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Choosing to Study Science in Taiwanese Schools:
Perceptions of Science and other Influences on
Students’ Choices
ACKNOWLEDGEMENT

PhD has been an unexpected long way to me. After working on this research for so many years, I should have a lot to say not only in my thesis but also in this acknowledgement. However, I feel words can’t express my feeling and gratefulness with what I have been through for what I have experienced since I first arrived five years ago.

Many thanks to my Taiwanese family and English family. They have shown a great support in my life and study. Without them, I would not be able to complete the PhD.

Special thanks to my supervisors, John Lowe and Paul Denley. They have given me a lot of support and caring during. Especially John, who has not only provided guidance for the thesis, read every word of my thesis and also gave me a lot of encouragement.

Special thanks to Joe and Alan who have spent countless hours reading my thesis. Nothing more can express my appreciations.
ABSTRACT

There is widespread concern in many Western countries over the declining levels of uptake of science at the upper levels of high school. In contrast, Taiwanese senior high school students have a greater tendency to choose science rather than social studies and achieve highly in international comparative tests. The well-developed technology industries in Taiwan also suggest that science education in Taiwan has been a success. However, the attitude toward school science, unlike the promotion of scientific attitudes, has received little attention in Taiwanese schools.

This paper firstly investigates 729 students’ attitudes toward both school and real-world science. The results show that the high level of uptake of science is not strongly associated with positive attitudes towards science as a subject. Few differences were found in the affective responses to school science between the Natural Sciences programme (NSP) and Social Studies Programme (SSP) students, with only a minority expressing a positive attitude to science in both cases. The research findings challenge the simplistic linking of attitudes and uptake in this context.

This research then seeks to understand this unusual phenomenon by exploring the nature of and influences on students’ subject choice decision-making. Through focus group discussions with students and interviews, this research explores the sources of students’ perceptions of science and social studies, identifying influences derived from the teaching of school science itself but also those arising from ‘external’ contexts of wider society, including cultural and economic influences.

The results show highly complex relationships between students and the surrounding actors, i.e. parents, teachers and the media. The findings also demonstrate possible explanations why students are doing well in school science and in industry but have not produced prominent discoveries or achievements in the world’s academic research. Drawing on Taiwan’s distinctive socio-cultural context, this research provides a different perspective from that in western science education research literature on the factors that shape science uptake.
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CHAPTER 1. INTRODUCTION

1.1. The Development of This Research in Chronological Order

In this thesis, the research will illuminate a variety of factors that influence Taiwanese high school students’ subject choices, from their perceptions of science to the surrounding actors that have influenced their decision-making in choosing their ‘study groups’ (see chapter 2). However, the development of this thesis emerged through several stages of the research, which also reflected my changing perspectives on the researcher’s role. For example, the initial research stage focused on the investigation of the Taiwanese students’ attitudes toward school science. From this preliminary study, students’ perceptions of school science and real science and factors influence students’ choice of study groups were explored in the latter stages. Therefore, the notion of exploring the decision making process, emerged from the interesting results of the first research phase on students’ attitudes.

The initial inspiration for this research was generated by the contradiction between the poor personal motivation, observed in science classes, and the good performance shown in international science and mathematics competitions. A further aspect was the links between Taiwan’s strength of engineering and science in the work place. The country’s well-known level of development in high technology industries appears to be inconsistent with the learning motivation of students. The intention was to examine whether students really dislike science or if it was an incorrect perception of mine, arising from my teaching frustration and fatigue. Therefore, primarily, it was important to understand the students’ attitudes toward science. Such considerations have not previously been brought to the attention of the government and educators in Taiwan, due to the sparse Taiwanese research literature and empirical data on this topic. The study of students’ attitudes towards real and school science was deemed necessary at the beginning, in order to avoid a personal bias and presumption about students’ attitudes.

The results from the first study showed that the attitudes toward school science did not necessarily determine the choice of study group but students’ attitudes towards
real science were highly positive. Other factors, such as the perceptions of school science and other concerns from their cultural background seemed to be possible factors taken into account by students during the process of their decision-making.

The second stage of the research was to investigate students’ perceptions of school and real science, in the hope that their perceptions of science and social studies would provide a good linkage or evidence of why students choose their subjects.

The third stage of the research involved further explorations of the reasons why students choose to study science (NSP) or social studies (SSP), because of the results from the first and second stage of the research. However, the results and their discussion are not arranged in this thesis in the same order as the research stages because the relationships of different topics identified in the later stage.

1.2. The Research Focus and Scope

1.2.1. The rationale for the research

There is a large body of research on students’ preferences for different subjects and the reasons why students have chosen their subjects. These studies have been carried out within various countries, although the culture of the country may not necessarily have been taken into account. Intrinsic interests, perceived difficulties, gender differences, and experiences of curriculum design and pedagogy are identified as the main factors in the students’ choice for subjects (Garratt, 1986; Hendley et al, 1996; Whitehead, 1996; Turner and DiMarco, 1998; Elsworth, 1999; Bennett, 2001; Osborne, 2003; Banya, 2004; Miller et al, 2006). The current science education in Taiwan tends to focus on promoting scientific attitudes, e.g. observation and logical inquiry, rather than considering students’ attitudes toward school science, e.g. whether they like to learn the subjects or not (Su and Huang, 1999; Lin and He, 2002; Chou and Gao, 2004; Zhang, 2005).

In many western countries, students have a more flexible and wider range of subject choices at the age of 17. However, in Taiwan there are two sets of subjects to choose from, known as study groups. Taiwanese students must decide on one study group at the end of the first academic year, at the age of 16, or at the beginning of the second
year of senior high school, at the age of 17. The choice of study group at the age of 17 is not solely determined by attitudes towards school science but would seem to include more external and cultural factors (Chang, 1999; Fan, 2004). The decision for choosing a study group appears to be very important and complicated. Research and information on the influences which affect students’ decisions and the modelling of decision-making tends to be sparse and I have tried to present these possible factors diagrammatically (see Figure 10-1). The choice of subject, similarly, might include various internal and external factors relevant to Taiwanese students’ decision making. The diagram of pro-environmental behaviour (Figure 3-3) was used initially as a framework in this research. It is used to explore the influences or concerns that Taiwanese students have during their decision-making process of study group. However, a new model of students’ decision making for their subject choice was constructed, based on the further empirical data collected from this research.

1.2.2. Research foci and scope
To present a more complete and comprehensive picture of students’ school science education, opinions from students have to be identified, invited, considered and taken into account without any preset stances or bias. Therefore, the main foci of this research will be exploring the factors that influence Taiwanese students’ subject choice at the point when the curriculum is separated, including their attitudes toward school science, their perceptions of school science and other concerns. Internal and external factors that may either shape or affect students’ attitudes toward different subjects and the up take of science are investigated. Thus, issues such as personal factors, systemic structure, and academic reason, are included in this research, together with the effect of cultural aspects, peer pressure, parental expectations, and teachers’ influence.

In summary, the aim of this research is to answer the following questions:
1. What are Taiwanese students’ attitudes toward school science?
2. What are the factors that shape students’ attitudes toward school science?
3. How is school science perceived by students in Taiwan?
4. What are the influences and context that affect the students’ decision-making process about further study of science?

Structure of the Thesis
The structure of this thesis consists of the consideration of three themes:

- The decision making process of subject choice.
- Attitudes toward school science and real science.
- Perceptions of natural science and social studies.

Figure 1-1 shows a concise and comprehensive summary of the structure of this research. The rationale and outcome are categorized into sections to show the relationships between different foci. The basic preparation of this research comprises the background, literature and methodology on students’ attitudes and the factors that influence their decision making. Data collected from the research is presented in three categories, namely, attitudes, perceptions and decision-making. These categories are interrelated. The research tools used for different foci are shown in the pink cells, and the participants in different research stages are shown in blue cells.

![Diagram showing the structure of the research](image)

Figure 1-1. The structure of this Research

The following paragraphs are brief descriptions of each chapter in this research:

**Chapter 1** gives a brief introduction of the development of this research in a chronological order. The research expanded over time and consisted of several research stages. The purpose of this chapter is to present the initial research enquiry leading to an overall picture research of the research. The research foci, scope and rationale are also introduced in this chapter to give readers a clear view and direction.

**Chapter 2** provides the background of the educational structure and examination
system in Taiwan. These are important aspects that could help to explain the boundaries and constraints of students’ choices. The context of the students’ background provides readers with a better understanding of the predicament faced by the Taiwanese students in making their choices.

Chapter 3 provides a review of existing research that has explored students’ subject choice, including attitude towards science, perceptions of science and decision-making. Theories, paradigms or models from related literature are also introduced.

Chapter 4 presents the methodology of this project, including the research questions, research aims, research framework, research methods, and research design. The particular research techniques used for this thesis, are discussed and justified.

Chapter 6 is the summary of students’ perceptions of school science and real science. Their perceptions of social studies are also included to show the similarities and differences with respect to natural science and social science.

Chapter 5 is the summary of students’ attitudes toward school science and real science, which provide an overall picture and insight of high school students’ science learning experience in the school. Suggestions from students to improve their attitudes toward school science are included. A model of choosing to study science in the school is constructed based on a previously-encountered pro-environmental behaviour model.

Chapter 7 reveals the factors and influences on students’ decision-making. Results of how students make their choice of study group are presented from different groups of participants: students, teachers and parents. It provides a clear and broad picture of the decision-making process, as well as displaying the relationships between the individuals and their surroundings. A basic model of influences that students encounter when making their decision was constructed based on the data collected.

Chapter 8 is a detailed illustrative personal story of a male social study student, Shaun, who chose not to take up natural science, when everyone was expecting him to do so.
Interviews with him, his mother, his former chemistry and biology teachers, as well as a focus group interview, are presented in this chapter to develop an understanding of his reasons for choosing social study, and the relationships between him and the influences. The story contextualises the difference between individuals and the possible pathways that individuals take that might be different from each other.

Chapter 9 is another illustrative personal story of a female science student, Jade, who choose to study natural science while she did not have a great pressure to take up science. Interviews with her, her father, her chemistry and physics teachers, as well as a focus group interview are presented in this chapter. An in-depth picture of how she made her decision and the relationships between her own concerns and other influences are discussed to illustrate the complicated interactions between different influencing actors.

Chapter 10 provides an exploratory framework for the following contributing factors: internal, external, structural, social and unpredictable. These factors are produced by different conflicts over time: individualism and collectivism, tradition and modernism, localisation and globalisation. The implications of factors and actors that influence students’ decision-making are also discussed in this chapter.

Chapter 11 presents the conclusions of this research. Apart from providing an insight into the Taiwanese students’ decision-making process on subject choice, the possible applications of this research and recommendations are also made. Suggestions are given to improve Taiwanese students’ attitudes toward science and to understand their choice. The conclusions from the data and analysis may also provide useful information and enlightenment for educators, working in contexts with similar cultural, educational systems and economic development, such as the Confucius Heritage Countries (CHC).
CHAPTER 2. BACKGROUND: CONTEXTUALISING THE RESEARCH IN THE RESEARCHER’S BACKGROUND

2.1. The Emergence of the Research

2.1.1. Performance of Taiwanese students in international competitions
Secondary and primary school students in Taiwan have always played a competitive part in many international assessments, especially in Science and Mathematics assessments. Every year, there are several major examinations held in Taiwan for secondary school students. Students both study hard and perform well for these particular examinations, in order to continue to the next education stage, namely the senior high schools and universities. Limited access to top schools promotes strong competition for these set placements. Furthermore, the results of the Third International Mathematics and Science Study (TIMSS) assessment in 1999 and 2003 have shown the excellent performance of Taiwanese students in Science and Mathematics for the student ages of 10 and 14 (see Appendix 1).

In 1999, the 14-year-old grade eight students, ranked third place in Mathematics and first place in Science. This was amongst 26 participating countries. In 2003, though slightly lower than the previous one test, the 10-year-old and 14-year-old students still both ranked at fourth and second place in Mathematics and Science among the 38 participating countries. In addition, Taiwan has just participated in another new international assessment, the Programme for International Student Assessment (PISA), held by the OECD, in 2006 and was one of the countries that has the highest scores.

It is not only the primary and junior high school students, aged 10-15, who have performed well in Mathematics and Science; the senior high school students have also won many prizes in the International Olympiad Competitions every year (see Appendix 2). During ten years (1996-2005) of participation, the Taiwanese high
school students have always been placed within the top 10, for all subjects, including Mathematics, Physics, Chemistry, and Biology. With a population of only 23 million, and an area of just 36,000 square kilometres, Taiwan is very effective, in terms of producing prize winners.

With all these outstanding performances, in various assessments, Taiwanese students appear to excel in Science and Mathematics, or at least have potential to develop knowledge in science. In fact, it is not only Taiwanese students who are competitive in the world but also other nearby countries, such as Singapore, Hong Kong and South Korea. Taking a brief look at the results from the TIMSS international assessment, these countries have all occupied the top places in the league table. However, this part of the world in recent years has not been recognised for great scientific discoveries or inventions. Most of the important scientific breakthroughs or discoveries of the century, regarding the origin of modern science that took place mainly in Europe and the USA. Medhat (2003) stressed that the UK has consistently had a leading position in the development of modern science and technology, although statistically, it shows the number of students studying science at the university has been declining in recent years.

Moreover to date, no person working in local institutions or organisations in Taiwan, Hong Kong, Singapore, or South Korea has been awarded a Nobel Science Prize, although there have been a few Japanese winners in recent years. (Hideki Shirakawa won 1/3 of a Nobel Prize in Chemistry; Ryoji Noyori won 1/4 of a Nobel Prize in Chemistry, 2001. Koichi Takana won 1/4 of a Nobel Prize in Chemistry, 2002). It is difficult to understand how countries, whose students have the best achievements in the world, do not make a notable contribution in world science.

