational administrators, school principals, technology teachers and senior secondary school students. Therefore, four sets of questionnaires for these four groups were formulated.

The data suggest that these technology subjects are widely recognized: 72% of the education administrators believe that they are necessary, 95.8% of the principals believe that they are urgently necessary or quite necessary, 41.3% of the teachers wish to teach these subjects and 95.5% of the senior secondary school students "strongly like", "quite like" or "like" them. Three of the school principals do not think these subjects are necessary.

It is clear from the interviews that the majority of the interviewees are convinced of the importance of the technology curriculum. They see them as playing an essential role in cultivating students' practical skills, social adaptability, and innovation. Almost all of the senior secondary school students are interested in the curriculum and believe that it will have a positive effect on their life.

Table 4.6 Curriculum Identification by Educational Administrators

Survey Subject	**Survey Item**	**Option**	**n**	**%**
Educational Administrators	Do you agree that the technology curriculum should be set up for students?	Strongly Agree	18	72
		Generally Agree	4	6
		Agree	3	12
		Disagree	0	0

Table 4.7 Curriculum Identification by School Principals

Survey Subject	**Survey Item**	**Option**	**n**	**%**
School Principals	Do you think that it is necessary to set up a technology curriculum for students?	Very Necessary	81	57.4
		Quite Necessary	54	38.4
		Indifferent	3	2.1
		Unnecessary	3	2.1

Table 4.8 Curriculum Identification by Technology Teachers

Survey Subject	Survey Item	Option	n	%
Technology Teachers	Do you want to be engaged in this field for the long term?	Yes	246	41.3
		No	52	8.7
		By School Arrangement	141	23.7
		Indifferent	26	4.4

Table 4.9 Curriculum Identification by Senior Secondary School Students

Survey Subject	Survey Item	Option	n	%
Students	What is your feeling about the technology curriculum?	Strongly Like	879	24.9
		Quite Like	1082	30.6
		Like	1412	40.0
		Dislike	151	4.3

4.3.2 Curriculum Offering Situation

As a bright spot in this nationwide curriculum reform, the success of technology depends on how well the curriculum complies with the curriculum requirements of the particular state.

In the questionnaire for teachers, the open-ended questions were asked to ascertain the reasons for schools not setting up the technology curriculum. Four reasons were given: 1) the curriculum is neither included for evaluation nor highly valued, thus some interested schools and teachers have stopped offering it as those schools that never started have avoided criticism; 2) many schools have no regular professional teachers for this curriculum; 3) failure to implement the curriculum at a practical level due to a lack of hardware facilities; and 4) teachers of this curriculum are overlooked and are not motivated as there are no regulatory provisions for their professional titles or rewards.

According to the questionnaires collected from the school principals, only 68.2% of schools offer all of the compulsory modules and 48.9% offer the electives. Some schools only offer compulsory module 1 or 2. The students' responses suggest that only 43.2% of the schools are in compliance with the education bureau requirement for 36 class hours for each module. The responses from technology teachers suggest that the percentage is 41.1%. The interview findings support the results of the questionnaires. Many schools may offer a technical class, but still fail to offer all of the classes. Some designate only 18 class hours for each class. When asked "Does your school comply with the curriculum scheme?", only 47.3% of the teachers agreed that their school strictly complied with the scheme, 4.3% admitted that these subjects are often replaced by other ones, and 6.8% considered the scheme to be poorly applied. It is clear from these data that insufficient class hours are provided for technical subjects, which is an inappropriate situation for mandatory courses.

Table 4.10 The Offering Situation of the Technology Curriculum

Survey Subject	Survey Item	Option	n	%
School Principals	Does your school offer compulsory modules?	Offering All	96	68.2
		Only Offering Module 1	33	23.4
		Only Offering Module 2	3	2.1
		Not Offering Yet	9	6.3
School Principals	Does your school offer elective modules?	Offering	69	48.9
		Not Offering Yet	57	40.4
		Will Offer Soon	15	10.6
Technology Teachers	What is the technology curriculum scheduling in your school?	Once a Week, Two Lessons Every Time;	54	9.2
		Twice a Week, Two Lessons Every Time;	19	3.2
		Twice a Week, One Lesson Every Time;	169	28.7
		Once a Week, One Lesson Every Time;	291	49.5
		Once Every Two Weeks, Two Lessons Every Time;	10	1.7
		Other	45	7.7
Students	What is the technology curriculum scheduling in your school?	Once a Week, Two Lessons Every Time;	269	7.6
		Twice a Week, Two Lessons Every Time;	127	3.6
		Twice a Week, One Lesson Every Time;	1130	32.0
		Once a Week, One Lesson Every Time;	1833	51.9
		Once Every Two Weeks, Two Lessons Every Time;	76	2.2
		Other	93	2.6
Technology Teachers	How is the technology curriculum progressing in your school?	Gradually Strengthening	347	59.1
		Gradually Weakening	54	9.2
		Continuously Good	116	19.8
		Continuously Poor	70	11.9
Technology Teachers	Does your school comply with the curriculum scheme?	Strictly Complies With	277	47.3
		Complies With	244	41.6
		Often Replaced	25	4.3
		Poorly Complies with	40	6.8

4.3.3 Faculty Status

In terms of teaching staff, 58.7% of technology teachers are full-time, 36.7% are part-time and 3.9% are temporary or external teachers. From the investigation, it is found that after several years of development, many schools in Haikou Hainan, Jiaxing Zhejiang, Liaoyan Jilin and Huannan Anhui have developed groups of professional teaching staff and set up academic research bodies. Some schools even enjoy a stable teaching staff consisting of both full-time and part-time technology teachers, which is favourable for the implementation of the technology curriculum. However, some schools do not have permanent teaching staff and only employ part-time teachers. The development of teaching staff is subject to various factors, such as curriculum evaluation, professional title, evaluation of teachers, attention from the school leadership, curriculum resources, and so forth. Among these factors, attention from the leadership is the most crucial. Many technology teachers stated that some directors do not fully recognize the importance of the technology curriculum, fail to implement the relevant requirements and interfere with the teaching of the subjects. The situation for technical subjects in such schools is insecure, as teaching the subjects is difficult and stressful and it is allocated insufficient class hours. These technology teachers suggested that the value of the technology curriculum and the teachers' interest in it will come to nothing if the curriculum is not supported by the school's leadership. All of the schools that enjoy good results in terms of the curriculum the teachers have set up invariably have a leadership that fully recognizes the importance of the course.

The general situation in terms of teacher training was found to be satisfactory. All teachers of technical subjects have attended various training programme at different levels; 3.9% of them have participated in training at the state level and 52.9% at the provincial level. However, from the open-ended questionnaire it is found that most technology teachers have attended only one short session. The training generally lasted only one or two days, yet such short sessions can have little effect in helping teachers to fully understand and implement the technology curriculum. When asked about the most effective features of the technology teacher training, 70.1% of technology teachers said that the curriculum concept was the most important and 35.9% chose practical skills. However, when asked what was lacking, 50% of the teachers chose practical skills, 50.7% curriculum resources, and 38.6% technical knowledge. Our interview data also suggest that technology teachers have three defects in their knowledge composition: 1) lack of sufficient basic knowledge about techniques and design; 2) few practical skills such as drafting, drawing, carrying out technical experiments, or producing technical articles; and 3) inability to understand and grasp the standards of the technical courses correctly, plan teaching procedures and select teaching resources. In light of this finding, the content and methods of the curriculum training need to be adjusted and improved.

Regarding curriculum teaching, some teachers are familiar with the professional skills of CNC machines, CAD applications and metalworking tools. This is a reflection of the importance of technical skills training in some provinces and cities. However, 53% of the technology teachers do not use tools and apparatus and 53.2% do not arrange practical work in their classes, thus a short period of training will not solve the problem of teachers' poor practical skills. The students' responses also reflect that only 45.3% of them have experience of the entire technical design procedure, a sign that there is still a long way to go in creating a teaching characteristic for the technology curriculum.

Table 4.11 Demographic Criteria of Technology Teachers

Survey Item	Option	n	%
Post Type of Technology Teacher	Full-time	350	58.7
	Part-time	219	36.7
	Temporary	22	3.7
	External	1	0.2
College Major	Educational Technology	181	30.4
	Physics	222	37.2
	Chemistry, Biology, or Geography	88	14.8
	Engineering	45	7.6
	Other	60	10.1
Highest Qualification Obtained	Master	7	1.2
	B.Sc./B.A.	570	95.6
	Junior College	18	3.0
	Other	1	0.2

Table 4.12 In-service Training Situation for Technology Teachers

Survey Item	Option	n	%
What level of teacher training have you obtained?	State Level	23	3.9
	Provincial Level	315	52.9
	Municipal Level	306	51.3
	County Level	124	20.8
What are the most effective features of the technology teacher training for you?	Curriculum Concept	418	70.1
	Technical Knowledge	258	43.3
	Practical Skills	214	35.9
	Pedagogy	267	44.8

Table 4.13 Knowledge Structure Situation of Technology Teachers

Survey Item	Option	n	%
Which areas would you like to improve in your teaching of the technology curriculum?	Technical Knowledge	230	38.6
	Practical Skills	298	50.0
	Pedagogy	83	13.9
	Understanding of Teaching Materials	143	24.0
	Curriculum Resources	302	50.7

Table 4.14 Teaching Situation of Technology Teachers

Survey Subject	Survey Item	Option	n	%
Technology Teachers	What kinds of tools and machines can you teach students to use?	Metalworking Tools	261	43.8
		Electronic Tools	218	36.6
		Woodworking Tools	204	34.2
		CAD Software	305	51.2
		CNC Machines	408	68.5
		None	316	53
Technology Teachers	How often do you offer technical practice?	Often	67	11.2
		Sometimes	205	34.4
		A Little	255	42.8
		None	62	10.4
Students	How much of the entire design process do you actually do in technical class?	Entire Design Process	1600	45.3
		Just Making, No Drawing	210	5.9
		Just Drafting, No Making	561	15.9
		Experiencing Design, Drafting, Making, No Testing	392	11.1
		Experiencing Design, Drafting, Making, Testing, No Optimization and Evaluation	385	10.9
		No Practical Operation	345	9.8
		Other	37	1.0
Students	How do technology teachers teach technical methods?	Just By Imitating	235	6.7
		By Teaching Thinking Methods	1633	46.5
		By Teaching Alternative Creation Methods	1435	40.8
		Other	211	6.0

4.3.4 Curriculum Resources

The implementation of any curriculum reform must be supported by relevant resources (Jones, Mather & Carr, 1995). The curriculum resources for technical subjects are the basis for implementing the course, and without this assistance no teaching plans can be fulfilled.

The resources for technical subjects include hardware such as workshops, tools, machines, apparatus, teaching aids and model charts, and software such as a school network, teaching and reference books and an academic network. The investigation shows that there is a great shortage of workshops, which represent the most basic hardware resources for the technology curriculum. According to the school principals, only 42.6% of schools have workshops. According to the education administrators and technology teachers, the main reason for not building workshops is a lack of funds (56% and 76.7% respectively). This is supported by the interviews. Many school principals state that it will be hugely difficult for the schools to raise these funds if they do not receive the necessary capital investment and support from the government. Currently, some provinces and cities, such as Zhejiang, Beijing and Liaoyuan Jilin, are arranging unified plans at the provincial or municipal levels to allocate special funds to schools, which will greatly facilitate the implementation of the curriculum.

Table 4.15 Current Situation of Curriculum Resources

Survey Subject	Survey Item	Option	n	%
Education Administrators	What is the biggest problem in the construction of workshops?	Lack of Corresponding Policy	2	8
		Lack of Sufficient Funds	14	56
		Lack of High-quality Resources from Enterprises	3	12
		Lack of Integration between Curriculum Teaching and Workshop Construction	5	20
		Other	1	4
School Principals	Are there any workshops for teaching the technology curriculum in your school?	Yes	60	42.6
		No	60	42.6
		Under Construction	21	14.9
Technology Education Coordinator	What are the kinds of curriculum resources provided by your local government?	Establishing the Platform for Academic Networking	36	56.3
		Constructing a Technical Practice Centre	7	10.9
		Providing Teaching Reference Books	25	39.1
		Others	18	28.1
Technology Education Coordinator	What is the funding source for workshop construction?	The Higher Authority Subsidy	17	26.6
		Local Educational Financial Arrangement	13	20.3
		School Fundraising	26	40.6
		Funds Raised in Various Ways	15	23.4
Technology Teachers	If there are workshops in your school, what is the total value of the tools, instruments, machines etc.?	Below RMB 50,000	195	43.8
		RMB 50,000-100,000	100	22.5
		RMB 100,000-200,000	95	21.3
		RMB 200,000-300,000	28	6.3
		Over RMB 300,000	27	6.1
Technology Teachers	What factors influence the construction of workshops?	The Idea	325	54.5
		The Funds	457	76.7
		The Sites	186	31.2
		The Personnel	157	26.3
		Other	24	4
Technology Teachers	What kinds of curriculum resources do you urgently need in your teaching?	Teaching Materials for the Technology Curriculum	297	49.8
		Teaching Reference and Assessment Handbooks	281	47.1
		Teaching Aids and Learning Kits	489	82.0
		Audio and Video Materials	361	60.6

4.3.5 Curriculum Evaluation

Evaluation is a bottleneck for the current reform of technical subjects. The research indicates that the implementation of technical subjects is greatly influenced by their evaluation. Therefore, a survey of the four groups asked about curriculum evaluation.

The findings show that all of the survey respondents believe that it is necessary to have appropriate evaluation of technical subjects, suggesting methods such as including them in the College Entrance Examination (CEE), holding academic tests and making them an entrance criterion for science universities. Among these methods, academic tests were suggested most frequently. This is further supported by the fact that the technology curriculum has been set up most successfully in those provinces where they are included in academic tests or associated with CEE. For instance, in the field trips to Jiaxing Zhejiang, it was found that the provincial unified examination has so far resulted in a 100% curriculum implementation rate and 36 class hours for each module. Those schools with a large proportion of students who can only apply for third-tier schools schedule three class hours a week for some modules, a total of 54 class hours overall. In Hainan, for example, the integration of the technology curriculum and CEE has ensured a 100% curriculum implementation rate. From the interviews, it is clear that the evaluation of the technology curriculum is an issue of concern for every participant, although their attitudes toward curriculum evaluation were quite complex. On the one hand, they believed that the technology curriculum should be included in the unified evaluation; yet on the other hand, they were worried that the technology curriculum may depart from its original purpose should it become part of CEE or academic proficiency tests (APT). Generally, the interviewees were cautious about the evaluation of the technology curriculum.

Table 4.16 Current Situation of Curriculum Evaluation

Survey Subject	**Survey Item**	**Option**	**n**	**%**
Education Administrators	Do you think that technical subjects should be classified into CEE in some provinces?	Very Necessary	9	36
		Quite Necessary	11	44
		Unnecessary	5	20
		Indifferent	0	0
School Principals	Do you think that technical subjects should be classified into CEE in some provinces?	Very Necessary	63	44.7
		Quite Necessary	21	14.9
		Unnecessary	54	38.3
		Indifferent	3	2.1
Technology Education Coordinators	Do you think that technical subjects should be classified into CEE in some provinces?	Very Necessary	23	35.9
		Quite Necessary	27	42.2
		Unnecessary	7	10.9
		Indifferent	6	9.4
Technology Teachers	Do you think that technical subjects should be classified into CEE in some provinces?	Very Necessary	195	41.5
		Quite Necessary	196	41.7
		Unnecessary	64	13.6
		Indifferent	15	3.2
Education Administrators	Do you think that technical subjects should be classified into APT in some provinces?	Very Necessary	13	52
		Quite Necessary	11	44
		Unnecessary	1	4
		Indifferent	0	0
Technology Education Coordinators	Do you think that technical subjects should be classified into APT in some provinces?	Very Necessary	30	46.9
		Quite Necessary	27	42.2
		Unnecessary	2	3.1
		Indifferent	2	3.1
Technology Teachers	Do you think that technical subjects should be classified into APT in some provinces?	Very Necessary	168	36.3
		Quite Necessary	218	47.1
		Unnecessary	47	10.2
		Indifferent	30	6.5
Education Administrators	Do you think that technical subjects should be used as an entrance reference criterion for science universities?	Very Necessary	12	48
		Quite Necessary	9	36
		Unnecessary	4	16
		Indifferent	0	0
Technology Education Coordinators	Do you think that technical subjects should be used as an entrance reference criterion for science universities?	Very Necessary	32	50
		Quite Necessary	20	31.3
		Unnecessary	7	10.9
		Indifferent	4	6.3
Technology Teachers	Do you think that technical subjects should be used as an entrance reference criterion for science universities?	Very Necessary	184	39.3
		Quite Necessary	201	42.9
		Unnecessary	53	11.3
		Indifferent	30	6.4