2.1.2. The prominent performance of Taiwanese industry and economic environment

For the past 10 years, Taiwan has become known for the high productivity of electronic goods, and semi-conductor and biotechnology manufacturing. Following the Innovation Act of the Taiwanese Government (1976), industry in Taiwan has changed from being largely labour-intensive to being high-tech development in 1980. High technology has boomed in the island and has become the primary basis of the economy (Gold 1986; Hwang 1995). As a result of annual revenue increases more
capital and labour have been put into the market every year. Every year more than 180,000 science undergraduates and postgraduates flow either into the labour market or into further education (see Appendix 4).

In view of the anomaly in school performance related to its scientific contribution, Taiwan is still renowned for its advanced techniques in manufacturing for both the semiconductor and computer related industry. This high-tech industry has contributed to one fourth of the GDP of Taiwan (see Appendix 4). More than 80% of the world’s computers, 70% of LCD monitors and PDAs and 95% of motherboards are made in Taiwan (see Appendix 4). Previously, between the 1960s and 1980s, Taiwan’s manufacturing industry was low-skill and low value-added, concentrating on products, such as shoes, bicycles, and toys (Gold, 1986). However, as Taiwan industry has attained a higher level of expertise, many Taiwanese factories have been moved to other countries such as Malaysia, Thailand, and Vietnam, due to the attraction of cheap labour in South-East Asia. The termination of Taiwanese martial law in 1987, brought a bigger impact to Taiwan because it became accepted for Taiwanese factories to be transferred to China for its cheaper land and labour, as well as the attraction of potential markets. Taiwan has experienced a gradual migration of its business, since the 1960s, however, this has become significant and complete over recent years. More than 80% of the traditional industry has moved or extended their production lines in China (Economy Report, Ministry of Economy, 2006). In addition to the above, the importation of foreign labour from South-East Asia, has caused a great impact on Taiwan’s economy and society. The result has been a change of the economic structure and a high unemployment rate (see Appendix 4). The unemployment rate was 1.23% in 1980, 4.1% in 2005 and 3.9% in the first half of 2005. The difference between the highest and lowest unemployment rate was more than 5%.

The Taiwanese government has set up a Technology Developing Program (TDP) to provide considerable funding for universities to build various research and industrial centres since 2003. More than 3% of the GDP was provided to the technology and research centres since 2004 (less than 6% of the GDP is spent in education) and more than 80% of this funding went to universities (see Appendix 4.). Over 53 themed industrial technology innovative Research & Developing (R&D) centres or
laboratories had been set up by 2006 (Department of Industrial Technology, Ministry of Economic Affairs, R. O. C., 2008).

More than twenty years have gone by since, the first migration wave; Taiwan still remains a leading export country in the world. The main difference is that industry has transformed from low-tech manufacturing, to the production of high-tech components and devices (Economy Report, Ministry of Economy, 2006). In addition, Taiwanese manufacturers have developed expertise in product design, to meet people’s needs in the areas of electronics, IT and other technologies and new materials, such as nanotechnology in fabrics. With the extension to China in the business world, the high-tech industry has combined the advantage of advanced design and development skills in Taiwan, with the cheap production cost in China.

2.1.3. Teaching experience in secondary schools
As a secondary school science teacher in Taiwan for five years, I encountered some difficulties in promoting students’ motivation towards learning school science. Colleagues at the same school often mentioned the same problems. After meeting many science teachers from other schools, I discovered that they also experienced these same difficulties. I realised that this is a serious problem for many science teachers and perhaps also students: many secondary school students are very reluctant to learn science in the school. This seems to contradict the good results in assessments described above, and the current well-developed technology and industry in Taiwan.

Furthermore, if the learning situation and students’ attitudes towards science are below teachers’ expectations, it is difficult to explain how students achieve an excellent performance in international competitions. In addition, many Taiwanese students choose science subjects at university level, whilst in many western industrialised countries there is a problem that a declining number of students are choosing to do science and engineering subjects at university (Dulski, 1991; Osborne, 2003; Guardian, 2005). To explain such a phenomenon needs a close and deep analysis, with exploration of students’ attitudes toward science, perceptions of science-based subjects and the supply of science human resources.
The current research arena that relates to science education in Taiwan mainly focuses on students’ scientific attitude and teaching pedagogy. The aim is to promote students’ knowledge in science. There appears to be little research in Taiwan to explore whether students enjoy their learning. In other words, students’ overall views toward learning science and the factors that shape Taiwanese students’ feelings toward science are rather unclear. This has neither been discussed in the government’s educational policy, nor has it been included in the curriculum documents. In addition, there would seem to be a sufficient supply of science students to Taiwanese industry. However, if teachers are having great difficulty teaching science at secondary school level, this contradicts the fact that many senior high school students choose to continue studying science subjects. The influence of teachers may be one reason for this inconsistency or possibly, there are other reasons for students to choose science. My observation over the five years of teaching suggest that there could be many underlying factors that also contribute to the formation of students’ views towards science. In addition, there may be other concerns that students take into account, when making their study group choice at senior high school level.

From my own working experience in Taiwan, I was fully aware of the problem that students were pressured to compete for the best senior schools. As a result of high stakes competitions, teaching and learning become very examination-orientated. Such methods may distract from the true purpose of education and this was also mentioned in the proposal of educational reform by the R. O. C., Ministry of Education in 1997.

2.1.4. Enrolment in higher education and subject choice
Although, education is compulsory up to the age of 15, more than 95% of the students continue the second part of their secondary education, after the age of 15. Furthermore, more than 80% of high school graduates have continued their education in the universities since 2004 (see Appendix 3). Most students continue with higher education after the age of 18.

Statistics over the last 10 years, of subject choice of undergraduate students in Taiwan, showed that the choice of science and technology remained steady at around 40-50% of all choices. The percentage continues to increase slowly every year. This is
different from the recent situation in the western world, where reports of the decline of science student numbers in many countries, such as the UK, U.S.A and Australia, are a serious issue (Dulski, 1991; Benett, 2001; Woolnough, 1991b; Medhat, 2003; LSAY Briefings, 2005). For example, Medhat (2003) revealed that, apart from biology, the fall in mathematics and science participation level at A or AS level, in the last ten years, was 30% in both physics and mathematics and 20% in chemistry. The decline at university level was 12% in physical sciences and 19% for engineering and technology. Up to 2002, 79 science and engineering departments had been closed in the UK (Guardian, 2004), and it was expected that more closures would follow; for example the closure plans of architecture, chemistry and physics departments in Cambridge, Sussex, and Reading Universities (Guardian, 2004; Smith, 2006). In contrast, however, there is no shortage of students choosing to study science subjects in Asia and the Far East, in countries such as China, Taiwan, Singapore, Korea and Japan (Guardian, 2005).
Figure 2-1. Percentage of students in the university level in 1998 and 2007 in Taiwan.


From an educational point of view, such prominent and cutting-edge achievements may only be attained through a successful science education programme. It would appear that the Taiwanese technology industry is supported by the science education in the Taiwanese schools. High-technology-based industries require sufficient scientific knowledge and labour market to support research and production in a fast changing technology and competitive commercial market. Naturally, the main suppliers for these demands are from Taiwan’s mainstream school education. The uptake of science related subjects is also high (see
Figure 2-1).

These subjects cover the area of basic science, applied science, engineering and technology. Every year, more than 110,000 science and technology students, graduate from Taiwan’s universities. Among them, more than 30%, equivalent to 35,000 students, continue with postgraduate courses, in science related subjects. The figures have remained consistent for more than 10 years, except that the growth of students choosing to do science increased 2% in 2007, in comparison to 1998.

It is not very clear why students choose to do science although we can hypothesise about key factors that influence students to choose to study science could be in particular, a major factor, the country’s economic and industrial development. However, it is important to understand and highlight the underpinning problems that accompany the superficial prominent uptake of science subjects.

The following section will provide some detailed information about the Taiwanese education structure in order to understand aspects of the Taiwanese context. Explaining the structure of the educational system, should provide a better understanding of the difficulties, dilemma, and pressure that students may experience or endure through their schooling. Also, factors and elements of structural and examinational concerns are mentioned during interviews in the empirical part of this research. It is important for the researcher and the reader to understand the context, in order to have a better understanding of the meaning of the interview data.

2.2. A Brief Introduction of Taiwan’s Modern History and Development

Taiwan was originally inhabited by people of Malay-Polynesian descent, who initially settled on the west coastal plains of Taiwan. The Island first appeared on the Chinese map in the “Three-country Era” (AD 220-285). However, the island was called “Pakan” by its own residents. During the subsequent settlement by the Dutch and the waves of settlers from China, the aborigines retreated to the hills, mountains, and one of the islands next to the east coast. Consequently the aborigines became
named the “mountain people” by the later immigrants from China.

![Map](http://www.worldatlas.com/webimage/country/as.htm) accessed on 2008-5-25

The history of the island enters into European history in around 1590, when the first Western ship passed by the island; Jan Huygen van Linschoten, a Dutch navigator on a Portuguese ship, exclaimed "Ilha Formosa" (Beautiful island), which became its name for the next four centuries. The Dutch started to bring in a large number of Chinese labourers from China during their occupation (1624-1662), while some of them returned after a few years and some of them stayed because of marrying the local aborigines or their family reunited in Formosa from China (Horrison, 2001; Government Information Office, 2008).

In 1663, the early Qing Dynasty in China, the Dutch were defeated by Zheng Cheng-Kong, who claimed to be the remnant of the Ming Dynasty and led a troop fighting against the Qing Dynasty. Zheng’s time ended in 1683 when the troops of the Qing Dynasty defeated his son. The immigrants from the coastal area of China near Taiwan continue to move to Taiwan in the next 200 years. Taiwan had also experience of several different short occupations by a few European countries.
However, Taiwan was ceded to Japan by China at the end of the nineteenth century when the Manchurian Qing Dynasty was defeated by the Japanese in the Sino-Japanese War.

During the 50-years of Japanese colonisation, the Qing dynasty was demolished and replaced by a “democratic” government- the Republic of China. Taiwan was returned to the Republic of China after the Japanese lost their war of invasion in China in 1945, also known as the end of World War II.

In 1948, the government of the Republic of China, led by Chiang Kai-Shek’s Nationalist party (Kuomintang, KMT), and its troops fled to Taiwan because of civil war in China against the Communist Party. Up to then, the Taiwanese had relied mainly on the island’s agriculture produce, a situation which started during the Dutch occupation and developed during the Japanese colonial time.

Taiwan’s economy started to take off in the 1970s due to the well-planned government-led economic strategies. By the mid-1980s, more than 60% of the island’s GDP was contributed by the manufacturing industry (Gold, 1986). However, with the opening up of China since the late 1980s, more than 80% of the traditional manufacturing industry moved to China because of the availability of cheaper labour. The economic development strategies led by the state switched from the traditional manufacturing industry to high-tech manufacturing in the 1990s and the innovative high-tech and bio-tech to date (Ministry of Economic Affairs, R. O. C., 2008).

2.3. **The People and Culture**

Before the KMT government fled to Taiwan in 1949, the people who settled in Taiwan were the early Chinese immigrants from the coastal area, a mixture of the Chinese immigrants and the plain-inhabiting indigenous people, and the indigenous people who were pushed to the mountains by the Chinese immigrants. When it was defeated by the community party in China, the KMT government brought mainly its congress members and soldiers (about 10-20% of the Taiwanese population at that time) to Taiwan. Most of them were from different areas of China. Thus the new wave of immigrants settled with the existing Taiwanese until the present.
Although there are different ethnicities and languages in Taiwan, about 97% of the population are Han Chinese. Therefore, the Han Chinese culture has been the dominant culture on the island. The traditional family values, customs, festivals and religions are still practiced in a traditional Chinese manner because of the relatively stable politics and society compared to communist China. 93% of the Taiwanese believe in Buddhism, Taoism, or a combination of Buddhism, Taoism and Confucianism. Confucianism is the fundamental philosophy that has run Chinese society for thousands of years (Jensen, 1997; Chen, 1994; Du 1998). It is a collective term for many scholars’ (known or unknown) books and teaching before and after Confucius. The term “Confucianism” is only used in the western world. The main teachings of Confucianism are: comply with the rituals, be loyal to the emperor, respect the elderly, show filial piety to parents, humanity and role/responsibility of the male in the family. The philosophy is taught and practiced in daily life and school. For example, the Analects of Confucius is still a compulsory subject in the Taiwanese school and excerpts from other books of Confucianism are included in the Chinese class on morals and ethics.

### 2.4. The Mainstream Education System in Taiwan

Taiwanese mainstream education is divided into three stages: elementary, secondary, and higher education. However, between the transition from junior high (Year 9) to senior high (Year 10) and senior high to higher education, students can choose to continue to different types of schools by taking different entrance examinations. These institutions and routes will both be introduced in this section.

The following diagram shows the routes and structure of the education system in Taiwan.
Figure 2-2. Main stream education system in Taiwan
(Source from Ministry of Education
data accessed on 2008-4-9)
Table 2-1. The Educational Stages in Taiwan

<table>
<thead>
<tr>
<th>Phase</th>
<th>Status</th>
<th>Age/ Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>Compulsory</td>
<td>6-12</td>
</tr>
<tr>
<td>Lower Secondary/ Junior High</td>
<td>Compulsory</td>
<td>12-15</td>
</tr>
<tr>
<td>Upper Secondary/ Senior High</td>
<td>Non-compulsory</td>
<td>15-18</td>
</tr>
</tbody>
</table>


2.4.1. Compulsory education

Compulsory education includes six years of schooling in elementary school, followed by three years at junior high school, which forms part of secondary education. Children begin schooling from the age of six; however, most parents send their children to kindergartens for private education before the official education commences. The higher education stage starts from university level after the completion of twelve years of education. Before 1979, all children were entitled to six-years of compulsory education, according to the Constitution of Taiwan, Republic of China (R.O.C.). However, compulsory education was extended to nine years after the newly promulgated National Education Law was enforced in 1979. All children aged between six and fifteen must attend six years in elementary school, and three years in junior high school, except for those with special needs. The act was reinforced by the establishment of the Statute of Compulsory School Attendance in 1982. Parents or guardians of school-age children are obliged to send their children to schools for compulsory education. The local Compulsory Attendance Committee are authorised to enforce the regulation with fines and/or other penalties. The enrolment rate of elementary and the first part of secondary education, had already reached 99% in the mid 1980s.
Table 2-1. The Educational Stages in Taiwan shows the different educational stages for each age group.

2.4.2. The upper secondary education
The secondary education system in Taiwan consists of two levels of schooling, known as junior high and senior high. The first part of the secondary education, the junior high, is compulsory. State schools are situated in almost every town all over Taiwan. According to the National Education Law, every ROC citizen between 12 and 15 years of age is eligible for public junior high school education and has the option of attending a private school. Students at this stage are encouraged to study hard, as well as to explore their aptitudes, to enable them to prepare for their further education, taking either the academic or vocational courses at senior high school level.

After the first part of secondary education, the junior high school students have to attend open examinations if they wish to continue to the next educational stage. There are four different institutions, which are senior high schools, vocational senior high schools, bilateral senior high schools and five-year (Junior) colleges. Since it is not part of compulsory education, students have to take entrance examinations to apply or compete to enter different types of schools. More than 96% of all junior high graduates have continued their studies in senior high schools since 2004 (see Appendix 3).

2.4.3. Higher education
The stage after the senior high school level is higher education and tertiary education (18+) in the five-year colleges. About 80% of the senior high graduates continued their education at university in 2005. This includes students who study in the universities and technology universities. Students have to pass different exams or entrance qualifications in order to continue to the higher education. The routes and examinations are described in the next section.

2.5. Admission of the senior high schools and universities

2.5.1. Transition from junior high to senior high or junior college level
Prior to 2002, there were three exams available for junior high school students to
continue to senior high schools, junior colleges and vocational schools. These were the Joint Public Senior High School Entrance Examination (JPSHS Entrance Examination) which took place after junior high, Joint Junior College Entrance Examinations (JJCEE) and the Joint Vocational Senior High School Entrance Examination (VSHSEE). Students had several opportunities to continue their study to the next stage because there were different examinations at different times and different types of schools from which to choose. However, the competition declined as the choice became less. The order of preference for students, was senior high school, junior college and vocational school. The time and order for the entrance examinations were the same: First, the High School Entrance examination in the beginning of the July, the Joint Junior College Entrance Examination (JJCEE) a week later, which was then followed by the Joint Vocational School Entrance Examination (JVSEE). The general public created a hierarchy of perceptions of students solely on their academic performance in the exams.

The old system of examination was simple but stratified: all students took examinations to proceed to the next stage, and competed with others for the limited placements in each future school, based solely on their results from the examinations. An educational reform campaign, starting in 1994 (Chou, 2003; Huang, 2003; Wu, 2004), called for the cancellation of such a monopolistic and academically focused examination system. Students now have more than one route to enter senior high school and university. The new system is called, the “Multi-Route Promotion Programme (MRPP), which relates to the goals of the Educational Reform Act since 1994 and 1997 (Huang, 2003; Li, 2005), and has more than two routes for students to apply to a school and university. The MRPP is a scheme that regulates routes of admission at each transition point. Originally, when the new system started in 2002, there were six routes at each transition point, but this was modified to two routes at the senior high school transit point and three routes at university transit point in 2004, due to complaints from teachers, students and parents about the complication and confusion.

The launch of the new Multi-Route Promotion Program (MRPP) system vowed to reduce study pressure, break down the highly selective mechanism of the old system, increase the flexibility of the curriculum and teaching, and improve the equality of
opportunity for every student (Ministry of Education, R. O. C, 1998; Wu, 2004). It is argued that examinations will always put pressure on students and for this reason, the old examination-only system should be abandoned. It is felt that students’ other talents, should be taken into account when they apply to schools, and not just their academic performance. However, the old nation-wide examination system remains in place and serves a similar selection function in the new exam system. Students still need to apply to schools with their results from the examinations. Most of the top students still take up the best vacancies that are thought to be in the best schools. Then those whose scores were slightly lower filled up the less good vacancies and so on accordingly. As a result, a clear hierarchical social status among students could easily be seen according to their school. Both parents and teachers pressure children to qualify for entry to the best schools.

The MRPP, thus, does not seem to achieve its original goals and has faced a lot of criticism since its introduction (Chou, 1998; Chen, 2002; Huang, 2003; Wu, 2004; Li, 2005). However, some researchers and the educational authorities still assume that the new exam system acts as a bringer of freedom and multi-choice, even though students still feel much study pressure (Huang, 2003; Du, 2005; Wu, 2004). The debate over the MRPP remain a regularly issue in the Taiwanese Educational Reform after its first introduction more than a decade ago, although it seems that the Ministry of Education has no intention to return to the old system.

2.5.2. The transition from senior high school level to university
Prior to 2002, there was only one single Joint University Entrance Examination (JUEE) for senior high school students who wanted to continue to universities. The JUEE was open to all students to compete for all universities. Students took the examination and when they received the results, they fill in a form stating their preference of schools and subjects. The final results are decided by a competition of scores. Students who failed or were unhappy with their result, could only re-sit the examination the following year.

The Multiple Route Promotion Programme (MRPP) has also regulated the entry routes for senior high school students. A new benchmark exam, the “Subject Ability Test (SAT) for College-bound Seniors”, was introduced. It serves the function of an
index examination for senior high students, in the same way that the BCT does for junior high students. The new examination takes place in the second term of the third year, at senior high school. Students must take all academic subjects, including Chinese, English, Mathematics, Physics, Chemistry, History, Geography and Biology. Students apply to universities with their expertise and results from SAT. Those students who want to study for certain special subjects, such as sports, art and music may need to take technical examinations, in addition to the academic SAT.

However, many universities also adopt another exam, the Appointed Subject Examination for Universities (ASEU). 60% of the students take the exams (3-6 subjects) according to the requirements of the department which they want to apply.

2.5.3. The Course Differentiation
In Taiwan, the curriculum of compulsory education aims to provide an all-round knowledge, in all subjects at an introductory level. After students start the senior high school level, they are encouraged to explore their interest in the first year. They choose their study groups by the end of the first year, especially in the normal senior and bilateral senior high schools. Students only take the subjects they choose in preparing for universities, and no longer have to do all subjects from this point onwards. Although some independent schools start the differentiated courses in the first year of senior high school based on a strategic approach to tackling the SAT, most of the pubic schools ask their students to decide their study groups before the beginning of second year of senior high school.

Unlike in the UK, students in Taiwan do not choose individual subjects. There are only two study groups available, which are the Social Study Programme (SSP) and Natural Science Programme (NSP). The students who choose SSP have to study Chinese, English, Mathematics, History and Geography, while those who choose NSP have to study Chinese, English, Mathematics, Physics and Chemistry. Biology is an optional additional subject in the NSP. Students are only allowed to choose one study group. Taking both study groups is almost impossible as the Natural Science Programme and Social Study Programme run at the same time in the school.

Further groups are made at the point of taking SAT for university level. These groups,
however, are slightly different from those at the senior high school level. Universities offer 4 collective groups of subjects, as shown in Table 2-8. Only choices in group 1 are offered to students who did the SSP, the rest of the groups are categorised as NSP groups. Data collected in this research often refer to the university entrance exam or choices in the university as group 1-4 (shown in
Table 2-2). Choosing a study group in the second year of high school is the first subject choice for Taiwanese students.
Table 2-2. Study group choice and required subjects in the University Entrance Examinations

<table>
<thead>
<tr>
<th>Types</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social Engineering</td>
<td>Science and Technology</td>
<td>Biology and Medicals</td>
<td>Home Economy and Agriculture</td>
</tr>
<tr>
<td>Required Exam Results of Subjects</td>
<td>Chinese</td>
<td>Chinese</td>
<td>Chinese</td>
<td>Chinese</td>
</tr>
<tr>
<td></td>
<td>English</td>
<td>English</td>
<td>English</td>
<td>English, Mathematics</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>Mathematics</td>
<td>Mathematics</td>
<td>Mathematics</td>
</tr>
<tr>
<td></td>
<td>History</td>
<td>Physics</td>
<td>Physics</td>
<td>Chemistry</td>
</tr>
<tr>
<td></td>
<td>Geography</td>
<td>Chemistry</td>
<td>Chemistry</td>
<td>Biology</td>
</tr>
<tr>
<td>Examples of majors/subjects</td>
<td>Chinese, Mathematics</td>
<td>Mathematics, Physics</td>
<td>Medical</td>
<td>Domestic, Education</td>
</tr>
<tr>
<td>in the universities</td>
<td>English</td>
<td>Chemistry, Electronics</td>
<td>School, Dentistry</td>
<td>Entomology, Horticulture</td>
</tr>
<tr>
<td></td>
<td>History</td>
<td>Material Engineering</td>
<td>Veterans, Nursing</td>
<td>Applied, Science of Living</td>
</tr>
<tr>
<td></td>
<td>Politics</td>
<td>Science, Environmental</td>
<td>Psychology, Agricultural</td>
<td>Forestry, Aquaculture</td>
</tr>
<tr>
<td></td>
<td>Finance</td>
<td>Engineering</td>
<td>Chemistry, Occupational</td>
<td>Food</td>
</tr>
<tr>
<td></td>
<td>International</td>
<td></td>
<td>Therapy, Food Science</td>
<td>Nutrition</td>
</tr>
<tr>
<td></td>
<td>Trades</td>
<td></td>
<td>Biotechnology, Biomedical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Music, Arts</td>
<td></td>
<td>Laboratory, Laboratory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Statistics</td>
<td></td>
<td>Science</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Applied</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science of Living, Social</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Therefore, readers need to bear in mind that when the participating students mention group 1-4, they refer to the choice they can have at the university level.

In the next chapter, I am going to examine some literature relating to factors that might shape students’ attitudes towards school science and their subject choice.
CHAPTER 3. LITERATURE REVIEW

The initial rationale of this research started from exploring students’ attitude towards school science as this is thought in the western literature to be more related to the behaviour/decision of students’ subject choice. Therefore, the literature reviewed at the first stage concerned factors that might influence or shape students’ attitudes toward school science. The second stage of the research focused on the exploration of the factors that influence students’ choice of subjects; therefore, literature related to the topic were reviewed and discussed. As a result this chapter introduces literature that investigates factors that

– shape students’ attitudes toward science, including the perceptions of school science;
– are involved in young people’s decision-making, such as family and cultural variables, in order to understand how students choose their study subjects.

3.1. Students’ Attitudes toward School Science

I begin by looking at some general definitions regarding this research, such as understanding the meaning, nature, and development of attitudes, and then progress to more specific attitudinal concerns regarding school science and the wider everyday science (real science). The term “science” mentioned in this research refers to the natural science taught in the school or which is encountered in daily life, rather than “social science” of the humanities arena.

The term “attitude” has been defined in many different ways. It is often perceived as whether you “like” or “do not like” an object or issue in our daily common sense language. An influential social psychologist, Allport, wrote his definition of attitude in the Handbook of Social Psychology in 1935 (p. 810):

A mental and neural state of readiness organised through experiences, exerting a direction or dynamic influence upon the individual’s response to all objects and situation with which it is related. In a sense, Allport thought that attitude is a joint outcome of emotion and consciousness that directs a person to react to a stimulus.
He also stressed the importance of attitude in modern social psychology (ibid. p.798): The concept of attitudes is probably the most distinctive and indispensable concept in contemporary American social psychology. No other term appears more frequently in the experimental and theoretical literature. Allport might not have lived to see the importance and the function of “attitude” in later years, but the development of attitude research in both psychology and social science has expanded, being applied to various interests and topics, since then. However, in the 1960s and 1970s, there was less interest in this topic, due to speculation of a low correlation between measured attitude and observed behaviour. After the 1980s, a considerable amount of research was generated because modern psychology attracted new attention in the arena of cognitive psychology (Tesser and Shaffer, 1990; Olson and Zanna, 1993).

Oppenheim’s (1992) definition of attitude is that it is involved with various reactions and behaviour. He states that attitude is a “tendency to act or to react in a certain manner when confronted with certain stimuli”. The stimulus may be an object, institution, person, idea, or anything else that a person can react positively or negatively towards. The reaction may also be in many forms, e.g. physical, mental, verbal and other forms.

Hogg and Vaughan and (2005) defined the term “attitude” based on these previous studies (p.150). They wrote:

Attitude (a) A relatively enduring organisation of beliefs, feelings and behavioural tendencies towards socially significant objects, groups, events or symbols. (b) A general feeling or evaluation-positive or negative- about some person, object or issue.

Apart from emotions and behavioural tendencies, Hogg and Vaughan’s definition of attitude also includes the element of belief, which individuals might hold before the emotion is formed. However, there is a vague boundary and overlap between attitude, belief and values. Page et al (1979) argue for a difference between attitudes, values and beliefs, stating that beliefs are held cognitively as the outcome of knowledge attainment, value is an internalised evaluation, and attitude is affective response to stimuli. Although different terms or descriptions might be used by different researchers, their perspectives differ only slightly, and many of them basically define
attitude as the beliefs, value or reaction, a person has to a certain subject. Hogg and Vaughan (2005) continue by identifying the components that exist in attitude. According to them, there are three different models of attitude that have been identified by different groups of researchers: the one-component, two-component and three-component attitude models. The one-component attitude model is that an attitude consists of affect towards evaluation of the object. The two-component attitude model states that an attitude consists of a mental readiness to act. It also guides evaluative (judgemental) responses. The three-component attitude model is that an attitude consists of cognitive, affective and behavioural components. This three-fold division has an ancient heritage, stressing thought, feeling and action as basic to human experience.

Although attitude might be a tendency towards some action and some studies have included behaviour as part of attitude, it might be inappropriate to discuss how students are going to behave when the element of behaviour has already been included. Therefore, in this research, attitude will be viewed more as the psychological reaction that is supported by one’s beliefs/values, perceptions and yet is sometimes shown in one’s action or behaviour rather than including all personal emotional and physical action into one term.