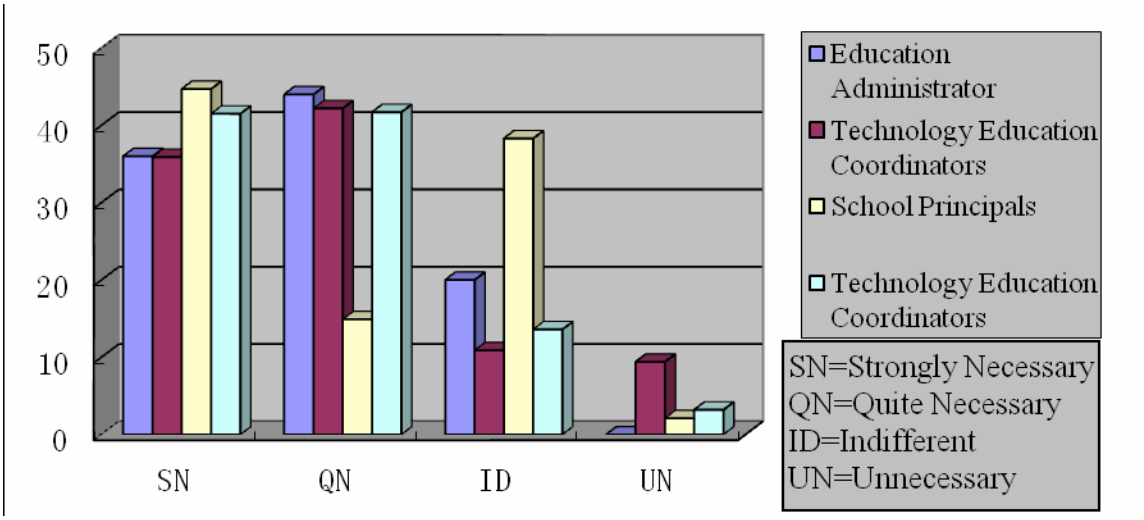


Figure 4.1 Whether Technical Subjects Should be Classified into

CEE

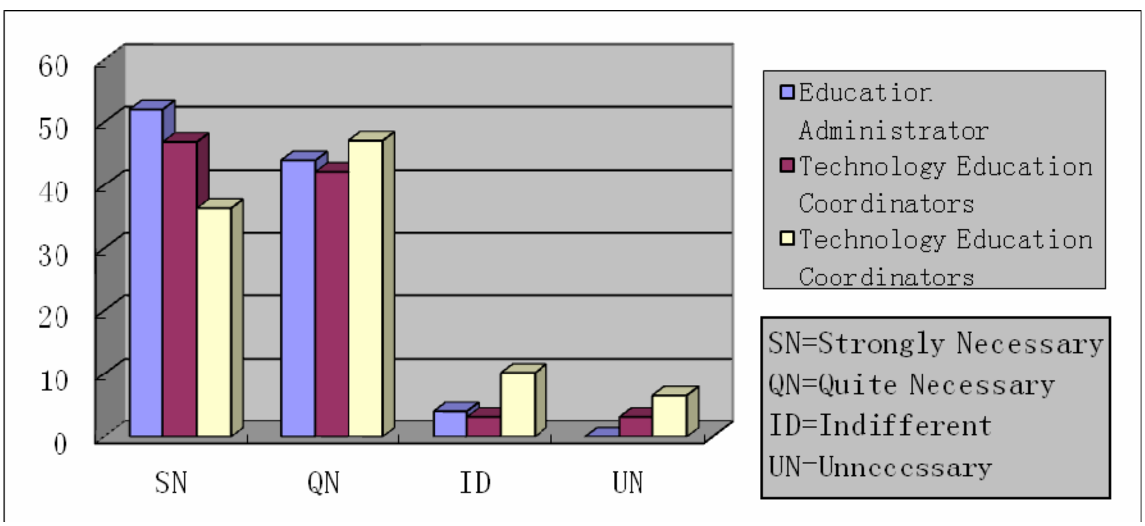


Figure 4.2 Whether Technical Subjects Should be Classified into

APT

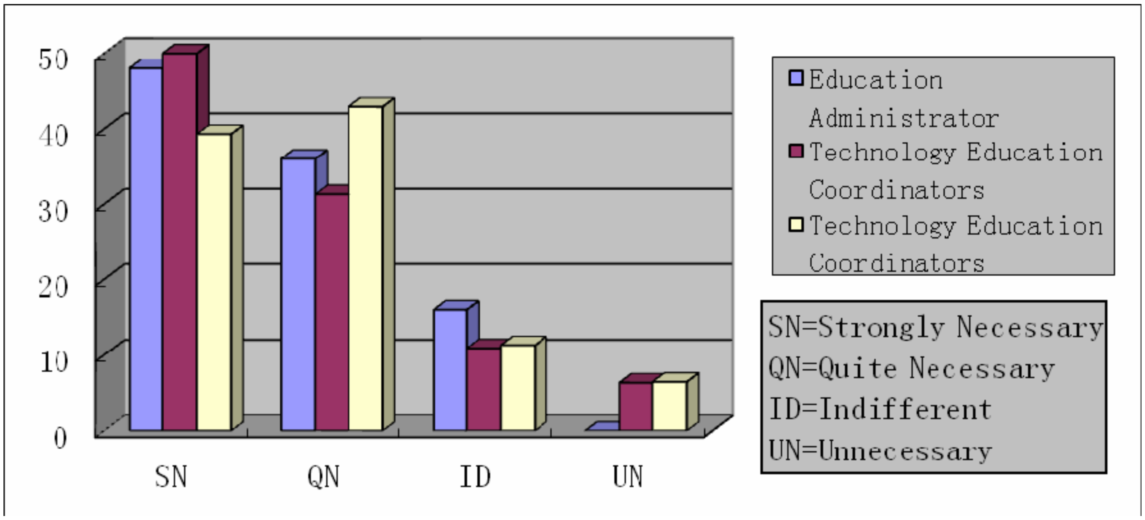


Figure 4.3 Whether Technical Subjects Should be used as an Entrance Reference Criterion for Science Universities

4.3.6 Academic Research Activities

Academic research activities refer to various research areas, lectures held by specialists, teaching, paper evaluation, open classes and so forth.

The participation of academic professionals in the implementation of the technology curriculum provides technical support and theory instruction for the curriculum. In some sense, they were the pilot for its implementation. The research findings suggest that the general situation is satisfactory. Many technology education coordinators take an active part in teaching and devise many effective methods for teaching and research. In Changsha Hunan and Dalian Liaoning, municipal visits and discussion activities are held every semester and a QQ group has been created to facilitate communication among technology teachers. Zhejiang and Hainan have set up abundant network resources and hold regular design and skills training. Teachers in Zhejiang are motivated to engage in research through the curriculum teaching, and the academic research body in Nanjing holds monthly teaching and research activities.

Table 4.17 Current Situation of Academic Research Activities

Survey Subject	**Survey Item**	**Option**	**n**	**%**
Technology Education Coordinators	How often is pre-service training arranged for technology teachers?	Once Every Year	33	51.6
		Only at the Beginning	13	20.3
		No Training	10	15.6
		Other	5	7.8
Technology Education Coordinators	How often is in-service training arranged for technology teachers?	Once Every Semester	39	60.9
		Only at the Beginning	11	17.2
		No Training	7	10.9
		Other	6	9.4
Technology Education Coordinators	What kind of academic research activities were they?	Collaborative lesson preparation	35	54.7
		Class Teaching Demonstration	50	78.1
		Technical Skills and Curriculum Training	43	67.2
		Expertise Training	20	31.3
		Other	2	3.1
		No Activity	3	4.7
Technology Education Coordinators	How often are the teaching skills of technology teachers evaluated?	Once Every Year	24	37.5
		Once Every Two Years	18	28.1
		No Evaluation	10	15.6
		Other	1	1.6

The research also shows that many technology education coordinators fail to provide professional leadership for the following reasons: they believe that research for the technology curriculum is not highly valued; they are burdened with other daily work; their major is not technology education; and they do not fully recognize the curriculum. One factor affecting technology education coordinators' participation in the implementation of the curriculum is that 56.2% of them are part-time or temporary coordinators.

4.3.7 Curriculum Guarantee Mechanisms

The findings indicate that only 42.1% of the regions have dedicated positions for technology teachers. Most areas have no dedicated positions or titles for technology teachers. This is a major concern expressed by technology teachers during our field trips and is the main reason for them choosing to teach other subjects.

The research reveals that technology teachers are also concerned about professional development. The teachers currently teaching technical subjects have transferred from other subjects, and thus are far from qualified in terms of their professional knowledge or teaching skills. Moreover, pre-semester training for technical subjects has not yet been set up, and it is impossible for technology teachers to solve their deficiencies in teaching through self-study and short-term training. This leads to instability in the teaching of technical subjects as each technology teachers deliver the contents of the technology curriculum based on their experience of teaching other subjects. Furthermore, delays in developing pre-semester training courses not only result in technology teachers' uncertainty about their career development, but also the notion that the technology curriculum is dispensable.

Table 4.18 Current Situation of Curriculum Guarantee Mechanisms

Survey Subject	Survey Item	Option	n	%
Education Administrators	Are there any regulations issued for the technology curriculum?	Yes	10	40.0
		No	12	48.0
		Not Sure	3	12.0
Education Administrators	Is there any implementation scheme issued for the technology curriculum?	Yes	12	48.0
		No	10	40.0
		Not Sure	3	12.0
Technology Education Coordinators	Is there a teachers' professional title for technology teachers?	Yes	27	42.2
		No	14	21.9
		Just for IT Teachers, not for GT Teachers	22	34.4
		Other	1	1.6

4.3.8 Implementation Effects of the Technology Curriculum

In light of the effects of curriculum implementation, a survey was conducted to ask about students' attitudes toward technical subjects, the gains from technical subjects and the effect of the technology curriculum on the other learning subjects.

According to the findings, senior secondary school students are most interested in the technical production, technical experimentation, technical conception and technical drawing classes. Students believe that the greatest benefits from learning technical subjects lie in the improvement of their practical skills, the acquisition of common thinking methods, cultivation of their critical ability, experimentation and exploration, and a better understanding of technology. The teachers identified similar points. More than half (58.3%) of the senior secondary school students believe that learning technical subjects facilitates other learning of academic subjects and only 5.4% think it obstructs other learning of academic subjects.

Table 4.19 Implementation Effects of the Technology Curriculum

Survey Subject	Survey Item	Option	n	%
Students	Which type of technical lesson is your favourite?	Technical Thinking	1390	39.4
		Technical Project	2107	59.7
		Technical Drawing	1113	31.5
		Technical Test	1428	40.4
		Technical Theory	649	18.4
		Technical Investigation	382	10.8
		Exhibition and Communication	937	26.5
		Other	68	1.9
Students	What are the biggest gains from studying technical subjects?	Improving Self-operating Skills	1989	56.3
		Mastering Some Common Thinking Methods	1956	55.4
		Forming Awareness of Trade-off, Experiment and Exploration	1502	42.5
		A Comprehensive Understanding of technology	1455	41.2
		Improving Self-confidence in Solving Technical Problems	540	15.3
		Other	65	1.8
Students	How would you describe the effect of the technology curriculum on other academic subjects?	Benefits Other Academic Subjects	2060	58.3
		Obstructs Other Academic Subjects	190	5.4
		Improves Learning for Some Students	971	27.5
		No Effect	251	7.1
		Other	39	1.1
Technology Teachers	What advantages does the technology curriculum give to students?	Improving Hands-on Ability	220	36.9
		Developing Skills in Technical Design Thinking and Methods	338	56.7
		Improving Creative and Practical Ability	240	40.3
		Improving Awareness of and Ability to Solve Problems	284	47.7
		Learning Rational View of Technology	168	28.2
		Other	16	2.7

The interviews with senior secondary school students suggest that they have a lot of interest in these technology subjects. The following quotes are selected from the interview recordings.

Student A: I have developed a new understanding of technology through learning this technology curriculum. Nurturing our practical ability is not just a simple operation; it also cultivates and liberates our thinking. We can apply knowledge learned from other subjects in a practical way, making it easier for us to consolidate and digest the knowledge.

Student B: This curriculum provides an opportunity for parents to participate. For example, my father helped me to find materials to make a stool. I made it with help from my father. I am so happy about this.

Student C: I was unfamiliar with technology before taking this curriculum. I would not have dared to fix simple devices at home. However, I gained confidence in doing this after taking this curriculum.

Student D: The technology curriculum is a lot of fun as many of my ideas and designs can be put into practice. We only learn theory in our other subjects, which is not much use in our daily life. However, in these technical subjects we learn a lot of practical skills that can be applied to daily life.

Student E: Many students adopt strategic thinking to solve problems, particularly science students. We can only figure out the most usual way to solve problems. Nevertheless, if we can think from a different perspective and solve problems with an open and creative mind, the results can often be surprising. Technical subjects have helped us to develop this ability.

Senior secondary technology education has undergone approximately ten years of development since the new technology curriculum was implemented on the Chinese mainland. Technology education has developed at a high speed during those ten years and the new technology curriculum is currently being experimented with in almost all provinces, with some encouraging feedback. Students are also reported to enjoy learning technology compared to other subjects. While these developments imply some success with the curriculum, many problems and challenges remain. For example, although technology is still a new curriculum on the Chinese mainland, there is still no formal education system at tertiary level to nurture technology teachers. Furthermore, even though technology is part of the government-driven curriculum, subjects have not been included in the college entrance examination in some provinces. Some schools offer these subjects only for short periods solely for government inspection. Under official pressure, some schools dispatch teachers from other disciplines to participate in face-to-face training. However, after finishing their training, these teachers have no opportunity to teach technology subjects. This situation ultimately results in a waste of training resources.

Chapter 5: Discussion and Recommendations

5.1 Summary of the Study

5.1.1 Common Practice and Effective Experience Sharing

Research has shown that several years after the launch of the new technology curriculum, schools all over the Chinese mainland have developed creative and practical ways to implement the curriculum. Almost all the provinces participated in the pilot scheme. Although they vary in terms of resources, delivery models and so on, they have several aspects in common, including the auxiliary system, faculty building, development of curriculum materials, execution, evaluation, etc. These common practices and effective experiences are summarized as follows.

Giving High Attention to and Overall Planning of an Auxiliary System

The implementation of the new technology curriculum does not rely on school leadership alone, but also involves setting up certain auxiliary systems and organizational support mechanisms (Evers & Lakomski, 1996). According to the research findings, it also requires support from more stakeholders, together with detailed guidelines. There are various forms of policy support, including curriculum planning, guidelines, equipment standardization, assessment systems, an advisory committee, etc. In Beijing, responsibility for the reform of technical subjects lies not only with the education sector, but also with the government, especially in terms of mobilizing resources from various stakeholders. At the start of the launch, guidelines were created for the following four aspects of implementation:

- Course objectives;
- Training for teachers;
- Equipment standardization; and
- Assessment and quality control.

In addition to these guidelines, there are also clear instructions for one or more elective modules to be offered during the three years of senior secondary school study, and the number of modules to be offered should increase each year. Nanjing issued similar guidelines when the new technology curriculum was introduced in 2005, focusing on problem, solution and action. Five guidelines were issued for 14 districts all over the city, resulting in a 100% curriculum implementation rate to date. Apart from the "classification for assessment and selection" model for vocational training institutions, Zhejiang province also proposed 19 detailed procedures at the launch of the curriculum. It specified the establishment of teaching staff and their career path. At present, both compulsory modules and electives are implemented and managed in the same way as regular subjects at the school level. A few other provinces, namely Hainan, Shandong, Guangdong and Liaoning, have effectively rolled out the curriculum reform by implementing a monitoring system. Shandong province, for example, penalizes schools that fail to offer the curriculum, or that alter the session duration without permission.

Guangzhou, on the other hand, conducts a sample test among students in the 14th week of each second semester to gauge the curriculum effectiveness, and subsequently publishes a report.

Nurturing Stable and Professional Technology Teachers

The research reveals that technical subjects face two main obstacles: one is the shortage and high turnover of teaching staff; and the other is technology teachers' unprofessional background. However, a few provinces and cities have taken the initiative in tackling these issues and have managed to nurture a team of stable and professional teaching staff.

In Hainan and Tianjin, education administrators have integrated human resources and salary reform to address technology teachers' concerns over job descriptions, professional development opportunities, remuneration schemes, etc. In other cities, including Huzhou, Hangzhou, Wenzhou, Taizhou, and Jiaxing in Zhejiang, all schools have recruited either full-time or part-time teachers thanks to a combination of the aforementioned measures. Nanjing has built up a team of teaching staff, mostly full-time, under the supervision of the Education Bureau Chief and School Principals Committee. In Beijing, one full-time teacher is required for five or six classes to teach compulsory modules, and electives can be taught by either full-time or part-time staff. Furthermore, education administrators and HR departments have created dedicated positions for teachers of technical subjects.

The training for technology teachers has adopted diverse models and multilayered approaches by combining theory and practice, combining pre-semester intensive training and long-term development, and combining classroom sessions and online sessions (Feng & Siu, 2009). In Tianjin for example, the resources from tertiary educational institutions are fully utilized, whereas in Fujian, it takes two years of special classes for a Bachelor's degree student to become a technology teacher at a Normal University. Hainan offers a wide range of training sessions to improve teachers' skills, such as course delivery, class materials design, online teaching, etc. Shandong also offers a follow-up online training programme. Nanjing organizes training camps at universities, two at the provincial level and three at the city level. Teachers have also participated in a research project on teachers' assessment. Beijing drew on resources from the Normal Universities to create teaching materials and Shenzhen organized trial teaching sessions as part of the training. Zhejiang provided long-term training and a two-week visit to Nanjing to broaden teachers' experience. Dalian and Qingdao created online platforms and a "masterclass" to monitor the quality of lessons.

Maximizing Curriculum Resources Both Online and Offline

A lack of curriculum resources is a common bottleneck that slows down the popularization of technical subjects (Medway, 1992; Wicklein, 1993). The following are some of the innovative solutions that schools have developed.

Tianjin has broken new grounds in creating the workshop space for technical subjects through centralized planning, regional sharing, university support and joint establishment. Beijing's local government combined schools with vocational training colleges, technical college training camps and other associated institutions; together, they integrated existing facilities and built new ones. Hainan classified high schools into three tiers, with each tier building facilities to their own requirements. The Changchun local government invested 30 million RMB to equip schools with new workshops, tools, facilities, etc., to be shared among all technical subjects. In Changzhou, the Education Bureau and Labour Bureau set up a special joint taskforce that allows schools to access the resources for technical subjects by partnering with vocational training colleges. In Nanjing, a special committee conducts an annual inspection of school facilities and the best-performing schools receive funding and awards. A seminar is also held every six months to brainstorm and facilitate the development of workshops. Henan province invested 6.1 million RMB in 2009 to help "model schools" to set up new labs. Zhejiang province issued a memo in 2008, listing the construction of workshops as one of the top 10 priorities. The project was injected with 10 million RMB, which benefited all schools including those located in rural areas. In Rui'an city, for example, 15 out of 17 high schools have already built workshops, and in Jiaxing city every school has at least one workshop looked after by a part-time teacher.

Figure 5.1 Workshops for Teaching Compulsory Modules

Figure 5.2 Workshops for Teaching Elective Modules

In terms of online resources, Hainan was the first to create a dedicated website for technical subjects. The website allows technology teachers to share original ideas and resources and collect the feedback. Two of its most influential columns are “Monthly Topical Issues” and “Teacher of the Year Awards”. In Jiangsu, Zhejiang, Shanxi, and Guangzhou, technology teachers are encouraged to write reference books and guidelines for designing class materials. In Zhejiang, a wiki page was set up so that notable university professors and leading academics could answer questions and share their experiences on a regular basis. This proved to be a big hit among local technology teachers. Similar trends have been observed in Shandong, Anhui and Zhejiang, where forums and instant messaging are deployed to maximize online resources.

In Jiaxing, for example, technology teachers register on the website using their real names and the Education Institute assigns website administrators. There are seven or eight administrators responsible for checking and uploading resources, and creating rich and up-to-date teaching contents.

Figure 5.3 Technology Teachers are Sharing Online Curriculum Resources

Designing and Issuing Local Facility Standard to Guarantee the Workshop Construction

Nanjing Bureau of Education issued the *Facility Standard of General Technology in Senior Secondary Schools in Nanjing (Experimental)* in May 2007. The standard consists of nine parts for all the modules. The design of the standard involved two stages: structure design and content design.

1. Structure Design

The standard is made up of four sections. The first section is to illustrate the specifications and standards in detail. The second section is the facility standard for two compulsory modules, and the third section is for the seven elective modules. The last section is the appendix, including government documents and guidelines. The structures of the second and third sections for the nine modules are the same. The structure of the standard is presented in Figure 5.4.