3.1.1. How do attitudes form?
Attitudes are developed over years from an early stage, throughout the entire schooling; teachers and parents are the primary influences as learning experiences and other stimuli integrate themselves into the developing of attitudes toward science.

Attitudes may produce motives, which tend to be expressed by goal-directed behaviour to achieve or do various things. Attitudes may be re-enforced by beliefs, which are verbalized in the form of opinion. (Page et al., 1979)

Attitudes can form before, by the time, or even after a person encounters the object. Since attitude does not only include a person’s knowledge and beliefs, it can also be affected by that person’s emotional reaction and that of other surrounding people, as well as the ongoing experience of the event. That is to say, that attitude can form at any time, towards an object.
Attitudes formed before encountering the object are usually related to the experience of the person’s family or friends, namely, they are very often influenced by other people’s attitudes, due to the lack of direct contact with the object (Hogg and Vaughan, 2005) For example, not every young child knows that fire is hot and she should not touch it because she has been burnt by a fire, but because her parents keep telling her so, when she is close to a fire. One will often seek for information before one encounters certain events because of the need to secure the unknown future, about which one will also often pick up information or conversation between other people unintentionally.

However, most existing literature suggests that students’ attitudes toward school science are formed in the school (Woolnough, 1991a; Woolnough, 1994a; Jarman, 1999; Bennett, 2001) , which means that teachers, curriculum and their pedagogy might have a greater influence on students than their parents and friends, and education practitioners should focus on promoting students’ attitudes toward science from schools.

Recently, the massive influence of media, like newspapers and television programmes, has also played an important role in influencing people’s attitude in many aspects, especially – in the context of the focus of this research - in real science and the image of scientists. A considerable number of reports show that many students have a stereotypical image of science and scientists, and this might have some effect on students’ subject choice (BBC News, 1997; BBC News, 1999; BBC News, 2000; Glaser, 2006). Although there are calls for raising public understanding towards real science and scientists (Dulski, 1991; Breakwell, 1992; Wymer, 1997), more research needs to be done on the level of media influence on the formation of students’ attitude towards their subjects before students are taught of that subject or choosing the subject.

Reports about the influence of the media in Taiwan on students’ perceptions of science and scientists have not been found, suggesting that more research is needed to explore students’ images of scientists in Taiwan and the influence of media on students’ perceptions.
3.1.2. Change of attitudes

Attitudes often change when there is an influential good or bad experience in a person’s life. They also change when a person receives information of how other’s experiences have influenced them. For example, a girl might become afraid of dogs and may never want to touch them after being bitten by a dog or a chain smoker might give up smoking when he obtains statistics for the relationship between chain-smoking and lung cancer.

Research has explored the change of attitudes through surveys, interviews, observations or experiments. None of these have successfully addressed the mental transaction process when a person changes attitude. The mechanism of attitude change still remains unclear.

Petty and Cacioppo (1981) identified the change of attitudes were caused by the process of persuasion. They also acknowledged many theories that had been developed to explain attitude change. There are seven classified approaches when persuasion occurs in attitude change: conditioning and modelling, message learning, judgmental, motivational, attribution, combinatorial, and self persuasion. However, although Petty and Cacioppo have described all these approaches in detail, the process of changing attitudes tends to be a personal psychological reaction. None of these truly reported or applied in the domain of science attitude. If the multitude of attitudinal phenomena that occurs in the changing process of attitude towards science can be identified, the seven approaches might be useful in helping us to understand better. Nevertheless the complexities of enduring mind interactions are often beyond observation.

3.1.3. Why are attitudes toward school science essential to developing and learning science?

It is almost universally acknowledged that educational objectives in the affective domain- those dealing with attitudes, interests and value, are of great importance. (Choppin and Frankel, 1976:57)

Various concerns are mentioned as possible contributions to students’ attitudes in some studies; for example, the way science is taught in school, students’ interests,
gender differences, perceived difficulties, perceptions of school science, perceptions of real/everyday science, the image of scientists, cultural background, structural variables, and family background. (Schibeci, 1984; Koballa et al, 1990; Oppenheim, 1992; Ebenezer, 1993; Sunberg, 1994; Elsworth et al, 1999; Osborne and Collins, 2000; Bennett, 2001; Campbell, 2001; Osborne et al, 2003; Miller, 2006).

The affective element in the science curriculum was often not emphasised, as much as the cognitive part, in the early stages of science education a century ago, and many studies in science education still mainly aim to research the cognitive goals, namely the acquisition of knowledge in science (Edwards, 1999; Roberts and Gott, 1999; Nott and Wellington, 1999; Jenkins, 2000; Braslavsky, 2003; Williams et al, 2003; Scherer, 2004). Although some of these studies argue that the attitude towards science can be improved, different opinions remain over the question of whether the cognitive or affective goals should be given the priority. Many studies report that the affective variables are very often ignored or omitted by the teachers, especially when the available teaching time is limited (Jenkins, 2000; 2001; Bennett, 2001; Campbell, 2000; Braslavsky, 2003).

Some writers declare that the affective variables are as important as the cognitive variables, in terms of influencing students’ learning outcomes (Toh 1991; Turner and DiMarco 1998; Dawson, et al. 2002). The delight of doing something can result in happiness and joy, which often, later on, generates more interest and motivation to continue the work. Therefore, pupils’ attitudes towards school and real science have been established as an important element for students’ behaviour in school science. The good circulation of a happy learning atmosphere and academic achievement will eventually help students to achieve the highest performance (Delargey 2001). On the other hand, a negative attitude might start a vicious cycle because the greater the reluctance in learning the subject, the more resistance will occur through frustration. Eventually the psychological effect might stop students from exploring the new experience and applying their ability in science.

Schibeci (1984) stresses the importance of attitude toward science, in science education, by referring to the number of research papers that directly relate to students’ attitude at the National Association for Research in Science Teaching (113
papers in 1983) and 13% of the theses in 1982 at the University Microfilm International, a substantial numbers of UK theses and dissertations, and in the Australian Science Education Research Association annual conference.

Interests in students’ attitude towards science are still evident in researches (Bennett, 2001; Osborne; 2003; Murphy, 2006). All these informal indicators reveal the significant importance of attitude towards science in the arena of science education in western countries.

3.1.4. Studies related to students’ attitudes toward school science in Taiwan
In Taiwan, students’ perceptions and attitudes towards school science have only recently been identified as a research problem. Many researchers have focussed on scientific attitudes but only a few have drawn attention to attitudes toward school science. Yang (1996) found gender, gender-role, co-classes and separated classes affected junior high school students in their self-concept and attitudes toward science in the Taipei and Hsin-Chu area. Chang’s (1998) survey of college students in Hualien County (East of Taiwan) showed that the college students’ attitudes toward technology were positive but low level; and male students tended to have a more positive attitude towards science than females, while older students also had a more positive attitude than the younger students.

Chen’s (1998) investigation around the Taipei area, showed that primary school students 1.) Had a positive attitude to biology, 2.) Family and scholastic achievement played an important role, and 3.) Gender and location of the school showed no difference in measures of attitudes toward biology. Chiu (2003) adopted an action research strategy by introducing a science history integrated teaching method to promote elementary school students’ attitudes toward science and pupils’ understanding of the nature of science. Attitudes towards science were improved after introducing this teaching method. Chen (2004) conducted a quantitative study of 425 second-year high school students, within the central area of west Taiwan. The study identified causal links between attitudes and behaviour toward school science; the correlation coefficient was 0.94 and inferred strongly that the more positive the attitude students held toward school science, the higher the possibility they would choose to study science.
Wang et al. (2007) explored factors that affected the learning of biological concepts among junior high school students’ in Taiwan. The results showed that students living in urban areas had clearer and ‘better’ biological concepts, than those in suburban and rural areas. Gender had no significant effect. Also, the study found that students with more positive biology self efficacy watched science-oriented television programmes. They had stronger motivation and more positive attitudes towards biology learning, and achieved higher scores for their biological concept learning in the survey. These findings indicated that improved attitude is associated with improved learning.

Some issues related to students’ attitudes toward school science discovered in the western literature have not been reported in Taiwanese science education, such as the perceptions of school science and educational structural variables. This might be because in Taiwanese mainstream education, senior high school students who aim to continue their education at university normally have only two choices: the Natural Science Programme (NSP) or the Social Study Programme (SSP). Taiwanese students have a limited choice compared to U.S. or British students. However, as the encouragement of bilateral senior school has been enforced since 1994, there was an increase of subject choices in senior high schools (see Appendix 3). Such structural variables might also become a factor that influences students’ choices in the future, based on experiences in western science education.

Although Su and Huang (1998) started to address the lack of awareness and the measurement of attitudes towards science in Taiwan, all subsequent research used rating-based questionnaires to measure students’ attitudes, and these instruments were adopted from the attitude inventories originating in the western world (Chang, 1998; Chen, 1998; Chiu, 2003). Science education in Taiwan seems to be more focused on improving students’ achievement and measuring their attitudes with existing instruments developed elsewhere. Perhaps the research of attitude towards school and real science is still at an early stage of development in Taiwan and the concept of understanding the attitudes and enjoyment of learning school science has not become prominent because of the glory of students’ achievements internationally suggesting that there is no problem here. Factors that shape Taiwanese students’ attitudes towards science still remain largely unidentified and unclear. More in-depth
understanding of the issue and exploration of the real situation is needed for a more effective science education and greater enjoyment of the subject.

3.1.5. **Factors that influence students’ attitudes toward school science in the western educational system**

Over the past 20 years, western studies have shown that various factors affect the formation of students’ attitudes toward school science including factors that originate inside and outside the science classrooms, or so called in-class and extra-curricular activities (Munby, 1983; Schibeci, 1984; Woolnough, 1991a; Keys and Fernandes, 1993; Wellington, 1994; Woolnough, Nott and Wellington, 1999; Osborne and Collins, 2000; Osborne et al, 2003). However, students may start forming different attitudes and preferences toward different subject choices, before they can choose their study subject at Key Stage 4 (Age 14). For example, Hendley et al (1996) in their research of students’ preferences among different subjects in the UK found that mathematics and science are the most loved and hated subjects among all those at Key Stage 3.

Krynowsky (1988) identified some variables influencing students’ attitude by investigating the relationships of grade 10 students to their learning environment in the U.S. Factors that affect students’ attitude toward school science are: satisfaction with their work in the class, interest in the class and difficulty associated with science classes, clarity and organisation of teacher’s teaching pedagogy and the usefulness of science as perceived by students. Barrington and Hendricks (1988) tested the influence of grade, gender and IQ on students’ attitudes toward school science in the U.S.A. A total of 143 students of grade 3, 7 and 11 participated. They found out that 3rd graders have the most positive attitude and 7th graders have the least; high IQ students have a more positive attitude than the average students and gender was not found to have a significant effect on their attitude.

Wright (1988) also explored the influence of performance on attitude towards school science and the motivation to achieve good performance in 130 secondary students. The results showed that performance contributed as much as 39% to students’ attitudes toward science, and 23% to students’ motivation. Koballa et al (1990) also concluded that similar variables relate to attitudes, interest, and other affective
variables from surveying the related research in the same discipline.

Shapiro (1988) carried out an experiment to test students’ interest in television scientific stories. He identified that relevance, entertainment, value, ease of understanding and familiarity with the information, were important to raise students’ interest.

The review of the research by Osborne et al (2003), which covered a substantial proportion of literature in the last 20 years, categorised the identified factors in the existing literature including interest, gender, structural variables, classroom and teacher factors, curriculum variables, perceived difficulty of science, and enhanced subject choice. These all seemed to contribute to influencing students’ attitudes towards school science and the decline in numbers of science students at A-level. No single variable was stated to be the most or least important factor. This also suggests that the mechanism of the formation and change of attitude might be complicated and also not unitary. The students’ attitude might be the sum of all these sub-constructs, which contribute in different proportions in the formation of the attitude towards school science. Based on the categories that Osborne et al (2003) has listed, the discussion below considers how each factor influences students’ attitude towards science.

3.1.5.1. Interest
Interest or lack of interest in certain subjects has always been one of the most frequent answers when students were asked why they like or dislike science (Care and Naylor, 1984; Elsworth et al, 1999; Benett, 2001; Lyons, 2006). It is difficult to know how interest is formed because it seems to involve many factors, even genetic or intrinsic, and might be developed from an early stage. Care and Naylor (1984) examined school students' subject preferences in 30 Australian schools; the result suggested a strong association between interest in school subjects and occupational interest, as well as an empirical basis for classifying school subjects in terms of interest themes. Similar results were identified by Elsworth et al (1999) in the same field in Australia.
Since there are always different voices in improving science education, in the science education community, some research has suggested that the curriculum should be designed based on students’ interest. For example, Dulske (1991) investigated the decline of engineering enrolment by identifying and evaluating the relationships of secondary school students' attitude and the six selected science-related topical areas: space exploration, nuclear energy, the energy concept, environmental issues, science concepts, and metrication. He claimed that the procedure may be subsequently used to formulate an analytic path model in producing an effective way for informational reference during current classroom teaching and future science curriculum development. It was hoped that the results would assist the reversal of the current trend of decreasing science enrolment, and to concurrently enhance general public scientific literacy, by emphasising the areas that students find most interesting.

A recent study in the UK (Williams et al, 2003) used questionnaires to determine why fewer Year 10 school students were interested in physics than biology. The results showed that although some topics in science might be inherently popular, other topics were inherently unpopular. Students have different/polarised attitudes and interests over the same subject, the same topic, or even the same practical work. What students perceived to be interesting, boring, practical, and relevant varies amongst them. For example, some of the students thought that the mathematical aspect in physics was boring and some though it was interesting. Nevertheless, a few topics, such as “Space”, were popular among most of the students. It was not completely correct to judge the subject based on the content of curriculum. Therefore, Williams et al (2003) suggested that extending the way in which we exemplify less popular areas of physics by reference to the more popular might be one strategy to make science teaching more effective.