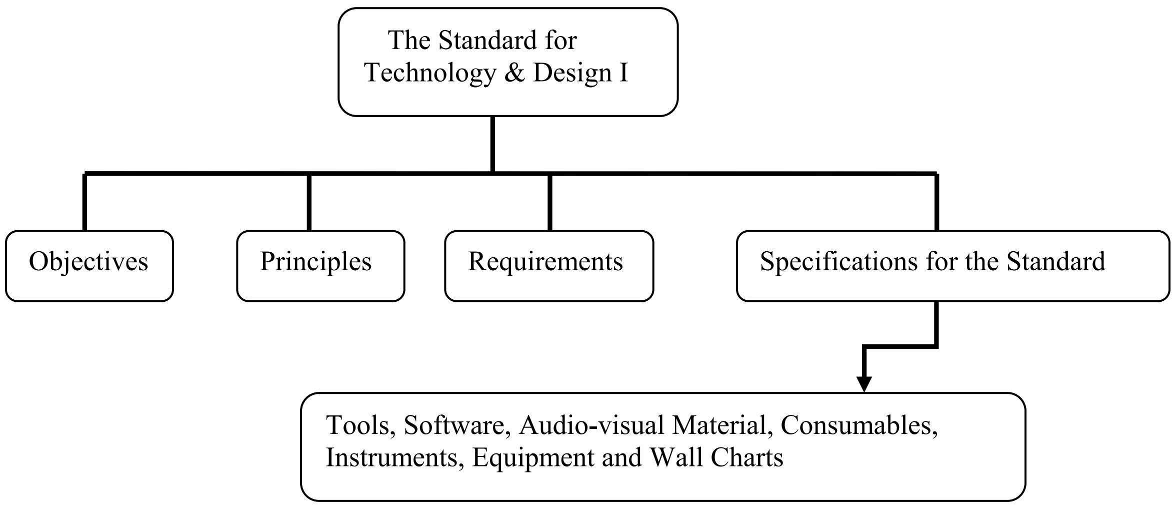


Figure 5.4 Structure Design for a Compulsory Module in the Standard

2. Content Design

Although the contents of the nine modules are different, the method of content design of the standard is the same. The content in the first section includes the equipment specifications, implementation requirements, and the quantity of the workshops as well as their space requirements. The second and third sections are the specifications of standard details for the nine modules. The content of the standard is divided into six columns: number, item, unit, quantity, specific and remark, which is shown in Table 5.1. In the quantity column, there are three levels: I, II and III, based on actual local needs.

The compilation of this standard started from 2006. In the first stage, some preparation work for the standard design was conducted, which was mainly investigations and surveys. In March and April 2007, some official staff from several educational departments in Nanjing gathered together to draw up the standard. At the end of May 2007, this standard was issued officially. Due to the consideration of the urgent requirement to offer the subject (including the construction of the workshops) in the secondary schools in Nanjing in September 2007, the compiling work had taken a short period of time. Up until now, the standard has not been considered the final one though its initial compiling work has been completed. This is because, following some reviews after the compiling work, there are many shortages and limitations to the standard. Thus, the modification of the standard is still an ongoing process.

Table 5.1 Content Design in the Standard as an Example

Serial Number	**Item**	**Unit**	**Quantity**			**Specific**	**Remark**
			I	II	III		
84	Hydraulic Control System Model	Set	1	1	1	To display the work flow of hydraulic control	Module II

Compared with other school subjects, general technology is a relatively new subject. For the design of the standard and the creation of equipment, much more time and repeated processes are needed. In Figure 5.5, the “Preparation” stage illustrated by dotted lines is the optional one. The “Preparation” is the fundamental work for the design of the facility standard. For this stage, some research work should be conducted, including the research of the curriculum, the status quota of the facility, present syllabus, standard, and teaching situation. Following the “Preparation”, the next step is the “Drawing Up” of the standard. The personnel participating in this stage should be from different positions (e.g., curriculum planners, school heads, teachers) in order to obtain different suggestions and opinions. Then, the standard can be issued (published) for trial run-the Pilot Study. The “Pilot Study” stage is essential and cannot be skipped since it is the only way to evaluate the standard and identify any problems. Moreover, the development of the related facilities needs to be conducted at the same time before the facilities are ordered by the schools for the construction of the workshops. After the Pilot Study, some modification work should be considered, and it is better to go through these four stages again, i.e., Preparation, Drawing Up the Standard, Publishing and Pilot Study. Nevertheless, whether this repeated process needs the Preparation stage depends on the actual need before the modification work.

In fact, the birth of the facility standard is the first step in the whole process. The manufacturing of the equipment, the order, installation and utilization of related facilities also need to be considered. In some developing regions in particular, due to their limited financial support, establishing industrial training centres in cooperation with selected industrial enterprises and universities is a good method that can kill two birds with one stone. On the one hand, students can taste the new technologies and learn some forefront information which can maintain the balance between theory and practice. On the other hand, many more schools can share the material resources at one or more common locations so that more students can obtain the opportunities to enrich their hands-on experience. According to the facility standard, these schools can be equipped with the fundamental facilities to meet the basic and daily teaching needs (Choi & de Vries, 2011). For the advanced contents, they can conduct the teaching in the industrial centres which provide shared facilities.

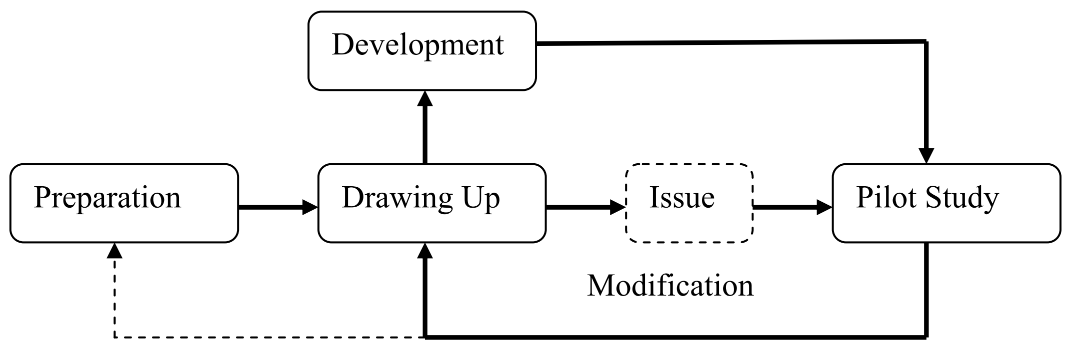


Figure 5.5 Design Process of Facility Standard

Leveraging the Leadership of Academic Research Bodies

Research shows that a well-developed academic research network, and a strong leader in particular, can significantly boost the curriculum implementation and considerably reduce the gap between the ideal and the reality (Lewis, 2000; McLaughlin, 1998; Medway, 1992).

There are mature research networks in Tianjin, Hainan and Zhejiang which facilitate academic research activities and regional cooperation at the city, district and school levels. Since June 2004, Hainan has held, at least once a year, a province-wide contest for class delivery, public exhibition, course material design, etc. As a result, technology teachers are highly motivated to improve their classes. At the city level, for instance in Nanjing, Qingdao, Changzhou, Dalian, Shenzhen and Tianjin, local technology education coordinators have set up dedicated task forces to organize regular activities and special seminars. Xiamen city has set up an academic research network across all three levels to facilitate cooperation. Once a week, a leading coordinator visits schools, especially in rural areas, to address problems and promote successful experiences. Beijing Western District has set up a sharing centre headed by the Affiliated Middle School of Beijing Normal University to assist less privileged schools, such as No. 8 Middle School, No. 4 and No. 44.

Academic research activities have flourished both online and offline. In Wuhu, technology teachers are getting together in groups to prepare class materials. In Jiangsu and Tianjin, academic research is headed by scientific research, which encourages technology teachers to conduct further research. The following schools have been identified as achieving the most significant and successful academic research: Guoxing Middle School and Huaqiao Middle School in Hainan, the Affiliated School of Beijing Normal University in Tianjin, No. 2 and No.9 Middle Schools in Qingdao, Shangdong, and Haimen Middle School in Jiangsu.

Figure 5.6 Offline Academic Research Activities

Implementing Technical Subjects in Creative Ways

The success of educational reform is determined by its implementation at the school level (Brady & Kennedy, 1999). Many schools have shown initiative, passion and courage in their implementation of technical subjects. Yinchuan Experimental School in Ningxia province, for example, was founded at almost the same time as the new technology curriculum was introduced. The leadership showed strong initiative, with the school principal conducting special research and proposing eight milestones to be achieved within four years. These milestones serve as long-term benchmarks, including the construction of workshop facilities, teacher training and so forth. New models of class delivery are now being introduced, the workshop is becoming the school's best facility, the technology curriculum is becoming the school's signature curriculum, and students are improving their attitude, habits and ways of thinking. The No. 2 Middle School in Huainan, Anhui province, has provided a lot of institutional support for technical subjects, including staffing, remuneration, workshop facilities, etc. The principal also personally attends the national conference and invites specialists from all over China and overseas to visit and offer constructional advice. A few school principals are teaching technical subjects themselves, including Cili No. 2 Middle School in Zhangjiajie, Hunan, No. 7 Middle School in Wuhu, and Anhui, Qingshuihe Middle School in Wuhu. They also actively participate in training and academic research activities. They have assigned part-time teachers as "substitutes" to ensure enough class hours devoted to the subject. Other schools, such as the No. 13 Middle School in Nanjing, have employed both workshop attendants and teachers to ensure the smooth delivery of practical workshop sessions. Kaiming Middle School has organized themed events, such as a "Technical Week/Month" to stimulate students' interest and creativity. Qingyuan Middle School in Guangdong and Yali Middle School in Hunan offer two or three elective modules in addition to the core technical courses.

Brainstorming to Develop a Comprehensive Curriculum Evaluation System

Following the principle of "scientific, orderly, proactive, and steady reform", individual provinces have found creative ways to assess the effectiveness of the technical curriculum. The effective practices are highlighted below:

1. 10% of Scores Count toward the College Entrance Examination (CEE) Score

In Hainan, students take the technology curriculum exam one year before the CEE, and 10% of their score on the exam counts toward their CEE score. The assessment method has been well received by technology teachers, senior secondary school students and the wider society, demonstrating that paper tests can be well utilized to assess technical competency.

2. Scores Count toward the CEE Score (simultaneous)

In Shandong, all students are required to take the technology curriculum exam and their scores count as part of their CEE score.

3. Vocational Training Colleges

In Zhejiang, technical subjects exams are held twice a year and students usually take the exam during the second semester of Senior Secondary Year 2. All students from vocational training colleges are required to take the exam (both IT and GT). The scores are valid for two years.

4. Academic Proficiency Tests (APT)

In Anhui, the APT comprises six subjects: Chinese language, Maths, English, humanities and social sciences, science foundation, and technology. In the technology curriculum, students are required to study IT and GT; IT counts for 40 points and GT 20 points. The APT is centrally coordinated and implemented at the provincial level.

The research shows that provincial-level tests are very conducive to the effective implementation of technical subjects. For example, in Zhejiang, technical subjects are offered in all schools, and in over 95% of schools in Haikou. This success is a direct result of provincial leadership and support.

Other provinces and cities are also experimenting with creative assessment mechanisms. Beijing adopts a two-stage plan: stage 1 involves tests designed at the district level (including both paper tests and operation tests) and stage 2 is at the city level. In Tianjin, both GT and IT scores count toward APT scores, which provide a reference benchmark for universities when selecting prospective students. In Guangdong and Ningxia, technical subjects are part of the final assessment for both technology teachers and students. Other efforts have been devoted to integrating the assessment of process and results, paper and operation tests, etc. All these trials and errors have helped to increase the popularity of technical subjects.

5.1.2 Major Problems and Obstacles

Despite the successful experiences outlined above, technical subjects still face significant challenges. First, at the national level it still takes a long time for education professionals to change their perceptions of the technology curriculum (Feng, Siu & Gu, 2011; Xie & Ma, 2008). Second, the gaps between urban and suburban, and between different regions and different schools, have resulted in imbalances in the rate of development (Feng, Siu & Gu, 2011; Liu, Gu & Yu, 2005). Therefore, the next step is to turn the technology curriculum into “core” curriculum to enhance its effectiveness. A survey of the common obstacles hindering the progress of technical subjects was conducted. The results are summarized below:

- CEE system 32%;
- Capability of teaching staff 24%;
- School leadership support 16%; and
- Lack of familiarity with the curriculum 12% (Table 5.2).

In terms of major problems to be solved, the following are identified as priorities:

- Training resources for teachers and staff 32.8%;
- Curriculum offered/curriculum reform policy 25%;
- Curriculum resources and workshop facilities 21.9%; and
- Assessment and test 18.9% (Table 5.2).

School principals and technology teachers were asked the same questions. The principals identified the following major obstacles: lack of social support and policy guidance, lack of funding, lack of qualified teaching staff, lack of regular academic research activities, diversified assessment methods and lack of professional development opportunities for technology teachers. For technology teachers, the challenges include the lack of a career path and qualification system, lack of equipment, high student-teacher ratio, and a lack of training, assessment methods and general curriculum resources.

Table 5.2 Survey of Major Problems and Obstacles in the Implementation Process

Survey Subject	Survey Item	Option	n	%
Education Administrators	What is (are) the main obstacle(s) to the development of a technology curriculum?	The Quality of Technology Teachers	6	24
		Low Priority for the Leaders	4	16
		Poor Understanding of the Technology Curriculum	3	12
		Unreasonable Work Assessment of Technology Teachers	2	8
		CEE Evaluation	8	32
		Other	2	8
Technology Education Coordinators	What is the most urgent problem that needs to be addressed?	Governmental Policy on offering the Technology Curriculum	16	25
		Teacher Training	21	32.8
		Evaluation and Examination	12	18.9
		Curriculum Resources and Workshop Construction	14	21.9

5.2 Recommendations for Practical Issues

After reviewing the research findings, it is concluded that technical subjects have successfully gained recognition as a necessary subject in the senior secondary school curriculum. In implementing the new technology curriculum, schools have explored a variety of methods for providing technology teacher training, the development of curriculum resources and the provision of equipment, the injection of funding, academic research and curriculum evaluation (Feng, Gu & Siu, 2011). The curriculum has effectively improved students' ways of thinking, skills in building gadgets and problem-solving abilities. However, as the above analysis shows, these achievements are still far from satisfactory. Implementation of the curriculum is still in its infancy and faces numerous challenges (Feng, Gu & Siu, 2011; Liu, Gu & Yu, 2005; Xie & Ma, 2008). Based on the obstacles and the priorities problems above, the following five measures are recommended to further facilitate the popularization of technical subjects. These five measures are also recommended based on the five main issues of national investigation. The linkage is as follows:

- Exercising the power of policy to create a springboard for technical subjects is to improve the situation of offering the new technology curriculum;
- Establishing training mechanisms for technology teachers is to improve pre-service and in-service teacher training;
- Leveraging the Leadership of School Principals to Facilitate Curriculum Development is to correct the attitude towards technology education;
- Promoting academic research bodies as curriculum researchers, leaders and trainers is related to academic research activities and also can rich curriculum resources ;
- Devising a fair and effective evaluation mechanism is also to improve the situation of offering the new technology curriculum.

5.2.1 Exercise the Power of Policy to Create a Springboard for Technical Subjects

The successful implementation of the new technology curriculum relies heavily on policies that act as a driver (Benson, 2000; Elshof, 2009; Moore, 2005; Wicklein, 2005).

Policies are control measures that ensure execution at the school level by encouraging school leadership to initiate internal reform (Sergiovanni, 1996). Therefore, policy changes are essential to effectively launch the new curriculum and technical subjects.

This research reveals the power of educational policies: effective intervention by education administrators facilitates the successful implementation of technical subjects and vice versa. It is much more likely that school leaders will prioritize a project policy that is developed by education administrators. In most successful cases, it is found that local education administrators are the key influencers of the adoption of macro measures – policies that bring about changes. Of course, if the school leadership is only supportive at the policy's launch, its subsequent execution is likely to fail (Filho, Manolas & Pace, 2009; Martin, 2006; Pavlova, 2007). However if the leadership maintains its efforts and follows through with concrete actions, the policy is likely to be more effective. These follow-up actions may include discussion with various stakeholders, frequent training programmes, visits by education administrators, demo classes and so forth. These follow-up measures can be even more effective than the policy itself. Education administrators should exercise their power and authority, together with an appropriate degree of intervention, to facilitate the process. Intervention can be effective when exercised appropriately and in conjunction with relevant support and actions.

Use Policies to Facilitate Curriculum Reform

No reform comes without the backing of policies, especially such a complex and systematic reform (Elshof, 2003; Rasinen, Virtanen & Miyakawa, 2009). Policy, with its power to control, protect and facilitate, is as essential to technical subjects as water is to fish. With policy support, technology teachers feel more confident about switching from other subjects to become technology teachers. This also eliminates certain short-sighted practices, such as school principals using temporary "substitute" teachers, which creates a high turnover in teaching staff. Education administrators should use policies to guide curriculum reform in the right direction, by eliminating the discrimination against non-core subjects such as technical subjects (Sanders, 2001; Sherman, Sanders & Kwon, 2010). They need to ensure that sufficient class hours are devoted to the subject, that technology teachers are recognized and rewarded, and that technology teachers are given training and professional development opportunities. At the school level, the leadership should ensure that technology teachers are offered incentives such as bonuses, awards, public demo classes, competitions, and so forth. Partnering with external parties such as education administrators can also help to reform schools' curricula and elevate the subject's status, helping technology teachers to feel pride in their subject. The key to reform rests on the school's culture and its reaction to new ideas. If the stereotypes and biases are not challenged, the reform will never be realized. It is apparent that the stereotypes of core versus non-core subjects are still deep-rooted in mainstream school culture. It is necessary to eliminate such beliefs with policies and support from education administrators to develop a conducive environment for technical subjects.

Use Policies to Facilitate Technology Teacher Training

Technology teacher training is the foundation for curriculum reform (Jones & Compton, 1998; Jones, Harlow & Cowie, 2004). According to our research findings, technology teachers are finding it difficult to access the training they need; in fact, the organizers of the training courses are also finding it difficult. Not only are the resources from tertiary institutions and wider society scarce, but the discrimination against non-core subjects also discourages the stakeholders, from education administrators to schools. Therefore, policy intervention is urgently needed to turn around the current situation, which is characterized by a lack of training, a mismatch with technology teachers' real needs and the monotony of the delivery format. In terms of specialized training, efforts need to be directed to enriching training content by orientating it toward technology teachers' real needs. There should also be more diversification of the delivery format, such as using case studies, public demonstrations, academic research, discussion, and so forth. At the same time, veteran teachers should be brought in to contribute toward a shared pool of resources. Policy should also be formulated to address organizational problems so that the quality and effectiveness of technology teacher training can be improved.

Use Policies to Develop More Online Curriculum Materials

In the process of launching technical subjects, an online curriculum resources centre has been developed with the support of policymakers, co-created by education administrators and academic research bodies. This effectively addresses the scarcity of curriculum resources, which has significantly hindered the popularization of technical subjects. It exemplifies the action-oriented, interactive and collaborative nature of online learning. It helps teachers to improve their specialized knowledge and skill, effectively reducing their anxiety about venturing into a new subject (Flowers, 2001).