3.1.5.2. Perceptions of school science, real science and science related jobs

_For we think of perception as a way, indeed, the basic way, of informing ourselves about the world of independently existing things. (Strawson, 1979:103)_

The perception mentioned here is different from attitudes, values and beliefs. Using
science as examples, “I like science” is an attitude towards science; “Science is about doing experiments” is a perception of science; “Water is made of H and O” is knowledge of science, and “Science is important because it helps to modernize a society” is a statement of value and belief of science.

In the field of psychology and cognitive sciences, the formation of perceptions is normally referred to as a series of mind interactions that are involved with acquiring, receiving, selecting, re-organising and interpreting the received information and internalizing the information as part of our sensory system (Merleau-Ponty, 1970; Pitcher, 1971; Piaget, 1979; Michaels and Carello, 1981; Malim and Birch, 1998; Barsalou, 1999; Vermeulen et al, 2007). In other words, perception is the way we gather information about the world, interact with it, and make sense of it through our physical and mental actions.

Malim and Birch (1998) argued that the perceptual information possessed about a phenomenon is critical for action/behaviour because it is normally the guidance of action and deficits in perception that may lead to serious deficits in action. Therefore, people’s perceptions of a subject might be a key to understanding or making sense of their decision or behaviour. Based on this, the rationale for understanding Taiwanese students’ perceptions of science is to explore the possible fundamental guidance it may offer them when choosing to take up science.

Recent studies (Barsalou, 1999; Solomon & Barsalou, 2001; Barsalou, 2003; Vermeulen et al, 2007) have developed several models of the conceptual system. It is found that the concepts held are grounded in the simulations of actual experiences in one’s sensory-motor systems. The studies claimed the models could illustrate the complex process of perception formatting, transformation and concluded the cognitive view of emotion is embodied within humans.

The perception of school/real science in terms of its nature, application and future career prospects seems to be an important element that forms students’ attitudes. For example, Scherer (2004) asserted, whether right or wrong, that mathematics and science have the highest respect in the world because people normally perceive mathematics and science to be more rigorous and intellectual than literature, social
study and the arts. Ironically, Nott and Wellington’s survey (1999) of 11-16 year-old students shows that students were not aware of what they might have learned about the nature of science during their science class, and did not feel any connection between their achievement in the examination and knowing the nature of real science.

There is an odd side of the literature giving evidence of contradiction in students’ attitudes toward science in real and school science among secondary schools. Ebenezer and Zoller (1993) surveyed 1564 high school students in the USA and 72% of them agreed that real science is valuable, 73% thought that school science is important, but about 40% of them thought that the science classes in school are boring. Osborne et al (2003) in their research presented the results from a large-scale survey conducted by the English Assessment of Performance Unit and The Research Business. The results from the English Assessment of Performance Unit, showed that although most (more than 90%) of 15-year-old students do not find school science easy, about half of them still think that school science is interesting and useful for jobs; the results from The Research Business showed that 58% of the students think that school science is interesting and 68% think that school science is useful. There was no significant difference between the two sexes. Moreover, 50% of the students thought that school science offers better employment prospects and 87% rated real science and technology as important or very important in daily life.

It seems that students who do not like school science might not necessary dislike science in the everyday world, and those who have a positive attitude towards real science will not necessarily choose to study science. Maybe attitudes, perceptions and decisions should be seen and treated different when investigating factors that make students choose school science.

Studies have shown that students and parents’ perceptions of school science have an important influence on students, attitudes toward school science and its take up (Ebenezer and Zoller, 1993; Jenkins, 1994; Osborne and Collins, 2000; Campbell, 2001; Osborne et al, 2003; Miller, 2006). However, both parents and students reveal differences in their views toward the everyday/real science and science education. Therefore, when investigating the perceptions of science, the subject should be divided into the perceptions of real and school science.
One special characteristic found by some studies is that students’ perceptions of science may be culturally linked (Lowe, 1995; Lowe, 1997; Murphy, 2006). For example, Lowe (1995 and 1997) found that the way that Solomon Islands students see school science as very separated from their daily life. Some students could do very well in the school science subjects but after the class they did not necessary believe what they have answered in the science class. This also suggests that the way students see science might also be an import factor not only for their attitudes but more importantly, their decision-making. This seems to be an important clue for exploring the attitudes of the Taiwanese students.

Students’ perceptions of school and real science are, somehow, also linked with the image of some great scientists. The stereotype image of a modern scientist appears to be Einstein, from the last century, who normally appears in the media with a white laboratory coat and messy hair (Osborne et al, 2003; Glaser, 2006; Woolnough, 1995; Miller et al, 2006). In Glaser’s report, he described the result of the exercise carried out in schools, by Sir Christopher Frayling (BBC News, 2006):

*Children consistently draw images from a bygone age long before they were born: with wild hair, lab coat, staring eyes, coke-bottle glasses, a withered hand; in some cases they’ve even written the word “MAD” with an arrow pointing at the scientist. Dr Glaser described that Sir Christopher has replicated his study several times and concluded that, “in the tests I’ve done about 80 to 90% are mad scientists with one or more aspects of the iconography of the 1960s alive and well.*

He concluded that the stereotype of the unhinged and dangerous scientist is not only held by school children but a part of a “funny sort of schizophrenia in the public understanding of science”. Therefore, the call to raise public understanding towards real science and scientists in the recent years has been made by many (Woolnough, 1991b; Woolnough, 1995; Wymer and Finegold, 1997; Glaser, 2006). These studies assume that a better awareness of the value of science and science related jobs would promote students’ attitudes towards science in schools, and hence, improve the participation level in science subjects. As in Wymer and Finegold’s (1997) paper citing from Wolfendale (1995) in the Report of the Committee to review the
contribution of scientists and engineers to the public understanding of science, engineering and technology:

It seems important that people at large should be helped to a deeper understanding of what the scientific process is like. It's not a matter of education in the simple sense-knowing the structure of DNA, for example –but of understanding the necessarily tentative character of scientific conclusions or theories which all began life as hypotheses.

How and to what extent the media influence students’ choice is not precisely determined by any of these studies and the difficulties of measuring such influence is subjected on individual differences. Students’ perceptions of science and jobs relating to it are gradually formed unconsciously from a number of sources through long permeating process, such as schools, friends, media and parents. The image of science and scientists are results that have developed over a long span of life and learning.

These studies showed that the perceptions of school science and real science are formed from everyday life and learning Although perceptions of school science are likely to be more directly influenced by experience in school, they are, nevertheless, also shaped by the wider living experience that one has in one’s everyday life, of which is the foundation of ones’ understanding of the world. The attitudes and perception of real science and school science should be treated differently, although they might be related or overlapped with each other.

3.1.5.3. The impact of gender
Gender is probably one of the most important factors associated with differences in attitudes to school science. Becker (1989) and Weinburgh (1995) reviewed a substantial body of literature, and they summarized this very succinctly by stating that boys consistently displayed a more positive attitude to school science than girls. Some later work, such as Keys and Fernandoes (1993), Hendley et al (1995), Parkinson et al. (1996), Campbell (2001), Leach et al (2002), Shirley et al (2003) and Medhat (2003) also arrived at the same conclusion. They all describe how gender difference might contribute to the take up of science.
Apart from the fact that girls tend to be less attracted to science, others also addressed other aspects of the gender distinction, in particular in relation to the attitude towards physics and chemistry (Garratt, 1986; Becker, 1989; Murphy, 1991; Weinburgh, 1995; Hendley, 1996; Wallace and Louden, 2002; Williams et al, 2003, Banya, 2004). From a survey of A-level students in England and Wales (n=342), Whitehead (1996) concluded that British secondary students revealed largely stereotypical views of school subjects. Such views were associated with sex-stereotyped attitudes toward occupations and roles. Boys showed much more bias in subject choices, and those choosing "masculine" subjects were more likely to support traditional sex roles. Although girls’ enrolment in science related fields of study, such as mathematics and information technology, rose during 1986 to 1990, their participation was still much lower than that of boys. Medhat (2003) also claimed that children’s ideas about gender roles are developed at an early stage and reinforced by parents, teachers and the media. Moreover, the stereotypes remained strong throughout life and female students in the field of science may be viewed negatively by others.

However, there has been an intriguing phenomenon in science education for decades: girls were found to have a more positive attitude in biology and a far less positive attitude towards physics than boys (Lightbody and Durndell, 1996; Whitehead, 1996; Clarke, 1998; Garratt, 1986; Wallace and Louden, 2002; Williams et al, 2003; Miller et al, 2006). For example, Williams et al (2003), investigated why secondary students were not interested in physics in the UK, showed that males and females offer different reasons: girls found physics boring and boys enjoyed practical exercises, however, girls still valued physics highly.

On the other hand, new evidence shows that there is a sign of attitude change among the young people. The stereotypical images of “masculine” subjects and science careers no longer act as critical factors that deter only female students from taking science subjects in the school. (Colley et al, 1994; Elwood and Comber, 1995; Havard, 1996; Whitehead, 1996). Elwood and Comber (1995) in their research pointed out that according to the GCSE results in 1994, girls were doing as well as or even better than boys in science subjects because in all eleven subjects, girls were ahead of boys in the percentage of A* -C levels gained. Whitehead (1996) also mentions that since 1986 the ratio of female students to male students had increased in most of the subject
areas to some extent, even in mathematics and the physical sciences. These findings suggested that gender identity has gradually become a less important part of why students choose or do not choose science. However, the key question which continues to be asked is why there are still fewer female students choosing to do science. Keller (1985), Harding (1991) and Osborne et al (2003) suggested that the feminist perspective, which often characterized science as universal, non-reflexive, objective and value free, still contrast with the inner feminine values deeply rooted in girls.

Research in 2006 by Miller et al probably explains why more girls are interested in biology. They examined gender differences in 79 high school students in a university affiliated high school, in the southern U. S. A. The research confirmed subtle aspects discussed above: girls generally found science uninteresting and the “scientific lifestyle” unattractive, but girls still appeared to be more attracted to biology than other science subjects; even female students who have planned to study in science subjects, show more interest in the people-orientated aspects. Moreover, the main reason for those who were planning to take up science subjects was that they needed a science background to obtain an entrance to a health profession, e.g. physiotherapy and medicine.

All these findings suggest that despite similar learning experience in the school, the attitudes and choice of science between boys and girls are still different. Whether they are inherited, fostered by their parents, or shaped by other variables is complicated. It is not appropriate to stratify the relations by simplified generalisation. Although some research does suggest different curriculum designs, and teaching strategies to improve female attainment in science, as far as our findings, and understanding of gender differences, there is a limit in promoting the attainment of Physics and Chemistry to the same level of boys. These subtleties between different genders still need to be understood, so that we can improve science education by helping students to develop their interests, and designing a better curriculum for both sexes. However, getting a balance between the different needs of both sexes, might be another difficult issue in the future.

3.1.5.4. Teacher and classroom environment
Brown (1976) surveyed 2800 Scottish pupils aged between 12-years and 14-years and concluded that interaction and communication between pupils and teacher in a science class, were highly crucial to their attitudes toward school science. Moreover, the different expectations transmitted from the teacher to the pupils, strategies and tactics that have used in the teaching could help to explain why different students have different attitudes to school science.

Other studies also identified that classroom management and the perceived difficulties in learning the subject are factors that affect students’ attitudes toward science (Jenkins, 2000; Campbell, 2001; Osborne et al 2003). In 1986, Fraser developed an instrument, based on Walberg’s (1969) device to measure the classroom environment, such as teaching style and class management. The result showed a positive correlation between classroom environment and attitude.

Mayers and Fouts (1992) studied 699 students in 27 high schools in the U.S.A. and concluded that the most positive attitude level was associated with a high level of involvement, personal support, strong good relationships with classmates, good use of different teaching strategies and special learning activities. Similar findings were also found by Piburn (1993) by interviewing 149 students from elementary school, junior high school and senior high school in the U.S. He reported that good teaching is one of the key factors that generate students’ interest in the science classroom.

Woolnough (1994a), and Nott and Wellington (1999) stressed that the most important factor which influences attitudes towards school science lies in the effectiveness of teaching and class assessments. This suggests that if students do not enjoy the teaching or do not feel the content of the teaching is effectively communicated to them, they tend to have a less positive attitude toward science. Hence, if the methods of assessments in the class provide an aspect of reward and reflection, students are more likely to develop a positive attitude towards science. Woolnough’s argument is that students’ attitude towards science is determined by the quality of science teaching in the school, which also affects the continuity of science uptake after age 16; many other studies also support this view (Haladayana et al, 1982; Ebenezer & Zoller, 1993; Sunberg et al, 1994). The issue Woolnough also raises is just what the characteristics of good teaching are. Enthusiasm for the subject, setting the teaching
content in relevant, everyday contexts, and running well-organised and stimulating lessons, are essential to good science teaching. In addition to good skills in teaching, good communication skills and a caring personality can also promote students’ positive attitudes toward science, though these might be general skills for all teachers in all subjects. Scherer (2004) also suggested that apart from offering a more standardized sequence of content of mathematics and science, analysing teaching methods and making learning science more meaningful are the best ways for improving the learning.

Hattie’s (2003) research on age 9-11 year-old students suggests that students’ ability contributes 50% to their performance; teachers contribute about 30% of the account, peers and school effect both contribute about 5-10%, and family also takes about 5-10%. Teachers have a strong influence on student’s academic achievement and perceptions. The phenomenon might be attributed to the stage at which the students are in the educational process, and young students are more likely to be influenced by their teachers in the school and some times their peers, at an early learning stage. Teachers play a large part in relation to students’ educational aspirations, and academic achievements, especially in primary school, which also implies that students’ perceptions of science and other subjects might be greatly influenced by the teachers’ point of view.