5.2.2 Establish Training Mechanisms for Technology Teachers

The training for technology teachers requires the most urgent attention (Starkweather, 2006). With the curriculum implementation still in its infancy, almost all technology teachers are stepping outside of their specialization area, resulting in less-than-professional teaching staff and a high-turnover of technology teachers. As a result, technology teachers' expertise and skills are severely limited. Thus, the key to improving curriculum effectiveness and student engagement lies in technology teacher training. As a standalone curriculum in the national education system, the technology curriculum is not even a major in Normal Universities, and the establishment of IT has barely even begun. It is apparent that the nurturing of future technology teachers cannot wait any longer.

Five years after the launch, a formal training programme for technology teachers is yet to be put in place and a stable teaching staff is yet to be formed (Feng & Siu, 2009; Feng, Siu & Gu, 2011). Some technology teachers only undergo one week of pre-service training and in some areas it is as little as one day, not to mention the non-existence of any systematic or follow-up training. The survey also calls into question pre-service and in-service training. Considering that the majority of technology teachers are stepping outside their area of specialization, a few days of training is far from enough. Overseas, technical subjects have developed over a long time and have reached maturity in countries such as the USA, Japan and Korea. It is suggested that the Education Bureau should coordinate resources from various tertiary institutions, including all-discipline Normal Universities, Technical Normal Universities and regular universities, to provide adequate training for technology teachers consisting of a systematic programme that works both before the job and on the job.

5.2.3 Leverage the Leadership of School Principals to Facilitate Curriculum Development

This may sound like a difficult challenge, but school leadership can exert great influence on classroom practice (Sergiovanni, 1996). School principals, with their power at the highest level, hold the key to success (Wright, Washer, Watkins & Scott, 2008). However, as decision-makers, school principals need a balanced overview and basic knowledge of each subject to exercise their power effectively. As for technical subjects, school principals must have enough knowledge and understanding to put the new technology curriculum into practice. Therefore, it is necessary to invest in enriching principals' knowledge and developing their leadership skills. The new technology curriculum implies a transfer of power from principals to curriculum leaders. This presents a major shift in mentality for school principals, who in turn will need to further orientate themselves to the various subjects, especially new ones. However, such special training programmes are not readily available, nor has much research been conducted. This is most unfortunate because the survey has established a direct link between principals' support and successful implementation. It is only with leadership support that the reform can enjoy substantial and long-term progress. This also points us to a new mechanism by which principals and teachers can grow together. In other words, training for school principals should become a criterion for evaluating the effectiveness of technical subjects.

5.2.4 Promote Academic Research Bodies as Curriculum Researchers, Leaders and Trainers

Academic research bodies provide strong support for schools to implement technical subjects (Cranston, 1999). They perform triple roles as researchers, leaders and trainers. In terms of research, they organize regular academic research activities to coincide with the syllabus, and research to address specific issues. They also act as leaders in building online resource centres, coordinating regional collaborations, collecting the feedback from senior secondary school students, managing the credits system, diversifying class delivery models, etc. All of these have provided valuable support during the implementation of the new technology curriculum, especially during its trial stages.

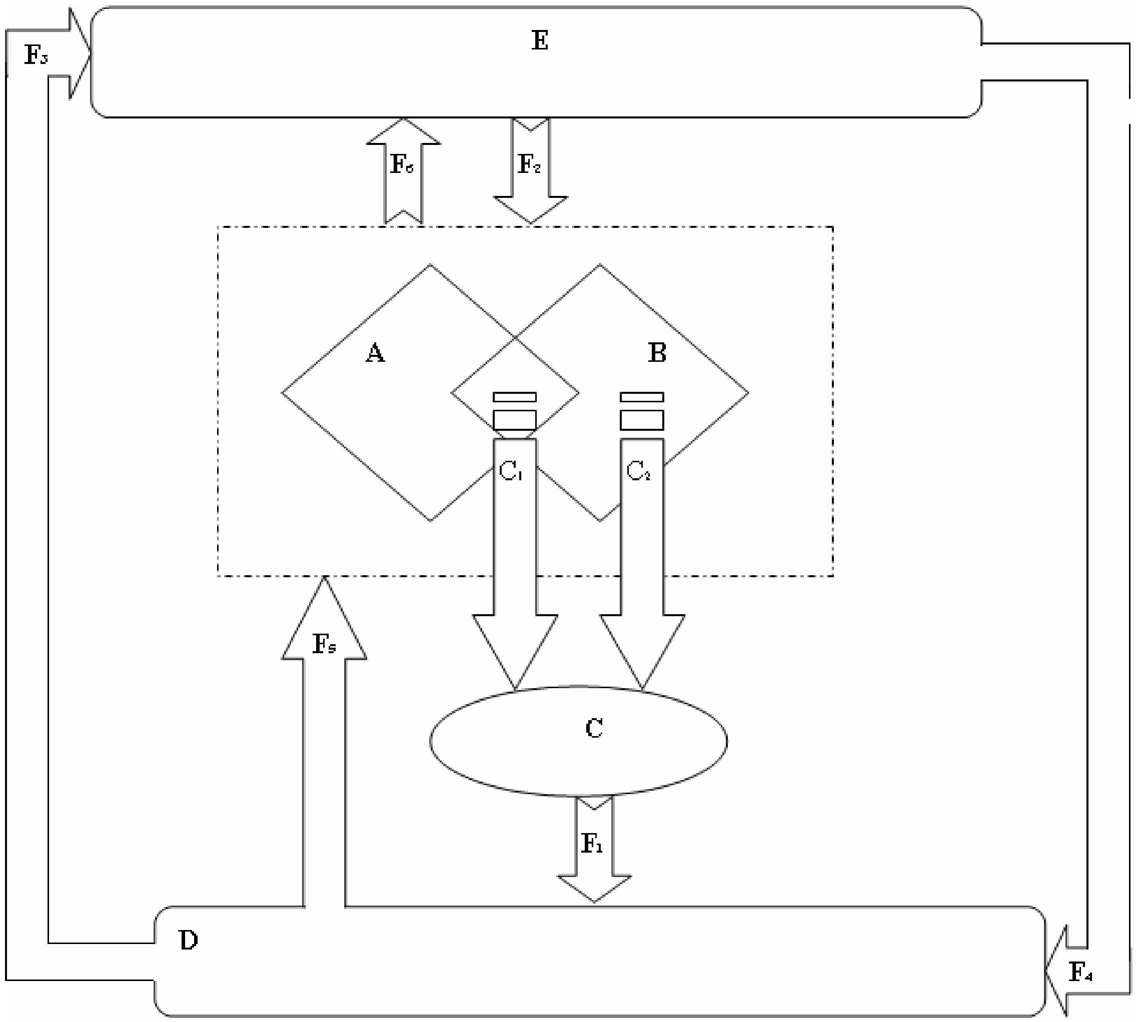
Curriculum reform is a complicated process that involves a diverse group of stakeholders (Ginns, Norton, McRobbie & Davis, 2007). If academic research bodies can perform their duties well, they will help to pull in support from education administrators and eliminate the obstacles for technical subjects.

5.2.5 Devise a Fair and Effective Evaluation Mechanism

Because the evaluation of technical subjects involves several different aspects, it is necessary to devise a fair and effective mechanism that can seamlessly integrate all of these aspects (Rennie, Treagust & Kinnear, 1992). The mechanism proposed by this study is directly relevant to teachers and senior secondary school students, and also to the wider society.

The flowchart below illustrates a comprehensive evaluation mechanism. The “pipes” form a feedback loop connecting the various aspects of the evaluation process. The following is an analysis of the proposed evaluation mechanism:

In Figure 5.7, Parts A and B, within the dotted lines, represent the teaching and learning aspects of technical subjects. Parts C1 and C2 represent students’ attendance, classroom activities, assignments, extra-curricular activities and overall engagement. This provides a dual student-teacher perspective, thereby allowing more pertinent judgment. Part D is the final assessment, which consists of three scores: technical test, technical works making and paper test; it also counts in the syllabus assessment scores. This combined score is then fed into two outlets: the next round of teaching (F3), and parents, education administrators and the wider society (F5). Part E represents parents, education administrators and the wider society; they are influenced not only by the factors listed in this chart, but also other sources of information that they acquire independently. In Part D the final assessment also includes Part E because the assessment comprises both technical test and technical works making. Execution of these two tests should not involve technology teachers alone, but also university professors and professional designers. Part F is a feedback loop, with the arrow pointing in specific directions. In conclusion, it is recommended that the evaluation of technical subjects should adopt such a model, so that all aspects are taken into consideration and seamlessly integrated to provide a comprehensive overview.



A. Teaching B. Learning

C. Syllabus assessment D. Final assessment

E. Parents, education administrators and wider society

F. Feedback loop

Figure 5.7 The “Pipes” Evaluation Mechanism

5.3 Technology Education for China

The impact of technology on our lives and the urgent need to educate future citizens in dealing with technology justify our continuous efforts to bring about that evidence (Ginns, Norton, McRobbie & Davis, 2007; Sjøberg, 2002).

There is no doubt about the importance of technology education in the general education system. Technology education, in whatever form, should be positioned in the school curriculum (de Vries, 2011). In recent international discussions about this, it has become clear that the position of technology education in the curriculum is never to be taken for granted (de Vries, 2011; Elshof, 2003). Even though very good practices have been developed in many countries, the place of technology education in schools is still easily questioned when curriculum changes are foreseen. For that reason there is a constant need for technology educators to think about the best way to teach technology as part of the total education of future citizens and the future workforce.

Compared with the development of technology education in other Western countries, due to the special environment on the Chinese mainland, some successful practices are not suitable (Ding, 2009; Feng, Siu & Gu, 2011). In this sense, it is necessary to examine the current situation of technology education in China.

For the past ten years, China has been undergoing general education reform (Ding, 2009; Gu, 2004; Feng, Siu & Gu, 2011). In this context, the key stakeholders, such as government, educators, education researchers and the public, appear to have different interests in and attitudes toward technology education. Although the crafts and technical aspects have been in curricula since many years ago, it is only recently that technology has been considered potentially to be part of a “curriculum for all”.

Technology education in China has never been stronger. After several years of research, trialling and development, a robust curriculum framework, a growing body of researchers and an increasingly collaborative network of technology teachers have been established (Feng, Siu & Gu, 2011). Almost all provinces offer the new technology curriculum. However, significant issues remain(Feng, Siu & Gu, 2011; Meng, 2005; Xie & Ma, 2008).

Based on reviewing the development of technology education in other countries as well as in China, an overview of the development of technology education has been obtained. This overview not only shows the achievements of previous technology education in practice and provides a platform for further development, but it also indicates the main issues of development in the near future: curriculum policy, teacher training, curriculum resources, academic research activities, evaluation and so on.

Responding to the research questions identified in Chapter 1, through the large-scale survey, this study attempts to explore a bright future for technology education in the general education system in China even can providing a useful reference for other countries.

A database of the development of technology education in China has been established based on the questionnaires and interviews. The results of quantitative analysis not only describe the basic situation of technology education in China, but also form a reference for further research in this field. In addition, more in-depth information is gained from the interviews which provide the direction of recommendations for practical issues. The database is not only the first record of technology education in China, but it also offers first-hand information for future research.

On the Chinese mainland, the technology curriculum has established a place within the national curriculum system, education research community, and to some extent at least, the real world of students in compulsory levels of schooling (Gu, 2004). It is a good start for the further development of the new technology curriculum in China. However, how to maintain this good momentum for the technology curriculum is the main problem. In this sense, the reviewing of the development of technology education in Hong Kong (as a case study) provides a consideration which cannot be ignored. In Hong Kong, the development of the technology curriculum is set within the social and political fabric of a region. In fact, the curriculum is political (Ding, 2009; Gu, 2004). The opportunities for research and development are also influenced by the political frame. In these circumstances, the development of technology education in Hong Kong appears to be a reversible trend. It is necessary to gain experience from the situation in Hong Kong. As for the Chinese mainland, the space of the new technology curriculum cannot be eroded and also needs strong educational policy support. Therefore, policy changes are essential to effectively launch the new curriculum and technical subjects. It was found that local education administrators were the key influencers of the adoption of macro measures – policies that bring about changes. Education administrators should exercise their power and authority, together with an appropriate degree of intervention, to facilitate the process with relevant support and actions. Moreover, it is necessary to establish training mechanisms for technology teachers as soon as possible to ensure the stable provision of professional technology teachers. Third, considering that school leadership can exert great influence on classroom practice, it is necessary to leverage the leadership of school principals to facilitate curriculum development. Fourth, academic research bodies can provide strong support for schools to implement technical subjects. They can act as leaders in building online resource centres, coordinating regional collaborations, collecting the feedback from senior secondary school students, managing the credits system, diversifying class delivery models, etc. All of these have provided valuable support during the implementation of the new technology curriculum, especially during its trial stages. Finally, evaluation is a bottleneck for the current reform of technical subjects. The survey indicates that the implementation of technical subjects is greatly influenced by their evaluation. This study devises the “Pipes” evaluation model-a fair and effective mechanism that can seamlessly integrate all of these aspects.

Chapter 6: Conclusions and Future Work

6.1 Conclusions

In most countries, technology education can be traced back to craft-oriented education, and actually it still exists in current practice. With the emphasis on the problem solving, more people have started to realize that the technology curriculum is a good approach to cultivating students' comprehensive abilities. In this sense, the birth of new technology education is necessary and also timely.

Technology education has a rather short history in China. Developments and problems coexist in China (Ding, 2009; Gu, 2004). The new technology curriculum is currently in a period of transition and change. The technology curriculum is being experimented with in almost all provinces at present. A group of technology teachers is growing up among the new curriculum experiments. The technology curriculum is being expanded in the aspect of validated learning. The teaching task of craft teachers has been transformed into helping students to possess the capacity to adapt, to initiate, to modify, to solve problems and to make decisions to enable them to live in a modern society. Technology education has developed at a high speed during those ten years and the new technology curriculum is currently being experimented with in almost all provinces, with some encouraging feedback. Students are also reported to enjoy learning technology more than other subjects. This is a good start for the further development of the new technology curriculum in China. However, how to maintain this good momentum for the technology curriculum is a key problem and concern. While these developments imply some success with the curriculum, many problems and challenges remain. For example, although technology is still a new curriculum on the Chinese mainland, there is still no formal education system at tertiary level to nurture technology teachers. Furthermore, even though technology is part of the government-driven curriculum, subjects have not been included in the college entrance examination in some provinces. Some schools implement these subjects only for short periods solely for government inspection. Under official pressure, some schools dispatch teachers from other disciplines to participate in face-to-face training. However, after finishing their training, many of these teachers have no opportunity to teach technology subjects. This situation ultimately results in a waste of training resources. All of these problems and obstacles need to be handled.

In brief, although the new technology curriculum is classified as a key learning area, the real implementation situation is not as expected (Liu, Gu & Yu, 2005). According to the findings, the development in technology education needs the support of policy; the instruments and equipment depend on the full use of native resources; the establishment of the evaluation system needs to be based on Chinese traditional culture to promote the steady development of the curriculum. It is an arduous task to change education officials' ideas about education and eradicate their ignorance of technology education.

It is necessary to establish a strong leadership position to ensure that technology education content is a significant part of the mainstream of the public education curriculum. The difficulties encountered by technology education are not regional. Many other countries have also experienced similar or different issues depending on different culture and perceptions of the parties related to the education systems. It is a fact that technology education is still new, particularly in Asian regions such as China (Ding, 2009; Gu, 2004). Thus, it is necessary for curriculum planners and teachers to realize that the reform of technology education is not a process of seeking a perfect final solution in curriculum development.

6.2 Contributions

Throughout the entire study, four categories of contributions are noted as follows:

(i) Review of the history of technology education in China;

(ii) Full picture of the current situation of technology education in China;

(iii) Summaries of successful experience and existing problems; and

(iv) Recommendations for the future development of technology education in China.

Some of these contributions have been published in the handbook, journals, and conference proceedings (Table 6.1).

Table 6.1 Contributions of Pressed Publications

Publication Items	**Contribution Items**
Exploring the position of technology education in China.	(i), (ii), (iii), (iv)
The dilemma and experience of international technology education curriculum assessment and its inspiration.	(I), (ii), (iii)
The development and reform of technology education in general education in mainland China and Hong Kong.	(i), (ii)
Facility design and development in secondary technology education on the Chinese mainland.	(ii), (iii), (iv)
Why fail? Experience of technology education in Hong Kong.	(iii), (iv)
Closing achievement gaps in design and technology education: Case study in mainland China and Hong Kong.	(ii), (iii),
The reflection on the summative assessment of general technology curriculum at senior secondary level.	(iii)
Social transition and value change of technology education in China.	(I), (ii)
Reflections on teacher training for technology education in China.	(iii)
E-learning and e-portfolio for in-service secondary technology teacher education on the Chinese mainland and in Hong Kong.	(iii), (iv)
Building a new future for technology education on the Chinese mainland and in Hong Kong.	(iii), (iv)
Distance learning: Professional development for technology teachers in mainland China and Hong Kong.	(iii)
Meeting the challenges of education reform: Curriculum development of technology education in mainland China and Hong Kong.	(I), (ii), (iii)
Professional development for technology teachers in mainland China and Hong Kong: Bridging theory and practice.	(iii)

6.3 Future Work

Technology education as a field is moving forward (Eggleston, 2001; Fung, 1997). Where technology has been more successfully introduced into general education there are some crucial factors which should be highlighted. These are in terms of a clear articulation of the discipline; a strong teacher education and professional development environment; strong professional research networks; and a developing research culture, including graduate and postgraduate programme.

In moving towards a coherent theory of practice, it is important to define the discipline both from historical and philosophical perspectives as well as from an analysis of current technological practice. This definition of the discipline is crucial if technology education is going to develop its own space in the general education system. The way in which a new curriculum is defined in practice depends on how it is defined by a range of stakeholders, including politicians, the community, teachers and senior secondary school students. In moving forward it is important that we understand how others view the field so that we may start from where their understanding is and develop strategies that may enhance perceptions of technology at different levels.

As a preliminary survey of technology education in China, due to the limited resources, time, and narrow research scope, the conclusions derived from this study concentrate on the practical issues. From the sustainable perspective of the development of technology education, as discussed before, the theory basis needs to be established in order to explore the practicability of the technology education system in the framework of general education.

Indeed, curriculum reform should be considered as a continuous cycle of research, implementation, evaluation and further research. Only continuous research, implementation and evaluation can make technology education fit the continuous social and educational change within society.