Such concerns with good teaching and over the demand for science graduate teachers have recently become a major topic for school science education in the UK because of the fall in numbers of science graduates. This in turn has caused a shortage of qualified and fully-equipped science teachers (Glaser, 2006; Pagano, Sunday Times, 2006.) Osborne et al (2003) drew some important conclusions on what is perceived as effective teaching. These include clear goals for pupils’ learning; clarity of communication of the lesson goals and agenda to pupils; use of preview and review of lesson content; helping students to contextualise content in terms of their own experience and knowledge, as well as in terms of other teaching goals and learning experiences; some willingness to allow pupils to have inputs to goals and agenda setting; a supportive social context designed by the teacher to help pupils feel accepted, cared for and valued; an ability and willingness to allow for different cognitive styles and ways of engaging with the learning process among pupils,
through multiple exemplification and the use of different types of illustration and modes of presentation, and offering pupils a choice from a menu of possible ways of engaging; a willingness to take into account pupil circumstances and to modify/pace/structure learning tasks accordingly.

3.1.5.5. Subject Choice Range
One of the possibilities identified as a reason why there are fewer students choosing science in the UK, is the emerging enhanced subject choice (Smithers and Robinson, 1988; Tarsh, 1994). More new subjects, such as psychology, business, economics, sports studies, sociology, film and theatre studies, etc, have appeared as alternative options for students at A-level in the UK. Students’ subject choices have been opened up from a limited to a much wider range. Although there are other new science-related or engineering subjects available, it is inevitable that there will be fewer students choosing to do science when there are more fashionable subjects available, such as computer science and multi-media design. However, Osborne et al (2003) articulated that no research has identified what effect this increasing range has had on individual student choice because it is difficult to gather meaningful data.

3.1.5.6. Perceived difficulty
Perceived difficulty was another important concern in why students do not like science subjects (Havard, 1996; Ebenezer and Zoller, 1993; Watson and Dawson, 1994; Woolnough, 1991a; Woolnough, 1994a; Hendley, 1996; Osborne et al, 2003). However, there seemed to be different perceived difficulty within different science subjects. Physics is commonly seen to be the most difficult by all students amongst these subjects, and comparatively fewer students choose to study physics at A-level and university (Knamiller, 1984; Woolnough, 1994a; Watson et al, 1994; Goodstein, 2001; Williams et al, 2003; Lyon, 2006). Nevertheless, perceived difficulty might be associated with other factors such as the curriculum design. It seems there may be circular causal relationships among some of the identified factors. For example, the perceived difficulty might result from the inclusion of difficult topics in the curriculum and thus influence students’ attitudes. The negative attitude, on the other hand, might also enhance their perceptions of the subject as being difficult, in a
vicious circle. Figure 3-1 is a simplified illustration of this kind of circular relationship. Much more complicated links will form when more factors are added.

Figure 3-1 Relations between attitude, perceived difficulty and curriculum

Some studies have identified students’ performance as playing a key role in their attitudes towards science. Studying about 14,000 UK students each year between 1989 and 1991, Cheng et al. (1995) identified that the most significant factor related to the uptake of physics for post 16 year olds was the grades they achieved at GCSE in science and mathematics. Those who achieve good results in their examinations generally continued with science, and this suggested that science uptake is raised in those who feel confident in their own ability. It is not clear whether the role of examination is one of motivation or selection but certainly students who do well were more willing to continue to study science.

3.1.5.7. Parental involvement and support
While most research on science attitudes has focused predominantly on teacher and learning environment variables, parental involvement has also become an interest in relation to students’ attitudes and on students’ science achievement. George and Kaplan (1988) propose a model of parent and teacher influences on the science attitudes of eighth graders in the U.S. This was based on a survey of the National Educational Longitudinal Study in 1988. The survey produced several findings:
science activities had a significant direct effect on science attitude, the availability of science facilities had a significant effect on science education, and parental involvement had a significant influence on student’ attitudes toward school science. The survey provided empirical evidence for the importance of parental involvement and suggested that parental involvement can improve students’ attitudes as significantly as improving the quality of science instruction and science activities in schools.

Within the studies of parental involvement, socio-economic class is the most discussed topic relating to students’ attitude towards science. Breakwell and Bearsell (1992) found that social class has a strong link with children’s attitudes toward science, namely children from lower classes were generally associated with a lower positive attitude towards science. They identified parental support, especially from the father, as being correlated with children’s extra-curricular activities, while mothers had a more critical influence their children’s attitudes toward science. They also drew attention to the influence of mothers on their daughters because they might unwittingly reinforce existing inequalities in science, by encouraging sons more than daughters. Hattie (2003) also pointed out that parents could contribute 50% of students’ formation of perceptions towards science, which has found to be one of the foundations of forming an attitude.

However, some studies also showed no significant correlation between social class and attitudes to science (McEwen et al, 1986; Brown, 1976). The role of social class of students’ attitude remains unclear.

3.2. Decision-making on subject choice

The process of selecting study subjects is described as a decision-making process in this research. Decision-making, in a broader sense, is a process which leads to the selection of behaviour/action or opinion. Although, people may possibly make decisions for emotional reasons, for the most part, decision-making involves a series of conscious thoughts and emerging choices. The detailed process may not even be clear to the person who made a decision. Although it is commonly thought that decisions are made through a cognitive process, the process of reasoning may, in turn,
be rational or irrational, and can be based on explicit assumptions or tacit assumptions, based on the complexity of human psychology.

Exploring factors that influence pupils’ subject choice of science is not totally new (Garratt, 1986; Lawson, 1990; Watson and Dawson, 1994; Whitehead, 1996; Hendley et al, 1996; Elsworth et al, 1999; Ball et al, 2000; Osborne, 2003; Langen, 2006; Lyons, 2006; Wang, 2006). Students’ attitudes toward school science, relevance of school science to daily life, learning experience, gender, cultural background, and career concerns are found to be factors that influence students’ subject choice. However, not all these issues are clearly identified in the recent literature, especially in non-western culture countries.

Recent literature defines subject choice as a preference among different subjects, which means that when an individual is presented with a range of choices, the one that is more favourable than others is normally the one chosen (Elsworth et al, 1999). Such a decision is normally developed over a period of time and involves various concerns and influences from other people around the choosing individual. Some of the factors of the decision-making process may be related to factors that shape students’ attitude towards science. For example, the perceived difficulty of science might be one of the factors that shape both students’ attitude and decision-making. Therefore, an examination of factors that shape students’ attitudes will not be repeated in this section; only literature that relates to decision-making or the process of subject choice will be discussed.

Figure 3-2 shows the factors that might influence students’ subject choice based on the literature and some unidentified factors (questions marks). The concerns seem to be interrelated. For example, gender differences (boys and girls) will generate different generic interest and attitudes toward school science. There might also be different expectations placed upon them, from their family and society, depending on their gender (Garatt, 1986; Dulski, 1991; Hendley, 1995; Lighthbody, 1996a; Whitehead, 1996; Wright, 1988; Campell, 2001; Bennett, 2001, Giles, 2002; Osborne, 2003; Murphy, 1991; Miller at al, 2006). Another example is the way students perceive the nature and implications of general and school science. This may affect their viewpoint towards science, which in turn determines their choice of school
subjects (Watson and Dawson, 1994; Hendley et al, 1996; Benett, 2001; Campbell, 2001; Pell and Farvis, 2001). Therefore, many of these factors do not appear to contribute solely to students’ choice but exert a collective and interrelated influence. For most students, the decision of choosing a subject study route is a critical transition point which will make an impact on their plans for their careers (Hollands, 1990; Banks, 1992; Hodkinson, 1996; Lightbody, 1996a; Whitehead, 1996; Hodkinson, 1997; Ball, 2000; Miller, 2006).

Figure 3-2 Factors that might influence the decision of subject choice

The mechanism of decision making is complex and varies from individual to individual. Individuals cannot see the complex process of decision-making taking place because it is a psychological construction, although the outcome of the decision-making, behaviour and action, is generally observable. This means that although we can never "see" a decision, we can infer from observable behaviour, that a decision has been made.
There are a number of studies that discuss students’ choice of schooling and work, post age 16. Some of these emphasise the rationality of the decision making procedure, while some focused on social background influence and some identified the difficulties and inequality of opportunities of young people as discussed in this chapter.

However, in the UK, students start to choose their subjects at the age of 14 (DfES, UK, 2006), but many literatures focused on the transition at post-16 because students must decide whether they want to start a career or continue their education before they even need to make a choice of study subjects. The choice is important, and a critical point for the development of their future life.

Adolescence is an important time for young people to explore who they are and establish their own identity. This time is crucial to young people because it is the transition period from childhood to adulthood. Young people explore the various roles they play, and integrate these roles into a perception of self/identity. However, there are people who are unable to integrate their many roles, and have difficulty coping with different or conflicting roles. Zastrow and Kirst-Ashman (2007) argued that the causes stem from role confusion, uncertainty of identity, and insecurity of life. There are eight stages of human experience based on the interaction of their biological development and social demands.

3.2.1. Subject choice and decision-making in Taiwan

Differences in their educational systems (as described in Chapter 2) mean that the nature and implications of subject choice in Taiwan are dissimilar to those of the UK. Taiwanese students are not free to choose their subjects until the second year of senior high school, at about the age of 17, whereas students in England and Wales can choose some of their subjects at the age of 14. It is not a completely free subject choice for Taiwanese students because students can only choose a study group, which consists of a fixed subject programme. Furthermore, there are only two study group choices, namely the Natural Science Programme (NSP) and the Social Study Programme (SSP), for senior high students. Subjects, such as accounting and electronics are only available in some bilateral and vocational schools. Subject choice
is thought to be important because it determines a vague map of the future career development for young people (Chang, 1999; Li, 2002a; Li, 2002b; Wong, 2006). However, not many researchers have investigated how young people make their decisions and what resources they have available to them in order to do so.

Chang (1999), based on her consulting experience in high schools, suggested students should choose their subject carefully because many of them have regretted their choice either after they started their new course programme or even at the university level. She recommended six steps to students when they are making a decision about their study group:

- First, explore your own family and try to build up a good communication and understanding with your family.
- Second, try to understand your parents’ expectations of you.
- Thirdly, try to understand the current trend of the job market.
- Fourth, try to experience the job that you are interested in by talking to people who are in that working field.
- Fifth, set up a blueprint of your own life plan, and
- Sixth, choose the study group based on your plan and work on the area in which you think you are not confident.

This does not show how students make their decisions, instead, it only suggests how they should do it. The notion of understanding difficulties that young people have in Taiwan is not recognised, instead, instructions of how to make a decision that is acceptable among parents and society seem to be the guideline from adults to the young people.

In addition, studies and reports showed a noticeable increase in the number of students choosing science subjects in high school in Taiwan in the last two decades (Ministry of Education, Taiwan, R. O. C., 2006; Li, 2002a; Li, 2002b). In addition, it is reported that there is a shortage of science teachers and an excess of history and geography teachers in many senior high schools because more students have chosen to take science recently, after the introduction of the new examination system and university entrance requirements. All public traditional and bilateral senior high
schools have more than half of the students choosing science, and an increase of 20-30% choosing to study science in most of the public senior high schools, for the year 2002. Within all the boys’ schools, more than 80% of the students chose to study science; in girls’ schools, the science take-up is reaching 50%. Li (2002a) interviewed some school authorities and believed that this is because a lot of the students think it is easier to get into a university, if they choose science. The report also notes concerns about students not choosing to study what they really like and not enjoying their subjects. This high fever of choosing science has still not cooled, according to the government’s survey on senior high school students’ subject choice in Taiwan (Education White Book, Taiwan, 2006).

In 2005, an educational report (Higher Education Survey Database of Taiwan) published by the Taiwanese government showed some results from a survey of 13,319 students, aged 17-years, who were studying in the second year of senior high schools (including vocational schools) and junior colleges. The questions asked in the survey were (1) who decided the type of the school you were going to study in? (2) Who has the main influence on your study group or vocational choice? 46.6% of the students declared that they decided for themselves the type of the school they were going to study, 30.2% decided it with their parents or family, 12.8% stated that their parents or senior family members decided the type of school they should go and 13.4% think that their scores decided where they should go. For subject/study group choice, 68.1% of them thought that they decided the choice themselves, 19.8% stated that their parents or senior family members had the most influence. The report claims that most of the students decide their subjects or study groups according to their own wishes but also suggests that senior high school students make their own choice of study groups because there are not many choices (NSP and SSP).

However, those who stated that they made their own decision did not indicate if they had received any influence or pressure from their parents or family because the question “Who made the decision?” normally refers to the person who makes the final decision. The decision may not reflect an objective reality. The question appears to acquire a simplified resultant answer for a series stages in a complicated decision-making process. These young students are normally living with and depending on their family; it is unlikely for them to make a choice completely free of
their family’s influence and solely based on their own opinion. Nevertheless, as these students are approaching their legal age of 18, to make their own legal decisions, parents normally do not try to control every educational decision at this stage. Although this report obtains the answers directly from students, it does not show a complete picture of the process of students’ decision making in choosing their study group and is slightly dogmatic on interpreting the figures. The survey seems not to have an enough in-depth investigation of the causal relationships between different actors.

Not only senior high school students have to confront difficult decisions and then struggle with their choice; a great number of university students seem to have the same problem according to the higher education survey database of Taiwan (2003). The report showed that 35% of university freshers did not study the subjects they wanted and 24.1% of the students were thinking of changing their subjects. This indicates that a high percentage of university students either do not choose their subjects carefully or feel they have no better choice. Wang (2006) identified two main dimensions, the education system and cultural values that contribute to this phenomenon. Firstly, students do not have enough chance to understand themselves and explore their interests in high schools because schools only put emphasis on academic subjects, knowledge transfer and collectivism training (teamwork and good relationships with other people). Students spend most of their time, including after school sessions and private lessons, working on school subjects. They rarely have time and opportunity to explore their own interests. Hence, 75% of students think that the ranking of the department and university on the league table is important to them, when choosing the university and subject because they are expected to go to the best school and get a good job. This is also a social norm for students to obtain the highest degree possible. Additionally, 62.4% of university students think that their parents’ opinion is important when they are choosing their universities and subject (also in Huang, 2001). However, the study did not continue to discuss how parents form their opinions, what are their concerns, and how might other factors also influence the students’ decisions.