Appendix A

Statements from Four Key Education Research Organizations

Education Research Training Institute of Hainan Province

海南省教育研究培训院

说　　明

南京师范大学技术教育硕士研究生冯蔚蔚同学提供了"中国大陆中小学设计教育体系建构研究"的研究计划，我们觉得这个研究计划针对中国大陆设计教育的发展状况和技术课程实施的现实情况，为中国大陆以后中小学设计教育的发展可以提供理论参考和实践建议，很有研究价值。关于研究计划中涉及到的对中国大陆中小学设计教育的实验研究，我们愿意为冯蔚蔚在研究期间提供全力的帮助。我们会帮助联系海南省不同水平层次的若干中小学校，以及学校的校长、教师和学生，为她的实验研究提供必要的研究平台和研究资源。

海南省教育研究培训院

2008 年 1 月 19 日

Teaching Research Office of the City of Nanjing

说　明

南京师范大学技术教育在读硕士研究生冯蔚蔚的研究计划“中国大陆中小学设计教育体系建构研究”是直接服务于中国大陆中小学教育改革，对丰富中国大陆设计教育实践，推进中小学课程改革实验的进一步探索具有较高的应用价值。我们愿意为冯蔚蔚在研究期间提供必要的帮助，为她的研究帮助联系南京市不同水平层次若干中小学，以及学校的校长、教师、学生，为她的实验研究提供必要的研究平台和研究资源。

南京市教学研究室
2008 年 月 21 日

General Education Research Office of the City of Qingdao

说　　明

南京师范大学技术教育硕士研究生冯蔚蔚同学提供了“中国大陆中小学设计教育体系建构研究”的研究计划。我们觉得中小学设计教育是中小学教育中不可或缺的一部份，可以为中国大陆以后中小学设计教育的发展可以提供理论参考和实践建议，很有研究价值。关于研究计划中涉及到的对中国大陆中小学设计教育的实验研究，我们愿意为冯蔚蔚在研究期间提供全力的帮助。我们会帮助联系（本省或本市，填具体的省或市）不同水平层次若干中小学，以及学校的校长、教师、学生，为她的实验研究提供必要的研究平台和研究资源。

青岛普通教育教研室

2008年1月20日

青岛市普通教育教研室

深 圳 市 教 学 研 究 室

关于为冯蔚蔚的研究提供帮助的函

南京师范大学:

贵校技术教育在读硕士研究生冯蔚蔚的研究计划“中国大陆中小学设计教育体系建构研究”是直接服务于中国大陆中小学教育改革，对丰富中国大陆设计教育实践，推进中小学课程改革实验的进一步探索具有较高的应用价值。应冯蔚蔚本人和其导师顾建军教授的要求，我们愿意为冯蔚蔚在研究期间提供必要的帮助，为她的研究联系我市若干所中小学，为她的实验研究提供必要的研究平台。

深圳市教学研究室

二〇〇八年[illegible]月十二日

Appendix B

Training Programme for Technology Teachers

at Senior Secondary Level

Modules	Contents	Instructional Mode
General Training	Decipherment of new curriculum scheme at senior secondary level	Analysis & Discussion
Fundamentals of the Discipline	The Technology curriculum at senior secondary level in new educational reform	Lecture & Discussion
	The concepts and objectives of the technology curriculum at senior secondary level	Lecture & Discussion
	The basic concepts and methods of technical design	Lecture & Discussion
	Information, system, control theory and technical design	Lecture & Discussion
Analysis of curriculum contents	Decipherment of *technology and design 1*	Lecture & Discussion
	Decipherment of *technology and design 2*	Lecture & Discussion
	Decipherment of elective modules	Lecture, Example Analysis & Discussion
Teaching and Assessment	Teaching examples and teaching design	Multi-example display & Making comments on-site
	Common problems and advices in the teaching	Analysis & Discussion
	Teaching and resource utilization	Analysis & Discussion
	Assessment, credit determination	Analysis & Discussion
Technical Practice	on-the-spot investigation in enterprises and factories	Visit & Discussion
	Technical design practice	Technical practice & Discussion
Professional Development	Teaching research and professional development	Discussion

Note: It is extracted from 2007 national technology teacher training scheme

Appendix C

The Implementation Progress of the Technology Curriculum in China

2004：Guangdong、Shandong、Ningxia、Hainan

2005：Jiangsu

2006：Tianjin、Zhejiang、Fujian、Anhui、Liaoning

2007：Beijing、Hunan、Shanxi、Heilongjiang、Jilin

2008：Shanxi、Jiangxi、Henan、Xinjiang

2009：Neimenggu、Hebei、Hubei、Yunnan

2010：Xizang、Gansu、Sichuan、Chongqing、Guizhou

2011：Qinghai

Appendix D

(Chinese Version[1])

普通高中技术课程实施现状调查教师调查访谈提纲

基本信息（被调查教师填写）

1. 您的性别 (　　)

A. 男　　　　　　　B. 女

2. 年龄(　　)

A. 21-30 岁　　　　　B. 31-40 岁

C. 41-50 岁　　　　　D. 51-60 岁

3. 您任教的学校属_____省（直辖市、自治区），是（　　）学校

A. 城市　　B. 区县　　C. 乡镇

4. 您学校的办学性质属于（　　）

A. 公办　　B. 民办

5. 您学校的类型属于（　　）

A. 省属重点　　B. 市属重点　　C. 区县属重点　　D. 一般学校

6. 您学校共有 ___个班级，

其中高一__个班，高二 __个班，高三__个班

7. 您的学历是（　　）

A. 研究生　　B. 本科　　C. 大专　　D. 大专以下

8. 您大学所学的专业是（　　）

---

[1] The Chinese version is the original copy.

A. 技术教育（含信息技术教育） B. 物理教育

C. 化学/生物/地理教育

D. 工科专业 E. 其他

9. 您任学科课教师已有（ ）年

A. 5 年以下 B. 5~10 年 C. 11~16 年 D. 16~20 年 E. 20 年以上

10. 您的职称是（ ）

A. 特级教师 B. 中学高级 C. 中学一级

D.中学二级 E. 其他

11. 您任技术教师前所任教的学科是（ ）

A. 劳动技术 B. 物理 C. 信息技术 D. 其他学科

12. 您任教技术学科的年限为（ ）

A.1 年 B.2 年 C.3 年 D.4 年

13. 您的技术教师岗位性质为（ ）

A.专职教师 B. 兼职教师 C. 临时教师 D. 外聘教师

14.您所在的教研组是（ ）

A. 技术教研组 B. 通用技术教研组

C. 信息技术教研组

D. 综合实践教研组 E. 其他

15. 您每周任教技术课节数 __，具体为高一___节，高二___节，高三___节

访谈提纲

1. 必修课程的相关问题：

(1) 贵校是否开设了必修课？

(2) 贵校必修课开设的年级？

(3) 每个模块开设课的时数？

(4) 必修课开设存在的问题？

(5) 您的对必修课开设的建议？

2. 有关选修课开设相关问题：

(1) 贵校是否开设了选修课？

(2) 开设了哪几个模块的选修？

(3) 每个模块开课课时数？

(4) 选修课开设存在的问题？

(5) 您的对选修课开设的建议？

3. 有关技术课程教学资源建设问题：

(1) 是否设置了技术教学的专用教室？

(2) 是否有教学必需的教学设施？

(3) 请您谈谈贵校在建设和配备技术课程教学资源方面的经验和做法。

4. 您认为开设技术课目前最主要的困难与问题是什么？需要得到些什么支持？需要解决哪些问题？

5. 您们在实施技术课教学中有些什么经验与做法？教育行政部门与学校出台了哪些政策与做法对技术课教学起到了较大作用？

6. 请你对推动技术课教学提出意见和希望。

7. 就您的教学过程来看，学生是否喜欢这门课，您发现学生学习这门课后有哪些收获与变化？

8. 请谈谈您任教技术教师以来的待遇情况。

(English Version[2])

Interview Outline for Technology Teachers

Background Information

1. Your gender (   )

   A. Male   B. Female

2. What is your age? (   )

   A. 21-30   B. 31-40   C.41-50   D.51-60

3. Where is the school you are teaching in located? (   )

   A. City   B. District   C. Town

4. What is the primary source of funding for your school? (   )

   A. Public   B. Private

5. What type of school are you teaching in? (   )

   A. Provincial key   B. City key   C. District key   D. General

6. How many classes are there in your school? (   )

   How many senior secondary one classes? (   )

   How many senior secondary two classes? (   )

   How many senior secondary three classes? (   )

7. What is your highest qualification? (   )

   A. Master   B. B.S./B.A.   C. Junior college   D. Other

8. What was your college major? (   )

   A. Educational Technology

   B. Physics Chemistry, Biology, or Geography

[2] The English version is the translated copy.

C. Engineering

D. Other

9. How many years of teaching experience do you have? (   )

A. Less than 5 years   B. 5-10 years

C. 11-16 years   D. 16-20 years

E. More than 20 years

10. What is your professional title? (   )

A. Special-grade teacher   B. Senior teacher

C. First-grade teacher   D. Second-grade teacher

E. Other

11. What subject did you teach before teaching technical subjects? (   )

A. Labour-technical subject   B. Physics

C. Information technology   D. Other

12. How many years of experience do you have teaching technical subjects? (   )

A. One year   B. Two years   C. Three years

D. Four years   E. Five years

13. What is your post classification? (   )

A. Full-time   B. Part-time   C. Temporary   D. External Part-time

14. What is your associated academic research body? (   )

A. Technology   B. General technology

C. Information technology   D. Comprehensive practical activities

E. Other

15. How many technology classes do you teach each week? (   )

(   ) in senior secondary one;

(   ) in senior secondary two;

(   ) in senior secondary three.

The Interview Questions

1. Questions related to compulsory modules in the technology curriculum

   (i) Are compulsory modules offered in your school?

   (ii) In which grades are compulsory modules offered?

   (iii) At your school, how many class hours are devoted to each compulsory module?

   (iv) What is the major problem in offering compulsory modules?

   (v) What is your opinion regarding offering compulsory modules?

2. Questions related to elective modules in the technology curriculum

   (i) Are elective modules offered in your school?

   (ii) What elective modules does your school offer?

   (iii) At your school, how many class hours are devoted to each elective module?

   (iv) What is the problem with offering elective modules?

   (v) What is your opinion regarding elective modules?

3. Questions related to curriculum resources

   (i) Does your school construct workshops for its technology curriculum?

   (ii) What facilities are necessary for your teaching?

(iii) How are curriculum resources constructed at your school?

4. What are the main challenges in offering a technology curriculum do you think? What kind of support is needed? What is the most urgent problem?

5. What are the practical issues faced when implementing a technology curriculum? Which regulations issued by education departments and your schools play an important role in teaching technology subjects?

6. What needs to be done to improve the teaching of technology subjects?

7. Are your students interested in the new technology curriculum? What do you think are the changes and what do your students gain from the new technology curriculum?

8. Please talk about the reaction to the new technology curriculum after you have taught it?

Appendix E

(Chinese Version[3])

普通高中技术课程实施现状调查（教师问卷）

尊敬的老师：

您好！技术课程是本次新课程改革中的一个亮点，也是一个难点，非常感谢您能加盟这伟大的事业。为更好地攻克难点，做好亮点，我们设计问卷开展调查，搜集课程实施的有关信息，发现问题、总结经验，为教育部制定推进课程的政策提供参考。此调查不涉及对学校、老师的评价，可以不填写单位和姓名，敬请您如实填写问卷，以便客观地反映课程实施现状，提出存在的问题，分享您的优秀经验。衷心感谢您的支持与帮助。

填写说明

1.选择题一般为单选，需要您多选的已在题目中标出，请您将选定选项的字母代号填在括号里。

2.划横线的地方，请在横线上写出您的答案。

3.如您有意犹未尽之处，可另电邮:wei-wei-feng@163.com

基本信息

1. 您的性别 (　　)

A. 男　　　　　　B. 女

2. 年龄(　　)

[3] The Chinese version is the original copy.

A. 21-30 岁　　B. 31-40 岁　　C. 41-50 岁　　D. 51-60 岁

3. 您任教的学校是（　　）学校

A. 城市　　B. 区县　　C. 乡镇

4. 您学校的办学性质属于（　　）

A. 公办　　B. 民办

5. 您学校的类型属于（　　）

A. 省属重点　　B. 市属重点　　C. 区县属重点　　D. 一般学校

6. 您学校共有 ___个班级，其中高一__个班，高二 __个班，高三___个班

7. 您的学历是（　　）

A. 研究生　　B. 本科　　C. 大专　　D. 大专以下

8. 您大学所学的专业是（　　）

A. 技术教育（含信息技术教育）　　B. 物理教育

C. 化学/生物/地理教育　　D. 工科专业　　E. 其他

9. 您任学科教师已有（　　）年

A. 5 年以下　B. 5~10 年　C. 11~16 年　D. 16~20 年　E. 20 年以上

10. 您的职称是（　　）

A. 中学高级或特级教师　　B. 中学一级

C. 中学二级　　D.其他

11. 您任技术教师前所任教的学科是（ ）

A. 劳动技术　　B. 物理　　C. 信息技术　　D. 其他学科

12. 您任教技术学科的年限为（　　）

A. 1 年　　　　B. 2 年　　　C. 3 年

D. 4 年　　　　E. 5 年

13. 您的技术教师岗位性质为（　　）

A. 专职教师　　B. 兼职教师　　C. 临时教师　　D. 外聘兼职教师

14. 您所在的教研组是（　　）

A. 技术教研组　　　　B. 通用技术教研组

C. 信息技术教研组

D. 综合实践教研组　　　E. 其他

15. 您每周任教技术课节数 __，具体为高一___节，高二__节，高三___节

课程开设情况

1. 学校哪些年级开设了技术课（　　）

A. 仅高一　　　　　B. 仅高二

C. 高一和高二　　　D. 高一、高二和高三均开

2.

(1) 贵校课程计划中每周技术课的节数和编排形式为（　　）

A. 每周 1 次，每次 2 节

B. 每周 2 次，每次 2 节

C. 每周 2 次，每次 1 节

D. 每周 1 次，每次 1 节

E. 每 2 周 1 次，每次 2 节　　F. 其他

(2) 如此排课的主要原因是：

3.

(1) 贵校通用技术课程必修模块《技术与设计 1》、《技术与设计 2》开设（　　）

A. 全部开出　　B. 只开设《技术与设计 1》

C. 只开《技术与设计 2》　　D. 未开出

(2) 如未开设技术与设计 1 和技术与设计 2，原因是________________；

(3) 如只开设技术与设计 1，未开设技术与设计 2，原因是____________。

4.

(1) 贵校开设的通用技术课程选修模块有（　　）（多选）

A. 《电子控制技术》　　B. 《建筑及其设计》

C. 《简易机器人制作》　　D. 《现代农业技术》

E.《家政与生活技术》　　F. 《服装及其设计》

G. 《汽车驾驶与保养》　　H. 未开设选修课程

(2) 能开设一些选修课的原因是________________________；

(3) 未开设选修模块的原因是________________________。

5. 您教授技术常用的教学策略有（　　）（多选）

A. 案例分析　　B. 项目教学　　C. 任务驱动

D. 合作学习　　E. 技术体验　　D. 其他

6.您的技术实践操作环节教学活动安排的场所主要在（　　）

A. 普通教室　　B. 技术实践室

C. 普通教室或技术实践室　　　　　　　D. 其他

7.

(1) 贵校建有技术实践室___间，

名称分别是________________；

(2) 如果建有技术实践室，通用技术工具、仪器等配备总价值约为（　　）

A.5 万以内　　　　　　B.5~10 万以内

C.10~20 万以内　　　　D.20~30 万以内　　　　　　E.30 万以上

8. 贵校一节技术的实践操作课通常安排的学生规模是（　　　）

A. 30 人以下　　B. 30~39 人　　　C. 40~49 人

D. 50~59 人　　　E. 60 人以上

9. 技术实践课中您熟悉并会指导学生使用的工具/设备（　　　）（可多选）

A. 金工工具　　　　　　　B. 电工工具　　　　　　C. 木工工具

D. 计算机辅助设计软件　　E. 数控机床　　　　　　F. 一般不用

10.

(1) 教学中，您对技术实践操作教学活动的安排是（　　　）

A. 经常有　　　　B. 一般有　　　　　C. 很少有　　　　D. 没有您认为技术实践教学

(2) 活动安排的最大困难是

11.

(1) 您认为影响贵校技术实践室配备和建设的原因（　　　　）

（可多选）

A. 认识问题　　B. 经费问题

C. 场地问题　　D. 人员问题

E. 其他

(2) 您对技术实践室建设的建议：

12.

(1) 近年来贵校技术课程呈现（　　）现象

A. 逐渐加强　　B. 逐渐削弱

C. 一直较好　　D. 一直较差

(2) 原因：

13. 实际教学中，贵校技术课的课时按照课程计划执行的情况是（　　）。

A. 严格执行　　B. 基本执行

C. 时常被占用　　D. 执行较差

14. 您是否曾独立、完整地经历技术设计作品和技术试验的实践过（　　）

A. 完整经历　　B. 大体经历

C. 没有经历　　D. 不需要

15.

(1) 您在教学过程中迫切需要的课程资源（　　　）（可多选）

A. 技术课课程教学书籍　　B. 教参及学习评价手册

C. 教学具　　D. 音视频素材

(2) 您在教学资源获取、自制等方面的经验和心得：

教师队伍情况

1. 贵校有技术教师 ___ 人，其中专职 ___人，兼职___人，技术教师 中有技术专长的 ___人

2. 您参加过____次技术培训，分别是（　　　）（可多选）

A. 国家级培训　　　B. 省级培训

C. 市级培训　　　　D. 县级培训

3. 技术新课程培训对您哪方面的作用较大（　　）（可多选）

A. 课程理念　　B. 技术知识　　C. 操作技能　　D. 教学方法

4.

(1) 您希望长期从事技术教学吗？（　　　）

A. 希望　　　B. 不希望　　C. 看领导安排　　　D. 无所谓

(2) 为什么？

5. 通过自己的教学经历，您发现技术课程给学生哪些变化（　　）（多选）

A. 动手能力提高　　　　　　B. 形成了一定得技术设计思想、方法

C. 创新和实践能力增强　　　　D. 解决问题的意识和能力增强

E. 较理性地看待技术　　　　　F. 其他

6. 您感觉自己在技术教学方面最缺乏（　　　）（可多选）

A. 技术知识　　　　B. 操作技能　　C. 教学方法

D. 教材的把握　　　E. 课程资源

7. 技术课程模块教学完成进行测评时您主要采用哪种测评方式（　　　）

A. 纸笔测试　　　B. 作品制作　　　C. 纸笔加作品　　　D. 其他

8. 贵校学生技术课程学分评定的方式是（　　）

A. 仅通过考勤　　　　　　　B. 仅通过考试

C. 考试与考勤结合　　　　　D. 无评定均给学分

9.

(1) 您认为现阶段将技术课程列入高考科目（　　）

A. 很有必要　　B. 有必要　　　C. 无必要　　　D. 无所谓

(2) 您的理由

10．

(1)您认为现阶段将技术课程列入学业水平测试科目（　　）

A. 很有必要　　B. 有必要　　　C. 无必要　　　D. 无所谓

(2) 您的理由：

11．

(1) 您认为现阶段把学生修学技术课程情况列入升入高校工科院校的参考依据

（　　）

A. 很有必要　　B. 有必要　　　C. 无必要　　　D. 无所谓

(2) 您的理由：

课程实施的经验、困难和建议

1. 请谈一谈在任教技术课程教学中，您感受到课程给学生带来了哪些变化？对学生发展有哪些独特的价值？

2．您在技术课程教学中有什么独特的感受或有趣的故事？

3．请谈谈您在课程实施中具体的措施、有效的经验和做法。

4．请谈谈您在课程实施时还存在哪些困难？您对推进技术课程有何建议？。

(English Version[4])

Questionnaire for Technology Teachers

Background Information

1. Your gender (　　)

   A. Male　　　B. Female

2. What is our age? (　　)

   A. 21-30　　　B. 31-40　　　C.41-50　　D.51-60

3. Where is the school you are teaching in located? (　　)

   A. City　　　B. District　　　C. Town

4. What is the primary source of funding for your school? (　　)

   A. Public　　　B. Private

5. What type of school are you teaching in? (　　)

   A. Provincial key　　B. City key　　C. District key　　D. General

6. How many classes are there in your school? (　　)

   How many senior secondary one classes? (　　)

   How many senior secondary two classes? (　　)

   How many senior secondary three classes? (　　)

7. What is your highest qualification? (　　)

   A. Master　　B. B.S./B.A.　　C. Junior college　　D. Other

8. What was your college major? (　　)

   A. Educational Technology

   B. Physics

[4] The English version is the translated copy.

C. Chemistry, Biology, or Geography

D. Engineering

E. Other

9. How many years of teaching experience do you have? ( )

A. Less than 5 years   B. 5-10 years

C. 11-16 years   D. 16-20 years

E. More than 20 years

10. What is your professional title? ( )

A. Special-grade teacher   B. Senior teacher

C. First-grade teacher   D. Second-grade teacher

E. Other

11. What subject did you teach before teaching technical subjects? ( )

A. Labour-technical subject   B. Physics

C. Information technology   D. Other

12. How many years of experience do you have teaching technical subjects? ( )

A. One year   B. Two years   C. Three years

D. Four years   E. Five years

13. What is your post classification? ( )

A. Full-time   B. Part-time   C. Temporary   D. External Part-time

14. What is your associated academic research body? ( )

A. Technology   B. General technology

C. Information technology

D. Comprehensive practical activities

E. Other

15. How many technology classes do you teach each week? (   )

(   ) in senior secondary one;

(   ) in senior secondary two;

(   ) in senior secondary three.

The Availability of the New Technology Curriculum

1. What grades does your school offer technology subjects to? (   )

A. Only Senior Secondary One

B. Only Senior Secondary Two

C. Both Senior Secondary One and Two

D. Senior Secondary One, Two and Three

2.

(i) What is the technology curriculum schedule in your school?

A. Once a week, two lessons every time;

B. Twice a week, two lessons every time;

C. Twice a week, one lesson every time;

D. Once a week, one lesson every time;

E. Once every two weeks, two lessons every time;

F. Other

(ii) What is the reason for this curriculum schedule?

3.

(i) Which compulsory modules are offered? (   )

A. All compulsory modules

B. Only Technology & Design 1

C. Only Technology & Design 2

D. None

(ii) Why are no compulsory modules offered?

(iii) Please explain the reason for only offering Technology & Design 1.

4.

(i) Which elective module(s) does your school offer (   )

(May be more than one choice)

A. Electronic Control Technology

B. Architecture and Architectural Design

C. The Construction of Simple Robots

D. Modern Agricultural Technology

E. Home Economics & Life Technology

F. Garments and Garment Design

G. Automobile Driving and Maintenance

(ii) Please explain the reason for offering the selected elective modules.

(iii) What are the reasons for not offering elective modules?

5. What teaching strategies do you use? (   )   (May be more than one choice)

A. Case study   B. Project learning

C. Task-driven   D. Collaborative learning

E. Technology experiencing

F. Other

6. Where do you teach hands-on practice? (   )

A. Classroom   B. Workshop

C. Classroom or workshop

D. Other

7.

(i) How many workshops are there in your school?

(ii) If there are workshops in your school, what is the total value of the tools, instruments, machines etc.? (   )

A. Below RMB 50,000   B. RMB 50,000-100,000

C. RMB 100,000-200,000   D. RMB 200,000-300,000

E. RMB Over 300,000

8. How many students are enrolled in a typical technical hands-on practice class? (   )

A. Fewer than 30 students   B. 30-39 students

C. 40-49 students   D. 50-59 students

E. Over 60 students

9. What kinds of tools/machines can you teach students to use? (   )

A. Metal-making tools   B. Electronic-making tools

C. Wood-making tools   D. CAD software

E. CNC machines   F. None

10.

(i) How often do you offer technical practice? (   )

A. Often   B. Sometimes

C. A little   D. Never

(ii) What is the biggest difficulty in arranging technical practice?

11.

(i) What factors influence the construction of workshops? (   )

(May be more than one choice)

A. The idea   B. The funds

C. The sites   D. The personnel

E. Other

(ii) What do you think needs to be done to get a workshop constructed?

12. How is the technology curriculum progressing in your school? (   )

A. Gradually strengthening   B. Gradually weakening

C. Continuously good   D. Continuously poor

13. Does your school comply with the curriculum scheme? (   )

A. Strictly complies with   B. Complies with

C. Often replaced D. Poorly complies with

14. Have you completed the entire technical making and test? (   )

A. Have completed the entire making and test

B. Have completed most

C. Have not completed

D. No need

15.

(i) What kind of curriculum resources do you urgently need in your teaching? (   )

(May be more than one choice)

A. Teaching materials for the technology curriculum

B. Teaching reference and assessment handbooks

C. Teaching aids and Learning kits

D. Audio and video materials

(ii) Please talk about your experiences obtaining teaching resources and making your own teaching materials.

Faculty Status

1. How many technology teachers are there in your school? (   ) How many are full-time? (   ) How many are part-time? (   ) How many have expertise in teaching technology? (   )

2. What level of teacher training have you obtained?

(May be more than one choice)

A. State level B. Provincial level

C. Municipal level D. County level

3. What are the most effective features of technology teacher training? (   )

(May be more than one choice)

A. Curriculum concept B. Technical knowledge

C. Practical skills D. Pedagogy

4. Do you plan to teach in this field for the long-term? (   )

A. Yes B. No

C. By school arrangement D. Indifferent

5. What advantages does the technology curriculum give to students? (   )

(May be more than one choice)

A. Improving hands-on ability

B. developing skills in technical design thinking and methods

C. Improving creative and practical ability

D. Improving awareness of and ability to solve problems

E. Learning rational view of technology

F. Other

6. Which areas would you like to improve in your teaching of the technology curriculum? (   ) (May be more than one choice)

A. Technical knowledge B. Pedagogy

C. Understanding of teaching materials D. Curriculum resource

7. Which kind of evaluation method do you use at the end of a module? (   )

A. Paper-based test B. Technical project

C. Paper-based test & technical project D. Other

8. How are credits assessed in the technology curriculum in your school? (   )

A. By attendance B. By test

C. Combined attendance and test D. No assessment

9.

(1) Do you think that technical subjects should be classified into CEE? (   )

A. Strongly necessary B. Quite necessary

C. Unnecessary D. Indifferent

(2) Give your reason for your answer:

10.

(1) Do you think that technical subjects should be classified into APT? (   )

A. Strongly necessary B. Quite necessary

C. Unnecessary D. Indifferent

(2) Give your reason for your answer:

11.

(1) Do you think that technical subjects should be as an entrance reference criterion for science universities? (   )

A. Strongly necessary B. Quite necessary

C. Unnecessary D. Indifferent

(2) Give your reason for your answer:

Experiences, Difficulties, and Suggestions for Curriculum Implementation

1. Please give your opinion of the changes in the new technology curriculum. What does it give to your students and what is its unique value to students' development?

2. Please describe your unique feelings about your teaching or an especially interesting story from your classroom.

3. Please discuss your detailed assessments, useful experiences and practices.

4. Please discuss the difficulties that still exist in the new technology curriculum implementation. What are your suggestions for further curriculum implementation?

Appendix F

(Chinese Version[5])

普通高中技术课程实施现状调查（省教研员问卷）

尊敬的老师：

您好！技术课程已经在全国范围内如火如荼的展开了，非常感谢您的加盟以及对技术课程的支持。我们设计问卷开展调查，了解各地区技术课程实施的具体情况，以便为教育部制定推进课程的政策提供参考，更好地推动技术课程的健康发展。此调查不涉及对地区的评价，敬请您就其内容如实填写，以便我们全面而真实地把握各地区技术课程实施的现状，并更好地发现大家迫切需要解决的问题。衷心感谢您的支持与帮助。

填写说明

1.选择题一般为单选，需要您多选的已在题目中标出，请您将选定选项的字母代号填在括号里。

2.划横线的地方，请在横线上写出您的答案。

3.如您有意犹未尽之处，可另电邮:wei-wei-feng@163.com

基本信息

1. 您的性别是（　　）

A. 男　　　B. 女

2. 您的年龄是（　　　）

A. 21-30 岁　　B. 31-40 岁　　C. 41-50 岁　　D. 51-60 岁

[5] The Chinese version is the original copy.

3. 您的工作类型是（　　　）

A. 专职技术教研员（含通用技术、信息技术、劳动与技术）

B. 专职的高中技术教研员（含高中信息技术、通用技术）

C. 专职通用技术教研员

D. 兼职通用技术教研员（同时兼技术学科之外的学科）

E. 临时通用技术教研员

4. 您的学历是（　　）

A. 研究生　　B. 本科　　C. 大专　　D. 大专以下

5. 您的专业是（　　）

A. 技术教育（含信息技术教育）　　B. 工科专业

C. 物理教育　　D. 化学 / 生物 / 地理教育　　E. 其他

6. 您担任技术教研员的年限是（　　）

A. 1 年　　B. 2 年　　C. 3 年　　D. 4 年及以上

7. 您是怎样走上技术教研员岗位的（　　）

A. 主动要求　　B. 领导安排　　C. 其他

8. 您参加过____次技术培训，分别有（　　）（可多选）

A. 国家级　　B. 省级　　C. 市级　　D. 县（市、区）级

课程方面基本状况

1.贵地区教育行政部门有无签发过技术课程方面的文件？

发布时间 ______________ 文件名称是

2. 贵地区教研部门有无签发过技术课程方面的文件？

发布时间 ______________文件名称是

3. 贵地区师资管理部门有无签发过技术课程方面的文件？

发布时间 _________文件名称是

4. 贵地区教育装备部门有无签发过技术课程方面的文件？

发布时间 _________文件名称是

5. 贵地区教育督导部门有无签发过技术课程方面的文件？

发布时间 ________文件名称是

6. 贵地区近年来技术课程所选用教材情况是：

7. 贵地区从教育行政部门来说对普通高中各年级开设技术课的课时要求为：

8. 贵地区技术教师上岗是否存在编制问题？（　　　）

A. 存在　　　　　　　　B. 不存在

9. 贵地区技术教师评职称是否有专门的技术教师职称系列？（　　）

A. 有　　　　　　　　　B. 没有

C. 有信息技术教师系列，无通用技术教师系列

D. 其他

贵地区教研活动情况

1. 去年贵地区开展技术教研活动次数？

2. 贵地区技术教研活动有哪些类型？（　　）

A. 共同备课类　　　B. 教学观摩、教学研讨类

C. 技术技能及课程培训类

D. 专业知识类　　　E. 其他　　　F. 未组织过

3. 贵地区为技术教师自身的专业发展提供了哪些渠道（　　　）（可多选）

A. 定期培训　　　B. 集体备课　　　C. 外出进修

D. 互相听课　　　E. 其他

4. 贵地区开展观摩课活动的情况是（　　）

A. 一学期一次　　　B. 一年一次

C. 两年一次　　　D. 未开展过　　　E.其他

5. 贵地区开展教师技能评比情况是

A. 一年一次　B. 两年一次　C. 未开展过　D. 其他

6. 贵地区为技术教师提供课程资源的情况是（　　）（可多选）

A. 建立了教研网络平台　　　B. 建立技术实践中心

C. 购买教学参考书籍　　　D. 其他

7.

(1) 贵地区有没有建立评价技术教师教学活动的机制？（　）

A. 有　B. 没有

(2) 若有，则评价的主要方式是（　）

A. 平时教学工作视导　　B. 学生考试成绩

C. 学生的评价　　D. 教师互评

E. 其他

8.

(1) 贵地区有没有对学生学习评价进行安排？（　）

A. 有　B. 没有

(2) 若有，则是（　）

A. 组织了地区性的学业水平测试

B. 发布要求，各学校自行检测

9. 贵地区技术实践室建设的资金来源一般是（　）

A. 上级拨款　　B. 本地区教育财政安排

C. 学校自筹　　D. 多方共同筹集

10. 贵地区技术新教师的岗前培训情况是（　）

A. 有，每年一次

B. 实验开始时有，后面没有

C. 没有　　D. 其他

11. 贵地区技术教师的跟进培训情况是（　）

A. 有，每学期开学前

B. 实验开始时有，后面没有

C. 没有　　D. 其他

12. 您对现阶段一些省份将技术课程列入高考科目的认识是（　　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

13. 您对现阶段一些省份将技术课程列入学业水平测试科目的看法是（　　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

14. 您对将学生修学技术课程情况列为升入高校工科院校的参考依据，其看法是（　　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

15. 您认为推进当前技术课程实施最需解决的问题是（　　）

A. 课程开设政策问题　　B. 课程师资培训及配备问题

C. 课程评价及考试问题　　D. 课程资源及实践室建设问题

16. 您对技术课程的发展前景（　）

A. 充满信心　　B. 基本有信心　　C. 较无信心　　D. 一点也没有信心

17. 您认为本地区在推动技术开设方面有哪些经验：

18. 请您为推动技术课开设提出自己的建议：

(Chinese Version[6])

普通高中技术课程实施现状调查（市、县教研员问卷）

尊敬的老师：

您好！技术课程已经在全国范围内如火如荼的展开了，非常感谢您的加盟以及对技术课程的支持。我们设计问卷开展调查，了解各地区技术课程实施的具体情况，以便为教育部制定推进课程的政策提供参考，更好地推动技术课程的健康发展。此调查不涉及对地区的评价，敬请您就其内容如实填写，以便我们全面而真实地把握各地区技术课程实施的现状，并更好地发现大家迫切需要解决的问题。衷心感谢您的支持与帮助。

填写说明

1.选择题一般为单选，需要您多选的已在题目中标出，请您将选定选项的字母代号填在括号里。

2.划横线的地方，请在横线上写出您的答案。

3.如您有意犹未尽之处，可另电邮:wei-wei-feng@163.com

基本信息

1. 您的性别是（　　）

A. 男　　　　B. 女

2. 您的年龄是（　　）

A. 21-30 岁　　B. 31-40 岁　　C. 41-50 岁　　D. 51-60 岁

3. 您是什么单位类别的教研员（　　）

[6] The Chinese version is the original copy.

A. 市教研员　　B. 县（市、区）教研员　　C.其他

4. 您的工作类型是（　　）

A. 专职技术教研员（含通用技术、信息技术、劳动与技术）

B. 专职的高中技术教研员（含高中信息技术、通用技术）

C. 专职通用技术教研员

D. 兼职通用技术教研员（同时兼技术学科之外的学科）

E. 临时通用技术教研员

5. 您的学历是（　　）

A. 研究生　　B. 本科　　C. 大专　　D. 大专以下

6. 您的专业是（　　）

A. 技术教育（含信息技术教育）　　B. 工科专业

C. 物理教育

D. 化学 / 生物 / 地理教育　　E.其他

7. 您担任技术教研员的年限是（　）

A. 1 年　　B. 2 年　　C. 3 年　　D. 4 年及以上

8. 您是怎样走上技术教研员岗位的（　）

A. 主动要求　　B. 领导安排　　C. 其他

9. 您参加过____次技术培训，分别有（　）（可多选）

A. 国家级　　B. 省级　　C. 市级　　D. 县（市、区）级

课程方面基本状况

1. 贵地区教育行政部门有无签发过技术课程方面的文件？

发布时间 ______________文件名称是

2. 贵地区教研部门有无签发过技术课程方面的文件？

发布时间 _______________文件名称是

3. 贵地区师资管理部门有无签发过技术课程方面的文件？

发布时间 __________文件名称是

4. 贵地区教育装备部门有无签发过技术课程方面的文件？

发布时间 __________文件名称是

5. 贵地区教育督导部门有无签发过技术课程方面的文件？

发布时间 _________文件名称是

6. 贵地区近年来技术课程所选用教材情况是：

7. 贵地区技术教师评职称是否有专门的技术教师职称系列（　）

A. 有　　　　　　　　B. 没有

C. 有信息技术教师系列，无技术教师系列

D. 其他

8. 贵地区有没有设立技术教师编制（　）

A. 没设立　　　　　　B. 设立

9. 贵地区有普通高中技术教师___人，其中，专职的__人，兼职的___人

10. 贵地区普通高中技术教师中本科学历___人，专科学历___人，本科以上___人，大专以下___人

贵地区教研活动情况

1.去年贵地区开展技术教研活动次数是

2. 贵地区为技术教师自身的专业发展提供了哪些渠道（　）（可多选）

A. 定期培训　　B. 集体备课

C. 外出进修　　D. 互相听课

E. 其他

3. 组织技术教师的教研内容有哪些类型（　）

A. 共同备课类　　B. 教学观摩、教学研讨类

C. 技术技能及课程培训类

D. 专业知识类　　E. 其他　　F. 未组织过

4. 贵地区开展观摩课活动的情况是（　）

A. 一月一次　　B. 一学期一次

C. 一学期两次　　D. 未开展过

E. 其他

5. 贵地区为技术教师提供课程资源的情况是（　）（可多选）

A. 建立了教研网络平台　　B. 建立技术实践中心

C. 购买教学参考书籍　　D. 其他

6. 贵地区开展教师技能评比情况是

A. 一学期一次　　B. 一年一次

C. 两年一次　　D. 未开展过

E. 其他

7.

(1) 贵地区有没有对评价技术教师教学活动的机制？（　）

A. 有　B. 没有

(2)若有，则评价的主要依据是（　）

A. 平时教学工作视导　　B. 学生考试成绩

C. 学生的评价　　D. 教师互评

E. 其他

8.