As a teacher who grew up in Taiwan and having five years teaching experience in secondary schools in Taiwan, I understand that most schools give students a form requiring their choice of study group at the end of the first year. This allows schools
to arrange teachers, class rooms and timetables for the coming semester. Ideally, students can choose freely and change their study group at any time. However, schools do not encourage students to change their study group without deep, serious consideration, as it may cause problems for administration and resource management. For example, if too many students want to change to a study group in the middle of the semester, the school may not have enough teachers or laboratories for students or the school may have a special strategy to increase the university enrolment for their students as this is good for the school’s publicity. This is a structural variable that is not controlled by anyone but the school. Students and parents have the freedom to make a choice but they could be influenced or led by the school. Such selection or decisions made by institutions were mentioned in Hatcher’s (1998) study in the UK, although he focused more on the decisions that were made by students and their parents.

For students who already have their preference in different subjects, it is easy to decide which study group they want to take up. Making a decision is not a difficult process for them, but it might be a problem for those students who do not have a particularly strong attitude towards different subjects. The process of the decision-making might involve other factors compared to those who already have a particular attitude to some certain subjects. Furthermore, it may not be easy for students to transfer to another study group and to catch up with the curriculum. Students may feel compelled to remain with their choice all the way to university level.

However, most existing literature introduced in this review comes from the western world, such as the UK, the USA, Canada, Europe, Australia, and there might be prominent differences between the East and West, such as educational systems, policy, and culture. With the crisis of falling numbers of science students in the Western world, which so far does not appear to be a problem in the East, the mechanism of how students make their subject choice is an important arena worth further exploration.

3.2.2. Model of pro-environmental behaviour
In order to try to understand the situation, I looked for any models that might help to
define the relationships between various factors and the process of decision making. Suggested by my MPhil/PhD transfer panel, a recent behavioural model in the environmental development area, constructed by Kollmuss and Agyeman (2002:256) and describing how people develop a pro-environmental behaviour, is used as the initial basic framework to analyse the influencing factors. Although not directly set in the context of science, the model illustrates how choice was made in terms of pro-environmental behaviour/action, as shown in Figure 3-3. Both positive and negative internal and external factors, with different barriers to developing a pro-environmental behaviour are shown.

In the top light grey box are internal factors, such as knowledge, emotional involvement and values from one’s environmental consciousness. These are all part of one’s personality traits and value system. One’s attitude, together with knowledge and values, are the basic guideline for one’s behaviour. A pro-environmental consciousness is the sum of all these guidelines, which is then internalized into one’s value system. Within the internal factors, there are barriers such as lack of knowledge, emotional blockages, existing knowledge and values, that prevent the formation of the whole environmental consciousness.

In the category of external factors, infrastructure, political, social and culture factors, economic situation, etc are catered for as important factors that exist outside an individual’s conscious system. These external factors are also important because they contribute to the final outcome of an individual’s behaviour. They can also interact and influence consciousness, which is also characterized as part of the value system in individuals. Nonetheless, the internal factors are discussed in more detail than the external factors, such as social, cultural, and economic variables. The motivation or factors that contribute to one’s behaviour are complicated, and thus, discussing behaviour without exploring the external factors will be inadequate. Therefore, this diagram leaves scope for further development to investigate more influences on the process of decision-making/behaviour, especially influences from the external factors.
Figure 3-3. Model of “Pro-environmental consciousness”

(Kollmuss and Agyeman (2002:256) based on the work of Fliegenschne and Schelakovsky (1998) who were influenced by Fietkau and Kessel (1981))
3.2.3. **Rational choice**

A limitation of the pro-environmental behaviour model is that it under values the nature of decision-making. It does not explicitly reveal its assumptions about how individuals make a decision to act. Rational choice theory is a widely used theory in explaining decision-making. It was first developed in the area of economics, but was increasingly applied in other fields, and eventually changed the faces of some theories in psychology, sociology, politics and education because of its success in economics (Boyds et al, 1994; Goldthorpe, 1996; Scott, 1999).

Rational choice theory adopted methodological individualism; it conceived social situations or collective behaviours as the exclusive result of individual actions. However, rational choice theory did not only apply to individuals. Often, the same pursuit of values was embraced by collective bodies, i.e. institutions or governments. The individualistic methodology and the mathematical formalization of rational choice behaviour allow an easier way of dealing with complex social phenomena. Thus, rational choice is normally regarded as maximizing *utility*, the "currency" for everything they cherish, for example, money and power. The assumptions behind rational choice theory are listed by Turner (1991:354):

- Humans are purposive and goal oriented.
- Humans have sets of hierarchically ordered preferences or utilities.
- In choosing lines of behaviour, humans make rational calculations with respects to:
  - The utility of alternative lines of conduct with reference to the preference hierarchy.
  - The cost of each alternative in terms of utilities foregone.
  - The best way to maximize utility.
- Emergent social phenomena—social structures, collective decisions, and collective behaviour—are ultimately the result of rational choices made by utility-maximising individuals.
- Emergent social phenomena that arise from rational choices constituted a set of parameters for subsequent rational choices of individuals, in the sense that they determine the distribution of resources among individuals, opportunities for various lines of behaviour, and nature of norms and obligations in a situation.
Strict rational choice theory denies the existence of any kind of actions other than the purely rational, based on calculations of ‘utility’. People calculate the likely costs and benefits of any action before deciding what to do. It is argued that all social action can be rationally motivated, as instrumental action, however irrational or non-rational it may appear (Scott, 1999).

For a choice to be considered "rational", a number of key assumptions have to be included: preferred route or outcome, all possible pros and cons, and the possibility of calculation. If decision-making also involves time, then the cost of time can be taken into account. The decision-maker must always choose the item he/she prefers by careful comparison and calculation. He/she must cognitively weigh every choice, against every other choice. In theory, individuals are motivated by the wants and goals that are expressed in their preference. They act within constraints, and on the information they have about the relevant conditions. Simply, the constraints and preference relationships can be seen in technical terms, as a means to an end. They must make choices in relation to their goals and how to reach them (Scott, 1999). To find the best outcome, all choices and outcomes are carefully considered. Rational individuals choose the alternatives likely to give them greatest satisfaction (Heath 1976 cited by Scott, 1999).

One of the potential applications of rational choice in education is students’ subject and career choice because they both involve an unknown future, preferences, reason, and free will—features and conditions for rational choice. Hatcher mentioned in his paper in 1998 that the term “Rational Action Theory (RAT)” first appeared in Boudon’s work (1974) in the context of education as an alternative explanation to the culturalist in the effect of social class on educational choice. Boudon explained how RAT can be employed on educational decision-making by calculating cost, benefit and possibilities of achieving the intended success or outcome.

The theory was further developed by Goldthorpe (1996; 1998) in an attempt to explore the interrelations among class structures, class mobility, class inequalities and class decomposition. Goldthorpe’s assumption was that individuals act as decision-makers, rather than thoughtlessly following social norms or cultural values;
they have goals, alternative routes of pursuing goals, and have the ability to assess the possible cost and profits in any course of action. However, he also noticed that pure RAT will fail to explain some decisions that are made through the influences of social class. He admitted that the RAT he implied, has a rather weaker rationality than the notion of the original RAT used in economics and that the theory still needs future empirical testing.

The reason why RAT was employed in sociological and educational studies was that there were different choices and outcomes for people and students (and parents) and human beings always have preferences. People do not always make the same decision because they are not always fully experienced and adequately informed. So when it comes to a critical point to make a decision, it is inevitable that people will compare different routes with different results. This is why RAT is useful in understanding people for its believers. Hodkinson (1996) in his observation of 115 students from six schools including secondary and sixth form schools, concluded three key qualities of decision-making: first, to some extent, the students’ descriptions showed they were acting instrumentally in their career decision-making. Secondly, most of the students in their opinion had good “rational” reasons for their choices and any changes to their choices. Thirdly, although sometimes students are restricted by some institutional, limited resources of information, and even emotional conditions, the rational decisions of the students were pragmatic, and they were seen to go about problem solving in practical ways.

The same theory has been discussed in non-western countries. Okano (1995) conducted a year-long participant observation of students in two vocationally oriented high schools in Japan. The research focused on the mechanism of individual decision making, namely, individual students purposefully make decisions according to their intentions, by evaluating the pros and cons of the expected outcomes of feasible alternatives on the basis of relevant information and in light of their preferences. The career pathway for Japanese students is served by the formalized school-based Job Referral System (JRS), which provides students with available job vacancies that are offered by outside companies and advises students to choose the best job according to their predisposition among other potential competitors. Information is also provided to help students understand the company and job. Teachers help students to
understand their preferences as well as their competence against others, and then make the best rational choice according to the opportunity they have. Okano found that such a system achieves a more meritocratic allocation of jobs and a smoother entry into the workforce for high school students as a whole, thus promoting a greater equity for those lower score students to make a choice in the limited and constrained situation.

In the UK, government policy has revealed a technically rational assumption on young people’s career decision-making:

We assume that, knowing their capacities and other personal characteristics, individuals form an estimate of expected earnings resulting from each education, training and labour market option, and, taking into account their taste for each, choose the stream which offers the greatest net utility. (Bennett et al, 1992:13)

Rational theory in educational choice is useful for individuals when they are in a situation where the decision made is going to be influential in their lives. However, RAT does not always explain the process and outcome of how individuals make their decision explicitly because of two main pitfalls. The first pitfall is the social background within which the young person is positioned, which means that one might choose what he/she is more aware or familiar with. For example, he/she might not choose to go to university because no one around him/her has gone to university, even though he/she can afford it and is capable (Reay, et al, 2005). The second pitfall, the limitations to freedom of choice that an individual possesses at the point, means that not every one or every decision can be made totally free. For example, one might have a preference to study at Oxford University but his/her competence might not allow him/her. So although RAT may provide a useful framework to explain how decisions are made, it still has its limits and cannot always explain all decisions.

3.2.4. Cultural reproduction and social inequality

One of the criticisms of rational choice is it does not acknowledge the social and cultural context within which decisions are made. An important element in young people’s decision-making is their social background or social class. Students’ attitudes, perceptions and decisions are so deeply influenced by the culture in which they are brought up. Several studies have pointed out that the impacts of differences
in social class on educational outcomes in industrialised countries, apart from Sweden and the Netherlands, have been “substantial and persistent” after World War II (Shavit & Blossfeld, 1994; Shavit & Blossfeld, 1996 cited by Hatcher, 1998).

Social class is an important determinant of the environment in which decisions are made, including the people who may influence decision-making. Hodkinson (1996) observed that many students stated that their choices were influenced by close relatives or neighbours who worked in the same job area. He concluded that the decision making of those students was also context-related to the culture, family background and life experience. It was also “opportunistic, being based on fortuitous contacts and experiences.” The career decisions of young people can only be understood in the terms of their own identity and life histories, for which he used a common general term “culture” to describe the socially constructed environment in which individuals are embedded and absorb while they grow up.

Even in Goldthope’s Rational Action (Goldthope, 1996) of educational decision-making, he argued that when RAT is applied to class analysis, the goal and routes towards the goal of the decision-maker are conditioned and constrained by the resources, and opportunities that are grounded within in the hierarchical social structure.

According to Bourdieu (1973), different cultures are reproduced by the people who are in the same class or institution. For example middle class parents are more likely to produce middle class children and working class children tend to stay in the working class. The reason why the same culture is reproduced through generations is that inequalities are recycled through the education system and other social institutions. Only people at the dominant level of the hierarchical structure within the cultural system are able to acquire knowledge in the way it is taught. Bourdieu called those who have more advantages over the power of knowledge acquisition “Cultural nobility” and described how their disposition is affected in today’s education system: 

Even in the classroom, the dominant definition of the legitimate way of appropriating culture and works of art favours those who have had early access to legitimate culture, in a cultured household, outside of scholastic disciplines, since even within the
educational system it devalues scholarly knowledge and interpretation as ‘scholastic’ or even ‘pedantic’ in favour of direct experience and simple delight. (Bourdieu, 1984:2)

Bourdieu (1973; 1984), therefore, focuses on the structural reproduction of disadvantages and inequalities that are caused by cultural reproduction. Those who are not in the dominant culture are at a disadvantaged position to receive cultural information, or possess less cultural capital, and therefore will remain at a disadvantaged status. Capitalist societies depend on a stratified and hierarchical social system, where working class education is suited for manual labour. And diminishing such inequalities means the break up of the system. Thus, schools in capitalist societies require a method of stratification, and often chose to do so in a way in which the dominant culture will remain its hegemony. One of the ways to maintain the stratification and domination is through cultural reproduction. That is why the middle classes hold on tight to education because they want to maintain their position in the system (Erikson & Johnson , 1996; Hatcher 1998).

Another important concept of Bourdieu’s cultural reproduction theory is “habitus”. Bourdieu (1977) referred to “habitus” as the durable and generalized disposition that permeates a person's action throughout an entire period of life or whole life. The term means the whole manner, turn, cast, or mould of one’s personality. Habitus is the way a person develops his/her beliefs, values and preferences in his/her own subjectivity, social networks and cultural traditions. Bourdieu (1977) called it, “that system of dispositions which acts as a mediation between structures and practice”. It permeates not only the thought of the person but also the person as a whole. Therefore, it is complicated and can be determined by any factors, or all factors, that exist in the lived reality, which makes no educational decision-making completely value-free or context-free.

In the discussion of one’s habitus, the notion of “cultural reproduction” is also important to the predictions of individual’s choices by Bourdieu (1977), which refers to the process of existing cultural values and norms passed down from one generation to the next one. As a result of reproduction, social classes and the culture replicate from generation to generation, known as “social reproduction” in Cultural
Much research has emphasised the long persistence of social inequalities between different groups of young people, and this has led to the inadequacy of resources in the process of their decision-making (Boyd et al., 1994; Ball et al., 2000; Hatcher, 1998). They are very often deeply rooted in the class, in which the young person is situated in society. Boudon (1974) believes that social class has two major effects on education: the differences in academic achievement and the educational choice made at the transition points. Hatcher (1998) and Goldthorpe (1996) both found in their data that middle-class pupils are more likely to enter long-term and academic courses at post-16 than those from a working class background even when their achievements are both at the same level. Hatcher (1998) articulated that the process of students’ decision-making is also a process of self-selection by students and parents. Also, not only class but gender and ethnicity create inequality, though they are often categorized within variations of social class or culture.