(1) 贵地区有没有对学生学习评价进行安排？（　）

A. 有　B. 没有

(2) 若有，则是（　）

A. 组织了地区性的学业水平测试

B. 发布要求，各学校自行检测

9. 贵地区技术实践室建设的资金来源一般是（　）

A. 上级拨款　　B. 本地区教育财政安排

C. 学校自筹　　D. 多方共同筹集

10. 贵地区技术新教师的岗前培训情况是（　）

A. 有，每年一次

B. 实验开始时有，后面没有

C. 没有　　　　　　　　D. 其他

11. 贵地区技术教师的跟进培训情况是（　　）

A. 有，每学期开学前

B. 实验开始时有，后面没有

C. 没有　　　　　　　　D. 其他

12. 您对现阶段一些省份将技术课程列入高考科目的认识是（　　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

13. 您对现阶段一些省份将技术课程列入学业水平测试科目的看法是（　　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

14. 您对将学生修学技术课程情况列为升入高校工科院校的参考依据，其看法是（　　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

15. 您认为当前技术课程实验最需解决的问题是（　）

A. 课程开设政策问题　　　　B. 课程师资培训及配备问题

C. 课程评价及考试问题　　　D. 课程资源及实践室建设问题

16. 您对技术课程的发展前景（　）

A. 充满信心　　　　　　B. 基本有信心

C. 较无信心　　　　　　D. 一点也没有信心

17.您认为本地区在推动技术课程开设方面有哪些经验与教训：

18.请你推荐几所你所在地区技术实施较好的学校及好的经验。

①学校名称：

主要经验：

②学校名称：

主要经验：

(English Version[7])

Questionnaire for Technology Education Coordinators

For Provincial Coordinators

Background Information

1. Your gender (   )

   A. Male   B. Female

2. What is your age? (   )

   A. 21-30   B. 31-40   C.41-50   D.51-60

3. What is your job description? (   )

   A. Full-time technology education coordinator

   B. Full-time senior secondary technology education coordinator

   C. Full-time general technology education coordinator

   D. Part-time general technology education coordinator

   E. Temporary general technology education coordinator

4. What is your highest qualification? (   )

   A. Master   B. B.S./B.A.   C. Junior college   D. Other

5. What was your college major? (   )

   A. Educational Technology

   B. Physics

   C. Chemistry, Biology, or Geography

   D. Engineering

   E. Other

[7] The English version is the translated copy.

6. How long have you been a technology education coordinator? (   )

A. One year   B. Two years

C. Three years   D. Over four years

7. How did you become a technology education coordinator? (   )

A. Volunteered to serve as a technology education coordinator

B. Appointed by the leader

C. Other

8. What level of trainings have you obtained? (   )   (May be more than one choice)

A. State level   B. Provincial level

C. Municipal level   D. County level

The Context of the Technology Curriculum

1. Has the education administration department in your province issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

2. Has the teaching research department in your province issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

3. Has the teacher management department in your province issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

4. Has the educational equipment department in your province issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

5. Has the educational supervision department in your province issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

6. Describe the type and availability of textbooks used in your province.

7. How many class hours of the technology curriculum for each grade are required by the education administration department?

8. Are there any officially budgeted posts for technology teachers in your province? (   )

A. Yes   B. No

9. Is there any special evaluation system for the professional titles for technology teachers in your province? (   )

A. Yes B. No

C. Only for information technology teachers, not for general technology teachers

D. Others

Academic Research Activities

1. How many academic research activities were arranged in your province last year?

2. What kind of academic research activities were they? (   )

(May be more than one choice)

A. Collaborative lesson preparation together

B. Class teaching demonstration

C. Technical skills and curriculum training

D. Expertise training

E. Other

F. No activity

3. What kind of professional development was provided for technology teachers? (   )

(May be more than one choice)

A. Regular training B. Collaborative lesson preparation together

C. Refresher course D. Visiting each other's Classes

E. Other

4. How often is the class teaching demonstration arranged each year? (   )

A. Once every semester   B. Once every year

C. Once every two years   D. None

E. Other

5. How often are the teaching skills of technology teachers evaluated? (   )

A. Once every year   B. Once every two years

C. No evaluation   D. Other

6. What kind of curriculum resources does your local government provide? (   )

(May be more than one choice)

A. Establish the platform for academic networking

B. Construct a technical practice center

C. Provide teaching reference books

D. Other

7.

(i) Is there any mechanism for evaluating teaching in your province? (   )

A. Yes   B. No

(ii) If the above choice is yes, what is the evaluation method? (   )

A. Peacetime teaching work supervision

B. Students' examination results

C. Evaluated by students

D. Self-evaluation

E. Other

8.

(1) Is there any mechanism for evaluating students' achievement in your province? (   )

A. Yes   B. No

(2) If the above choice is yes, what is the evaluation method? (   )

A. APT

B. School specific methods, according to the requirements

9. What is the funding source for workshop construction in your province? (   )

A. The Higher Authority Subsidy

B. Local educational financial arrangement

C. School fund-raising

D. Funds raised in various ways

10. How often is pre-service training arranged for technology teachers in your province? (   )

A. Once every year   B. Only at the beginning

C. No training   D. Other

11. How often is in-service training arranged for technology teachers in your province? (   )

A. Once every semester   B. Only at the beginning

C. No training   D. Other

12. Do you think that technical subjects should be classified into CEE in some provinces? (   )

A. Strongly necessary   B. Quite necessary

C. Unnecessary   D. Indifferent

13. Do you think that technical subjects should be classified into APT in some provinces? (　　)

A. Strongly Necessary　　B. Quite Necessary

C. Unnecessary　　D. Indifferent

14. Do you think that technical subjects should be as an entrance reference criterion for science universities in some province? (　　)

A. Strongly necessary　　B. Quite necessary

C. Unnecessary　　D. Indifferent

15. What is the most urgent problem needs to be addressed? (　　)

(May be more than one choice)

A. Governmental policy on offering the technology curriculum

B. Teacher training

C. Evaluation and examination

D. Curriculum resources and workshop construction

16. What is your attitude towards the future of technology education? (　　)

A. Full of confidence　　B. Some confidence

C. A Little confidence　　D. No confidence

17. In your province, what are the plans for the further implementation of the new technology curriculum?

18. Please give your suggestions for strengthening and promoting the new technology curriculum.

(English Version[8])

Questionnaire for Technology Education Coordinators

For Local Coordinators

Background Information

1. Your gender (   )

A. Male   B. Female

2. What is your age? (   )

A. 21-30   B. 31-40   C.41-50   D.51-60

3. What is your job title? (   )

A. Municipal level coordinator

B. County level coordinator

C. Other

4. What is your job description? (   )

A. Full-time technology education coordinator

B. Full-time senior secondary technology education coordinator

C. Full-time general technology education coordinator

D. Part-time general Technology education coordinator

E. Temporary general technology education coordinator

5. What is your highest qualification? (   )

A. Master   B. B.S./B.A.   C. Junior college   D. Other

6. What was your college major? (   )

A. Educational Technology

[8] The English version is the translated copy.

B. Physics

C. Chemistry, Biology, or Geography

D. Engineering

E. Other

7. How long have you been a technology education coordinator? (   )

A. One year   B. Two years

C. Three years   D. Over four years

8. How did you become a technology education coordinator? (   )

A. Volunteered to serve as a technology education coordinator

B. Appointed by the leader

C. Other

9. What level of training have you obtained? (   )   (May be more than one choice)

A. State level   B. Provincial level

C. Municipal level   D. County level

The Context of the Technology Curriculum

1. Has the education administration department in your region issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

2. Has the teaching research department in your region issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

3. Has the teacher management department in your region issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

4. Has the educational equipment department in your region issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

5. Has the educational supervision department in your region issued any document regarding the technology curriculum? If yes, please give the time of issue and name.

6. Describe the type and availability of textbooks used in your region.

7. Are there any officially budgeted posts for technology teachers in your region? (   )

A. Yes   B. No

8. Is there any special evaluation system for the professional titles for technology teachers in your region? (   )

A. Yes   B. No

9. How many technology teachers are there in your region? (   ) How many are full-time teachers? (   ) How many are part-time teachers? (   ).

10. In your region, how many technology teachers have a B.S./B.A. degree? (   ) How many have a junior college degree? (   ) How many have a higher degree than a B.S./B.A. degree? (   ) How many have a lower degree than a B.S./B.A. degree? (   )

Academic Research Activities

1. How many academic research activities were arranged in your region last year?

2. What kind of academic research activities were they? (   )

(May be more than one choice)

A. Collaborative lesson preparation together

B. Class teaching demonstration

C. Technical skills and curriculum training

D. Expertise training

E. Other

F. No activity

3. What kind of professional development was provided for technology teachers? (   )

(May be more than one choice)

A. Regular training

B. Collaborative lesson preparation together

C. Refresher course

D. Visiting each other's Classes

E. Other

4. How often is the class teaching demonstration arranged each year? (   )

A. Once every semester   B. Once every year

C. Once every two years   D. None

E. Other

5. How often are the teaching skills of technology teachers evaluated? (   )

A. Once every year   B. Once every two years

C. No evaluation   D. Other

6. What kind of curriculum resources does your local government provide? (   )

(May be more than one choice)

A. Establish the platform for academic networking

B. Construct a technical practice center

C. Provide teaching reference books

D. Other

7.

(i) Is there any mechanism for evaluating teaching in your region? (   )

A. Yes   B. No

(ii) If the above choice is yes, what is the evaluation method? (   )

A. Peacetime teaching work supervision

B. Students' examination results

C. Evaluated by students

D. Self-evaluation

E. Other

8.

(1) Is there any mechanism for evaluating students' achievement in your region? (   )

A. Yes B. No

(2) If the above choice is yes, what is the evaluation method? (   )

A. APT

B. School specific methods, according to the requirements

9. What is the funding source for workshop construction in your region? (   )

A. The Higher Authority Subsidy

B. Local educational financial arrangement

C. School fund-raising

D. Funds raised in various ways

10. How often is pre-service training arranged for technology teachers in your region? (   )

A. Once every year B. Only at the beginning

C. No training D. Other

11. How often is in-service training arranged for technology teachers in your region? (   )

A. Once every semester B. Only at the beginning

C. No training D. Other

12. Do you think that technical subjects should be classified into CEE in some provinces? (   )

A. Strongly necessary B. Quite necessary

C. Unnecessary D. Indifferent

13. Do you think that technical subjects should be classified into APT in some provinces? (   )

A. Strongly Necessary B. Quite Necessary

C. Unnecessary D. Indifferent

14. Do you think that technical subjects should be as an entrance reference criterion for science universities in some province? (   )

A. Strongly necessary B. Quite necessary

C. Unnecessary D. Indifferent

15. What is the most urgent problem needs to be addressed? (   )

(May be more than one choice)

A. Governmental policy on offering the technology curriculum

B. Teacher training

C. Evaluation and examination

D. Curriculum resources and workshop construction

16. What is your attitude towards the future of technology education? (   )

A. Full of confidence B. Some confidence

C. A Little confidence D. No confidence

17. In your region, what are the plans for the further implementation of the new technology curriculum?

18. Please recommend several schools in which the implementation of the new technology curriculum has been successful.

Give the names of the schools and describe their successful practices.

Appendix G

(Chinese Version[9])

普通高中技术课程实施现状调查（教育行政人员问卷）

尊敬的领导：

您好！技术课程是普通高中的一门新课程，是本次课程改革中的一个亮点，非常感谢您给予这个伟大事业的支持。我们委托设计此调查问卷，收集课程实施的信息、总结优秀的经验、发现存在的问题，以期为教育部制定推进课程的政策提供参考。此调查不涉及对教育部门、学校、教师及学生的评价，您可以不填写单位和姓名。敬请您就其内容如实填写，衷心感谢您的支持与帮助。

填写说明

1.选择题一般为单选，需要多选的已在题目中标出，请您将选定选项的字母代号填在括号里。

2.划横线的地方，请在横线上写出您的答案。

3.如您有意犹未尽之处，可电邮：wei-wei-feng@163.com

基本资料

1. 您的年龄：（　　）

A. 21-30 岁　　B. 31-40 岁　　C. 41-50 岁　　D. 51-60 岁

2. 您从事教育行政工作的年限是（　　）

A. 5 年以下　　B. 5-10 年　　C. 10-15 年

D. 15-20 年　　E. 20 年以上

3. 您大学所学的专业是（　　）

A. 文科专业　　B. 理科专业

[9] The Chinese version is the original copy.

C. 工科专业　　　D. 其他

4. 您对技术的了解情况是（　　）

A. 十分了解　　　B. 比较熟悉

C. 不太了解　　　D. 一点不了解

5.您了解技术的渠道是（　　）。

A. 通过课标　　B. 通过教材　　C. 通过培训　　D. 通过本地活动

有关技术课程的情况

1. 贵局（处）有无发布有关技术课程的规章制度_________，

具体的文件是①

②

2. 贵局（处）有无关于技术课程实施的具体规划________，

其核心的观点是①

②

③

3. 您认为新课改中开设技术课程的主要目的是（　　）

A. 增强学生的动手能力　　　B. 提高学生的就业能力

C. 提高学生的技术素养　　　D. 促进学生的个性发展

4. 对于国际上普遍重视中小学技术教育的现象，您认为我国是否也要加强（　　）

A. 很需要　　B. 较为需要　　C. 需要　　D. 不需要

5. 您认为当前技术课程发展中遇到的主要障碍有（　）

A. 技术教师素质不高

B. 主要领导不够重视

C. 大家对技术课程不够了解

D. 对技术教师的工作评价不科学不合理

E. 高考评价制度问题　　　　F. 其他

6. 您认为，目前推进本地技术课程高质量实施的关键是（　　　）（多选）

A. 领导更加重视

B. 加强师资队伍建设

C. 加大经费投入

D. 加强政策支持

E. 建立技术课程的评价机制　　　F. 其他

7. 对于通用技术与信息技术两部分内容的关系，您认为（　　）

A. 可以替代，学生只要选学一方面就行了

B. 不可替代，但可以相互融合

C. 不可替代，要体现各自特点

D. 其他

8. 对于解决信息技术与通用技术教师的职称问题，您认为（　　）

A. 可沿用原有的信息技术、劳动技术教师职务系列

B. 可增设技术学科教师职务系列

C. 可独立增设通用技术学科教师职务系列

D. 可各自申请原有的学科系列

9. 对于一些学校在高中阶段设立技术学科教研组这一现象，您的态度是（　　）

A. 赞成，利于技术课程融合

B. 反对，信息技术、通用技术各自建教研组较好

C. 可以两种形式并存

D. 无所谓

10. 对于目前技术实践室建设，您认为存在的最大问题是（　　）

A. 缺乏相应政策

B. 缺乏充足经费

C. 缺乏优质专业性企业及优质资源

D. 缺乏教师课程教学与实践室建设的有机融合

E. 其他

11. 您认为应采取什么措施解决学生技术课上实践操作的材料问题（　）

A. 将耗材列入技术实践室装备配备方案

B. 将耗材列入学校一费制收费科目

C. 将耗材列入学校日常使用经费预算序列

D. 其他

12. 您对现阶段一些省份将技术课程列入高考科目的认识是（　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

13. 您对现阶段一些省份将技术课程列入学业水平测试科目的认识是（　）

A. 很有必要　　B. 有必要　　C. 无必要　　D. 无所谓

14. 您对现阶段一些省份拟将学生修学技术课程情况列为升入高校工科院校的参考依据，其认识是（ ）

A. 很有必要　B. 有必要　C. 无必要　D. 无所谓

15. 您对一些省份逐步将学生动手设计制作能力和技术试验能力列入全省统一学业水平测试内容，其认识是（ ）

A. 很有必要　B. 有必要　C. 无必要　D. 无所谓

16. 您对加强和促进技术课程的实施还有哪些宝贵的意见和建议？

(English Version[10])

Questionnaire for Education Administrators

Background Information

1. What is your age? (   )

   A. 21-30   B. 31-40   C.41-50   D.51-60

2. How long have you been engaged in education administration work? (   )

   A. Less than 5 years   B. 5-10 years

   C. 10-15 years   D. Over 20 years

3. What was your college major? (   )

   A. Humanities

   B. Science

   C. Engineering

   D. Other

4. How would you describe your understanding of the new technology curriculum? (   )

   A. Very familiar   B. A little familiar

   C. Unfamiliar   D. Ignorant

5. How have you learned the new technology curriculum? (   )

   A. Through curriculum standard

   B. Through textbooks

   C. Through training

   D. Through the local academic research activities

[10] The English version is the translated copy.

The Situation of the New Technology Curriculum

1. Has your department issued any documents regarding the new technology curriculum? If yes, give the full document name:

2. Has your department issued any curriculum schemes regarding the new technology curriculum? If yes, give the core content:

3. What are the main objectives of the new technology curriculum? (   )

   A. Improving students' hands-on abilities

   B. Enhancing students' employability

   C. Promoting students' technological literacy

   D. Promoting students' personal development

4. Given the worldwide trend to strengthen technology education in the general education system, do you think it is necessary to strengthen it in our country? (   )

   A. Strongly necessary　　B. Very necessary

   C. Necessary　　D. No need

5. What is (are) the main obstacle(s) to the development of a technology curriculum? (   ) (May be more than one choice)

   A. The quality of technology teachers

   B. Poor understanding of the technology curriculum

   C. Low priority for leaders

   D. Unreasonable work assessment of technology teachers

E. CEE evaluation

F. Other

6. What are the key factors in promoting the further development of the new technology curriculum? (   ) (May be more than one choice)

A. More priority given by leadership

B. Improving the training of teaching staff

C. Increasing funding

D. Strengthening policy support

E. Establishing evaluation mechanism

F. Other

7. What is the relationship between general technology and information technology in the curriculum? (   )

A. Can be substituted for each other and students can choose one of them

B. Cannot be substituted for each other, but can be integrated

C. Cannot be substituted for each other, each has distinct features

D. Other

8. Which of the following is the best solution to the professional title problem? (   )

A. Following the original professional title series

B. Adding a new professional title series

C. Adding a new professional title series independently

D. Applying their respective disciplines

9. What is your attitude towards establishing an academic research body for the new technology curriculum at the senior secondary level? (   )

A. Agree. It will help to integrate the technology curriculum

B. Object. Establishing separate academic research bodies for IT and GT is a better option

C. Either of the above two approaches is acceptable

D. Indifferent

10. What is the biggest problem in the construction of workshops? (   )

A. Lack of corresponding policy

B. Lack of sufficient funds

C. Lack of high quality resources from businesses

D. Lack of integration between curriculum teaching and workshop construction

E. Other

11. How should the materials used by students for hands-on practice in technology class be classified? (   )

A. Workshop construction standard

B. School expenses

C. School budget

D. Other

12. Do you think that technical subjects should be classified into CEE in some provinces? (   )

A. Strongly necessary   B. Quite necessary

C. Unnecessary   D. Indifferent

13. Do you think that technical subjects should be classified into APT in some provinces? (   )

A. Strongly necessary   B. Quite necessary

C. Unnecessary   D. Indifferent

14. Do you think that technical subjects should be as an entrance reference criterion for science universities in some province? (   )

A. Strongly Necessary   B. Quite Necessary

C. Unnecessary   D. Indifferent

15. Do you think that the technical making and test should be classified into APT in some provinces? (   )

A. Strongly necessary   B. Quite necessary

C. Unnecessary   D. Indifferent

16. Please give your suggestions for strengthening and promoting the new technology curriculum.

Appendix H

(Chinese Version[11])

普通高中技术课程实施现状调查（校长调查问卷提纲）

基本信息

1. 您的年龄(　　)

A. 21-30 岁　　B. 31-40 岁　　C. 41-50 岁　　D. 51-60 岁

2. 您的学校属_____省（直辖市、自治区），是（　　）学校

A. 城市　　B. 区县　　C. 乡镇

3. 您学校的办学性质属于（　　）。

A. 公办　　B. 民办

4. 您学校的类型属于（　　）

A. 省属重点　　B. 市属重点　　C. 区县属重点　　D. 一般学校

5. 您学校共有 ___个班级，其中高一__个班，高二 __个班，高三__ 班

6. 您的学历是（　　）

A. 研究生　　B. 本科　　C. 大专　　D. 大专以下

7. 您大学所学的专业是（　　）

A. 技术教育（含信息技术教育）

B. 物理教育

C. 化学/生物/地理教育

D. 工科专业　　E. 其他

[11] The Chinese version is the original copy.

8. 您了解技术课程的渠道是（　　　）

A. 通过培训　　　　　　　　B. 通过看课标

C. 通过看教材　　　　　　　D. 通过网上学习

E.通过参加会议等活动

9. 您认为在普通高中开设技术课程（　　）

A. 非常必要　　　　B. 较为必要　　　　C. 可有可无　　　　D. 不必要

10. 您校开设通用技术课必修模块的情况是（　　　）

A. 仅开《技术与设计 1》

B. 仅开《技术与设计 2》

C.还没开设

D. 全部开设

11．贵校开设技术课选修模块的情况是（　　　）

A．已开设　B . 未开设　C. 即将开设

12．贵校已经开设了哪些选修模块的课程？（　　　）（可多选）

A. 家政与生活技术

B. 电子控制技术

C. 简易机器人制作

D. 建筑及其设计

E. 现代农业技术

F. 汽车驾驶与保养

G. 服装及其设计

13. 贵校技术课程每个模块开课的课时数（　　）

A. 18 课时　　　　B. 36 课时　　　　C. 其它

14. 贵校技术教师共有____名，其中专职技术教师有__名，兼职技教师有____名

15. 贵校是否设置了技术教学专用教室?（　　）

A．有　　B. 无　　C. 正在建设

16. 贵校技术课程是否配备了必要的教学设施？（　　）

A. 有　　B. 无　　C. 正在配备

17. 您认为技术课程是否应纳入高考？（　　）

A．很有必要　　B. 必须纳入　　C. 无必要　　D. 无所谓

座谈交流的问题

1．您认为当前开设技术课程最主要的困难与问题是什么？需要得到哪些支持？现在急需要解决哪些问题？

2. 您认为学校未能配备必要教学资源的主要原因是什么？应如何解决?

3. 教育行政部门与学校出台的哪些政策和措施对您校开设技术课程起到较大的推动作用?

4. 您校在实施技术课程教学中有哪些经验或教训？ 今后准备怎么办？

5. 您对实施技术课程有哪些宝贵的意见或建议？

(English Version[12])

Questionnaire and Interview Outline for School Principals

Background Information

1. What is your age? (   )

   A. 21-30   B. 31-40   C.41-50   D.51-60

2. Where is the school you are teaching in located? (   )

   A. City   B. District   C. Town

3. What is the primary source of funding for your school? (   )

   A. Public   B. Private

4. What type of school are you teaching in? (   )

   A. Provincial key   B. City key   C. District key   D. General

5. How many classes are there in your school? (   )

   How many senior secondary one classes? (   )

   How many senior secondary two classes? (   )

   How many senior secondary three classes? (   )

6. What is your highest qualification? (   )

   A. Master   B. B.S./B.A.   C. Junior college   D. Other

7. What was your college major? (   )

   A. Educational Technology

   B. Physics

   C. Chemistry, Biology, or Geography

   D. Engineering

---

[12] The English version is the translated copy.

E. Other

8. How did you learn the new technology curriculum? (   )

A. Official training

B. Curriculum standard

C. Textbooks

D. Internet Learning

E. Attending conferences

9. Do you think the new technology curriculum should be offered at senior secondary level? (   )

A. Strongly necessary B. Quite necessary

C. Unnecessary D. Indifferent

10. Which compulsory modules are offered? (   )

A. All compulsory modules

B. Only Technology & Design 1

C. Only Technology & Design 2

D. None

11. How many elective modules are offered? (   )

A. Some

B. None

C. Will offer soon

12. Which elective module(s) does your school offer (   )

(May be more than one choice)

A. Electronic Control Technology

B. Architecture and Architectural Design

C. The Construction of Simple Robots

D. Modern Agricultural Technology

E. Home Economics & Life Technology

F. Garments and Garment Design

G. Automobile Driving and Maintenance

13. How many class hours are there for each module? (   )

A. 18 hours B. 36 hours C. Other

14. How many technology teachers are there in your school? (   ) How many are full-time? (   ) How many are part-time? (   ).

15. Are there any workshops for teaching technology subjects? (   )

A. Yes B. No

C. Under construction

16. Do you have access to the necessary facilities for teaching technology subjects? (   )

A. Yes B. No

C. Will be available soon

17. Do you think that technical subjects should be classified into CEE? (   )

A. Strongly necessary B. Quite necessary

C. Unnecessary D. Indifferent

Questions for the Symposium

1. What obstacles and problems have you encountered when offering the new technology curriculum? What kind of support do you need? What problems need to be handled urgently?

2. What is preventing your school from creating the necessary teaching resources and how can this problem be solved?

3. Which policies and regulations issued by education administration department are most affecting the implementation of the new technology curriculum in your school?

4. Please talk about the experiences and practices in teaching technology subjects at your school.

5. Please give your suggestions for strengthening and promoting the new technology curriculum.

Appendix I

(Chinese Version[13])

普通高中技术课程实施现状调查（学生问卷）

亲爱的同学：

你好！在本次新课程改革中，技术课程成为高中学生的必修课程，这是促进学生全面而健康成长，推进国家与社会进步的一个重要举措。为了全面、真实地了解普通高中技术课程的实施现状，我们编制了此问卷。你可以不填写学校和姓名，调查不涉及对学校和个人的具体评价，敬请如实填写。谢谢你的参与和帮助！

填写说明

1. 选择题一般为单选，需要多选的已在题目中标出，请您将选定选项的字母代号填在括号里。

2. 划横线的地方，请在横线上写出你的答案。

3. 如你有特别的感受与体会可另电邮:wei-wei-feng@

基本信息

1. 你的性别是（　　）

A.男　　B. 女

2. 你的年级是（　　）

A. 高一　　B. 高二　　C. 高三

3. 你父母的职业是：父亲______，母亲______。

4. 你的文化科目学习的状况（　　）

A.好　　B.较好　　C.一般　　D. 较弱

[13] The Chinese version is the original copy.

基本的学习情况

1. 你校技术课开设的情况（　　）

A. 仅开必修一　　　　B. 仅开必修二

C. 必修开齐未开选修

D. 仅开选修　E.未开课

2. 你校技术课的排课方式是（　　）

A. 每周 1 次，每次 2 节　　　　B. 每周 2 次，每次 2 节

C. 每周 2 次，每次 1 节　　　　D. 每周 1 次，每次 1 节

E. 每 2 周 1 次，每次 2 节　　　　F. 其他

3. 你们进行技术技能学习的场所经常在（　　）

A. 普通教室　　　　B. 技术实践室

C. 根据需要确定教室　　　　D. 其他

4. 技术课上，你经历过技术设计全过程吗（　　）

A. 经历了全过程　　　　B. 只做了作品，没有绘图

C. 只做了绘图，未进行制作　　　　D. 有构思、绘图、制作，但未试验

E. 有构思、绘图、制作、试验，但未优化与评价

F. 没有动手操作过

G. 其他

5. 你对技术课学习中所亲自制作的作品常常是（　　）

A. 下课就扔掉　　　　B. 精心收藏

C. 经常拿出来给他人展示

D. 放置一段时间后扔掉

E. 其他

6. 你对待上技术课是（　　　）

A. 觉得很有兴趣，每次都上课　　　　B. 觉得没有意思，经常不上课

C. 觉得无所谓　　　　　　　　　　　D. 其他

7. 技术课教师通常会布置作业吗？___ 如布置，通常作业的类型是（　　　）

A. 资料调查类　　　　　　　　　　B. 实践制作类

C. 设计构思类　　　　　　　　　　D. 其他

8. 技术制作课上，教师在教授技术方法方面的情况是（　　）

A. 不教授技术方法，只是让我们模仿　　　B. 教一些思想方法

C. 教一些创造技法　　　　　　　　　　　D. 其他

9. 你校技术课程的考评方式一般为（　　）

A. 纸笔考试　　　　　　　　　　　　　　B. 作品制作

C. 平时成绩加作品制作成绩　　　　　　　D. 不考试

10. 你认为技术课程对学生发展的最主要价值在于（　　）

A. 促进动手能力提高　　　　　　　　　　B. 促进技术素养提高

C. 促进创造发明能力增强　　　　　　　　D. 促进艺术素养提高

E. 促进技术素养提高和人的个性发展　　　F.其他

11. 你认为你在技术课程学习方面的状况是（　　　）

A. 很有潜能　　　B. 有一定的潜能　　　C. 没有潜能　　　D. 其他

12. 你喜欢的技术课型有（　　　）（可多选）

A. 技术构思课　　　B. 技术制作课　　　C. 技术绘图课

D. 技术试验课　　　E. 技术理论课　　　F. 技术调研课

G. 展示交流课　　　H.其他

13. 技术课时被其他科目占用时，你觉得（　　）

A.很讨厌　　　B.希望不要再这样　　　C.很正常　　　D.挺好

14. 你认为现有技术课时满足你的学习需要吗（　　）

A. 课时不够　　　B. 正好

C. 太多，需要减少课时　　　D. 无所谓

15. 你认为技术课程学习与其他文化科目学习的关系是（　　）

A. 技术学习有利于文化科目的学习

B. 技术学习会影响文化科目的学习

C. 对部分同学来说具有促进意义

D. 两者之间没有关系

E. 其他

16.技术学习中你最大的收获是什么（　　）（可多选）

A.动手能力提高了

B.掌握一些了常用的构思方法

C. 形成了权衡、试验、探究的意识

D. 对技术的理解更全面了

E.解决技术问题信心增强了

F.其他

17.

(1) 你对技术课的态度是（　　　）

A. 非常喜欢　　　　B.很喜欢　　　C.喜欢　　　　　D.不喜欢

(2) 说说原因

18.

(1) 你在技术学习方面有什么独特的感受和有趣的故事：

(2) 你最想对技术课程说的一句话是：

(English Version[14])

Questionnaire for Senior Secondary School Students

Background Information

1. Your gender (   )

A. Male   B. Female

2. What is your grade? (   )

A. Senior Secondary One

B. Senior Secondary Two

C. Senior Secondary Three

3. What are your parents' occupations?

4. Your performance in other subjects learning is: (   )

A. Excellent   B. Good   C. Pass   D. Poor

The Learning Situation of Technology Subjects

1. Which modules are offered? (   )

A. Only compulsory module 1

B. Only compulsory module 2

C. Only compulsory modules

D. Only elective modules

E. None

2. What is your school schedule of the technology curriculum? (   )

[14] The English version is translated copy.

A. Once every week, two lessons every time

B. Twice every week, two lessons every time

C. Twice every week, one lesson every time

D. Once every week, one lesson every time

E. Once every two weeks, two lessons every time

F. Other

3. Where do you conduct hands-on practice? (　　　)

A. Classroom　　　　　　　　　B. Workshop

C. Depends on demand

D. Other

4. How much of the entire design process do you actually do in technical class? (　　　)

A. Entire design process

B. Just making, no drawing

C. Just drafting, no making

D. Design, drafting, making, no testing

E. Design, drafting, making, test, no optimization and evaluation

F. No practical operations

G. Other

5. What happens to the articles you make in the technology class? (　　　)

A. I throw them away after class

B. I keep them carefully

C. I often show them to others

D. I throw them away after keeping them for a while

6. Which of these choices best describes your attitude towards technology class? (　　　)

A. Very interesting, attend every time

B. Boring, always absent

C. Indifferent

D. Other

7. Does your technology teacher often give you coursework?

If yes, what type of coursework is it? (   )

A. Reviewing the materials

B. Hands-on making

C. Technical conception

D. Other

8. How do technology teachers teach technical methods? (   )

A. Through imitation

B. By teaching thinking methods

C. By teaching alternative creation methods

D. Other

9. In your school, how is the technology curriculum evaluated? (   )

A. Paper-based test   B. Technical project

C. Daily performance and technical project

D. No test

10. What is the main value of the technology curriculum for students' development?

(   )

A. Enhancing hands-on ability

B. Promoting technological literacy

C. Enhancing creative ability

D. Promoting arts literacy

E. Promoting technological literacy and personal development

F. Other

11. How would you describe your access to technology subjects learning? (   )

A. Full potential   B. A Little potential

C. No potential   D. Other

12. Which type of technical lesson is your favorite? (   )

(May be more than one choice)

A. Technical thinking

B. Technical making

C. Technical drawing

D. Technical test

E. Technical theory

F. Technical investigation

G. Exhibition and communication

H. Other

13. What is your attitude towards other subjects being taught in technical classes? (   )

A. Strongly against   B. Hope it will not happen in the future

C. Neutral   D. Positive

14. Was the number of class hours spent in technical classes enough to satisfy your learning? (   )

A. Not enough

B. enough

C. Too many, need to be reduced

D. Indifferent

15. How would you describe the effect of the technology curriculum on other academic subjects? (   )

A. Benefits other academic subjects

B. Obstructs other academic subjects

C. Improves learning for some students

D. No effect

E. Other

16. What are the biggest gains from studying technical subjects? (   )

(May be more than one choice)

A. Improving self-operating skills

B. Mastering some common thinking methods

C. Forming awareness of trade-off, experiment and exploration

D. A comprehensive understanding of technology

E. Improving self-confidence in solving technical problems

F. Other

17. What are your feelings about the technology curriculum? (   )

A. Strongly like　　　　B. Quite like

C. Like　　　　D. Dislike

Give reasons for your choice:

18.

(i) Please talk about your experience about learning technical subjects and give an interesting story about your technical subject class.

(ii) What do you think about the technology curriculum?

Appendix J

(Chinese Version[15])

普通高中技术课程实施现状调查学生座谈提纲

基本信息（学生填写）

1. 你的性别是（　　）

A. 男　　　　B. 女

2. 你的年级是（　　）

A. 高一　　　　B. 高二　　　　C. 高三

3. 你父母的职业是：

4. 贵校技术开课的起始时间是（　　）

A. 高一上学期　　　　B. 高一下学期

C. 高二上学期　　　　D. 高二下学期

5.你们技术课的排课方式是（　　）

A. 每周 1 次，每次 2 节　　　　B. 每周 2 次，每次 2 节

C. 每周 2 次，每次 1 节　　　　D. 每周 1 次，每次 1 节

E. 每 2 周 1 次，每次 2 节　　　　F. 其他

6. 你们上技术课的场所经常在（　　）

A. 普通教室　　B. 技术实践室　　C. 根据需要确定教室　　D. 其他

7. 技术课上学生动手操作情况为（　　）

A. 很多　　B. 较多　　C. 一般　　D. 很少

[15] The Chinese version is original copy.

8. 技术课上，你经历过技术设计全过程吗（　　）

A. 经历了全过程　　　　　B. 只做了作品，没有绘图

C. 只做了绘图，未进行制作

D. 有构思、有绘图、有制作，但没有试验

E. 有构思、绘图、制作、试验，但没有优化与评价

F. 没有动手操作过

G. 其他

9. 您通过技术课独立制作过自己心爱的作品吗（　　）

A. 没有　　B. 偶尔　　C. 经常　　D. 其他

问题访谈

1. 你认为技术课程与其他学科课程之间有无差别？你了解技术课程培养的目标是什么？技术课程的价值是什么？

2. 技术老师课堂常用的教学方式有哪些？你喜欢哪种？是否有动手实践，如有，是在普通教室上还是技术专用教室上课，所需的材料从哪里来？

3. 在动手制作之前有没有方案的设计？如有，一般方案设计所花的时间是多少？

4. 你是否喜欢你的技术老师？为什么？

5. 技术老师主要依据什么来评价你的技术课的学习？你是怎样看待的？

6. 你喜欢上技术课吗，为什么?是否愿意花时间在技术课程上面，为什么？有没有被其他学科占用或改为自习课，你是如何想的？

7. 技术课程学习中你最大的收获是什么，请举例说明？对其他学科是否有帮助，理由是什么？

8. 你认为学校、教师、家长对技术课程的态度是怎样的，你为什么这样认为？请举例说明。

9. 你认为现在技术课堂存在的问题有哪些？

20. 请用一句话表达你对技术课程的想法？

(English Version[16])

Interview Outline for Senior Secondary School Students

Background Information

1. Your gender (   )

A. Male   B. Female

2. What is your grade? (   )

A. Senior secondary one

B. Senior secondary two

C. Senior secondary three

3. What are your parents' occupations?

4. When did you start learning technical subjects in school? (   )

A. Semester One in Senior Secondary One

B. Semester Two in Senior Secondary Two

C. Semester One in Senior Secondary Two

D. Semester Two in Senior Secondary Two

5. What is your school schedule of the technology curriculum? (   )

A. Once every week, two lessons every time

B. Twice every week, two lessons every time

C. Twice every week, one lesson every time

D. Once every week, one lesson every time

E. Once every two weeks, two lessons every time

[16] The English version is the translated copy.

F. Other

6. Where do you conduct the hands-on practice? (   )

A. Classroom   B. Workshop

C. Depends on actual demand

D. Other

7. How much hands-on activity is there in your technical classes? (   )

A. Very much   B. Much

C. A little   D. Little

8. How much of the entire design process do you actually do in technical class? (   )

A. Entire design process

B. Just making, no drawing

C. Just drafting, no making

D. Design, drafting, making, no testing

E. Design, drafting, making, test, no optimization and evaluation

F. No practical operations

G. Other

9. Have you had the opportunity to make your favorite objects in technology class?

(   )

A. No   B. Sometimes

C. Often   D. Other

The Interview Questions

1. Is there any difference between technical subjects and other subjects?

Do you know the curriculum standards for technical subjects?

What value do technical subjects add to the curriculum?

2. What teaching methods does your technology teacher use? Do you like them? Is there any hands-on practice activities? If yes, are they conducted in a normal classroom or a workshop? What is the source of the materials?

3. Do you create a design scheme before making an object?
   If yes, how long does it take to finish the design scheme?

4. Do you like your technology teacher? Why?

5. How does your technology teacher evaluate your learning?
   What do you think of this evaluation method?

6. Do you like technology classes? Why?

Do you want to spend your class time on technology courses? Why?

Are other subjects often discussed in technical classes?

If yes, what do you think of this phenomenon?

7. What have you gained from the technical classes?

Please give an example.

Does the technology curriculum contribute to learning in other subjects?

Please give your reasons.

8. What are the attitudes of your school, teachers and parents towards the technology curriculum? Please give some examples.

9. What are the problems in the technology classes?

10. In one sentence, express your opinion of the technology curriculum.

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