From Hatcher’s (1998) point of view, the concerns that students take into account when making their decisions are much related to their background culture, which is embedded in the social class, in which they are situated. Therefore, RAT cannot completely explain why and how students and parents make their educational decision-making because of their social position. Individuals are embedding in the living environment, interactions between self and others, and living experiences that everyone has.

Social class differentiation in education results not only from differences in academic ability and processes of institutional differentiation but also from processes of self-selection by pupils, students and their parents in the progression through the school system and into higher education, training and employment. (Hatcher, 1998)

Hodkinson (1996) suggests that the career decisions made by young people are only “pragmatically rational decision making” because their decision making can only be understood in their own identities and life histories. The term “rational” is only valid in the eyes of their own subjectivity because they describe their choice as rational and would have the best prospective outcomes. However, their judgements are grounded in their experiences and backgrounds. Therefore, their subjectivity is situated in the
culture which they inhabit. The way in which a habit or habitus of a person is developed is complicated because it is gradually constructed over years, and is influenced by many factors, such as surrounding people and experiences. While cultural and internal factors interact with each other during the process of decision-making, external factors might also be taken into account. Students rationally seek opportunities that are available within the social structure and job market. They calculate all the pros and cons in their own way and come out with a final decision/choice. The process of opportunities emerging in one’s life and one trying to make the best choice is defined by Hodkinson (1998:304) as “Horizons for action”:

Young people make career decisions within horizons for action. By “horizon for action” I mean the area within which actions can be taken and decisions made. Habitus and the opportunity structures of labour market both influence horizons for action and are interrelated, for perceptions of what might be available and what might be appropriate affect decisions, and job or training opportunities are simultaneously subjective and objective.

He completed his definition of horizons for action by saying that they both limit and enable our view of the world and the choices we can make within it because when information or opportunities arise, one’s existing schemas already filter out the information that one does not prefer. Young people, therefore, tend to make decisions based on their cultural background and experiences. A similar culture keeps reproducing through people within the same group. Although reasons for decisions may often appear reasonable and rational by the young people’s description, not all young people have adequate accessibility to resources. Those “rational choices” described by young people are often based on the unequal resources individuals can access.

Although cultural reproduction and social inequality may explain how and why some young people make decisions that do not seem to be completely rational to others, some young people’s decision making may be related with other factors. In this research, the notion of Bourdieu’s cultural reproduction (1977; 1984; 1990) and social inequality will be used as a framework for exploring the influences in
Taiwanese young people’s decision-making process as well as examine the applicability of the theory in a Confucian influenced culture.

3.2.5. Careership

The two notions of rational choice and cultural reproduction are brought together in Hodkinson & Sparkes (1997)’s concept of careership. They stressed the importance of understanding and theorising the process of young people’s decision-making, which may contribute to broader sociological questions of choice, structure and agency in ways which we do not have space to explore. They also claimed that the current education and training policy discourses in Britain often focus upon notions of markets driven by choices made by customers, but there is a total absence of attention both in policy and literature to the explicit process of how the customers actually make their decision in their education and training fields. Other sociologically-informed research tends to focus on life patterns and career trajectories as the determinants of young people’s decision-making. From these arguments, they developed a new sociological theoretical model of career decision making based on Hodkinson’s previous theory, “horizons for action” and Bourdieu’s work in sociology and named it, “Careership”. The model involves three completely integrated dimensions: 1) pragmatically rational choice decision-making which is located in the habitus of the decision-maker, 2) interactions with others in the youth training field that relates to the unequal resources that individual possess, and 3) unpredictable patterns of incidents or turning-points that make up the course of life. They claimed that the model can avoid the two pitfalls of arguments among other studies: The implicit social determinism on the one hand, and seeing young people as completely free agents to make decisions on the other.

The presumption of pragmatically rational decision-making was based on the two conclusions drawn from the examinations of Hodkinson & Sparkes’ (1997) data. Firstly, students’ decision-making was rational in their own opinion, though they do not fit in government policy completely. Secondly, rather than being systematic, students’ decisions were pragmatic. Decision-making, in a sense, was related to everything of the person, including their knowledge, perceptions, life experience, learning style, teachers, family and friends. Students make sense of their decisions but in their own cultural settings, in which they were born and develop through their life,
and with the possible opportunities of available choices. The decision is pragmatic but remains rational.

According to Hodkinson & Sparkes, the unequal resources that an individual has in a training field might also affect his/her choice. By, “field” Hodkinson & Sparkes referred to Bourdieus concept, which means “a game” or “a market”. In the game, there are different players playing at different positions and the every player has his/her own ideal goal. However, these players all have different resources and powers that form the “relations of forces” in the field. The resources and power that each player has is deemed as his/her capital. How players play their game on the field involves different capital power and different horizons for action. In Hodkinson and Sparkes’ example:

Young people may be primarily concerned with getting a job and/or training programme which they want, employers may be concerned primarily with the labour requirements of running a business profitably, and training providers may be most concerned with creating viable teaching groups. What results is a fluid mixture of alliance, negotiations, agreements and conflicts.

However, Hodkinson and Sparkes also noticed that the career decision-making is only part of the interactions in the field because, while the players are playing the game, there are other things happening in the field, such as unexpected opportunities that come up sporadically over time. For example, someone might be offered a job position or training opportunity which was completely unexpected (or it was not seen as an opportunity to the player). Sometimes such an opportunity appears several times before the player takes it. He/she might reject the opportunity in the beginning because of the complete negative attitudes he/she holds before the transition point. This is the transition point when and where young people change their trajectories. Hodkinson & Sparkes quoted Strauss’s (1962) view about the development of career turning-points, “These points on development occur when an individual has to take stock, to re-evaluate, revise, resee, and rejudge”.

Naturally, there are many turning points in one’s life or career decisions. Some are based on free choice and some are offered by systems or institutions. No matter how
dramatic turning points can be, they always take place in one’s routine. Hodkinson & Sparkes have identified five types of routines from their study. Whether the routine is confirmatory, contradictory, socialising, dislocating, or evolutionary, there are always opportunities for turning points to occur.

Once the player makes the decision to take the opportunity, a new route will arise from the existing routes. The whole map of the field thus changes because of the decision made at the transition point. Thus, the new route will generate a new pattern of life.

The model of careership demonstrated a valid and explanatory model of the existing cases of students’ career decision-making in an understandable sociological framework. However, although Hodkinson & Sparkes had incorporated as many elements and variables as they could from their empirical data, it was a general macro-contextual model that might not explain or predict exactly what one would do in decision making and still needed more testing and support from other empirical data. Also in their attempt to open up wider constructive perspectives on sociological issues, aspects like the nature of individual’s identity and the relationship between structure and actors should require further examination.

3.3. Summary

In conclusion, the current literature in the UK and other western countries seems to place a major emphasis on students’ attitudes towards science (both school and real science) when discussing the low uptake of science in schools. In contrast, science education research in Taiwan has paid little attention to students’ attitudes both toward school science or real science, placing more emphasis instead on the development of ‘scientific attitudes’. Therefore, the exploration of students’ attitudes and factors that influence them suggests itself as an important pre-requisite in the examination of students’ subject choice. Of particular interest is whether the different cultural contexts, Taiwanese and Western, might lead to students’ perceptions of school science and real science playing different roles in relation to their choices of subjects.
Various sociological theories have been discussed in this chapter regarding young people’s decision making. Although these theories were not directly generated from studies of, nor applied to students’ subject choice, they have been used in other areas of decision-making, either in life more generally or in certain educational/training fields. It is hoped that these theories will provide some basic frameworks for analysing and interpreting the data collected for this research, at the individual as well as the social and cultural levels. The application of these theories of decision-making to this new domain can also be seen as a form of testing of their wider applicability beyond the substantive and cultural contexts in which they were originally developed.
CHAPTER 4. METHODOLOGY

4.1. Introduction

The main purpose of this research is to examine influences that act upon students’ decision making when choosing their study group/subjects in Taiwan. According to the existing western literature, students’ attitudes toward school science appears to be the main and critical factor in why students choose or not to choose science subjects (Schibeci, 1984; Toh, 1991; Turner and DiMarco, 1998; Osborne and Collins, 2000; Osborne et al, 2003; Dawson, 2002). This inquiry into Taiwanese students’ attitudes toward school science was first generated due to their extraordinary achievements in international science competitions and the country’s highly developed technology industry, which contrasts with students’ negative attitudes and motivation in learning school science. As my own, and colleagues’ teaching experiences in schools in Taiwan has shown, students’ attitudes toward school science does not appear to be positive. Unfortunately, this problem remains unresolved by the education authorities. In addition, research undertaken into students’ attitudes toward science in Taiwan has been sparse. Because there is a constant supply of students to the cutting edge (science orientated) markets, the actual feelings, views and aspirations of students, tend to be neglected. Therefore, the first objective in the preliminary stage of this research has been to investigate Taiwanese students’ attitudes towards school science. The attitudes toward real science were also examined due to the possible link with attitudes toward school science. The intriguing results then led to further questions of why and how students choose to study science in Taiwan because of the low interest they revealed in school science.

The data collection in this research was carried out in three stages because this research developed over a period of time and shows specific stages of data collection and analysis. The results from the first stage provide a basic understanding of students’ attitudes and a clearer direction for the development of the second stage. However, it was felt necessary to understand the culture, values, and social behaviour of students, using more suitable qualitative orientated methods, such as interviews and observations. In this chapter, the designs, approaches, weakness and strengths of
this research will be outlined and discussed, in order to answer the research questions below.

The first theoretical rationale of this research is a recent behavioural model in the environmental development area, developed by Kollmuss and Agyeman (2002:256) (see chapter 3), describing how people produce pro-environmental behaviour. The model illustrates how behaviour is brought about, in terms of pro-environmental behaviour/action. My early stage of understanding students’ attitudes (pro-school science attitudes and pro-school science behaviour) were based on this model.

The notion of exploring students’ attitudes cannot exclude the examination of their perceptions of science because it is found in the western literature that this is a foundation of how attitudes form, and thus it could be a key to understanding the divergence of their choices. Further research exploring other factors that affect students’ subject choice was then carried out, in order to understand the perceptions of science for deciding study groups, and to unravel the decision making process. Interviews with teachers, parents, and some in-depth individual student interviews were conducted around the same period of time, in order to examine the second theoretical rationale, Careership, a sociological theory of young people’s career decision making (Hodkinson and Sparkes, 1997). Four senior high schools along Taiwan’s populated west coast were chosen for this study. From these schools, 49 second year students, aged 17 years, 10 school teachers (mainly science teachers), and 16 parents participated in the discussions and interviews. Factors that influence students’ subject choice/decision-making were analysed and discussed, after the data collection.

4.2. Research Questions

The research questions of this study, were gradually formed and deepened during the development of the research. The questions are:
1. What are the factors that shape Taiwanese students’ attitudes towards school science and real science?
2. How are real science and school science perceived in by students in Taiwan?
3. What are the concerns students take into account during the subject choice
decision-making process and what are the influences from the surrounding environment?

Objectives generated by these research questions may be summarized:

• To produce a questionnaire to identify Taiwanese students’ attitudes toward school science in junior high and senior high schools.
• To gather data to enable understanding of Taiwanese students’ attitudes toward school and real science in junior high and senior high schools.
• To identify reasons for or explanations of why students like or do not like real science and school science.
• To generate discussions among students in order to explore Taiwanese students’ perceptions of school and real science.
• To interview students in order to explore and analyse the concerns they take into account when making their decision of choosing study groups.
• To interview parents in order to understand their points of view thus shedding light on their children’s decision making process.
• To interview teachers on how they think students’ decisions are influenced or made from teachers’ point of view.

The term “students” in this study refers to the children aged between 12 and 18 years, who are currently receiving formal education in secondary schools. For convenience I shall use ‘he’ and ‘him’ as generic, non-generic pronouns, unless specifically referring to a female student.

The term “school science” in this study is defined as the subject taught in the school science classes. And the term “real science” refers to the subject perceived as a more rounded and yet vaguely delineated body of natural science by the general community.

4.3. Research Design

The development of this research at each stage was based on the previous results and review at every stage to dig out a deeper meaning of the observed phenomenon. The
first survey of students’ attitudes towards school science and real science was conducted between December 2003 and January 2004. The second and third stage of data collection on students’ perceptions of science and reasons of choice was conducted between October 2004 and December 2004. More data collection of some individual pathways was conducted between the July and August in 2005. This second and third stage focus on the students who have just decided their study groups Students who participated in the third stage were those who have taken parts in the second stage of data collection. The actual practice of the research design was not entirely clear at the beginning. The plan was modified a few times as the research developed A concise research framework is shown in Figure 4-1. More details, steps and plans were involved and will be described, although not shown in this diagram.
In order to understand the situation we need to obtain real stories from those who have actually experienced or are experiencing such processes. The formation of the reasons, core foundation of the concerns, and the interrelationships between individuals and influences are more of the interest in this research rather than, for example, knowing
what percentage of students made their own decision.

Qualitative research: Any type of research that produces findings not arrived at by statistical procedures or other means of quantification. It can refer to research about persons’ lives, lived experiences, behaviours, emotions, and feelings as well as about organizational functioning, social movements, cultural phenomena, and interactions between nations (Strauss and Corbin, 1998: p.10-11)

To understand the formation and causality of an event, a qualitative method will be more suitable than the quantitative one because rather than isolating variables and focusing on specific factors, qualitative research generally can exhibit an ability in seeing things “in context” or a “whole picture” and emphasise the interdependence and interrelationship of some events or factors. Qualitative research involves the collection and analysis of data. For this research, its aim is to investigate the qualitative characteristic of students’ attitudes and decision making in relation to their education. To obtain this information, it is necessary to discover the deep structure of social relations, particularly during their education. Thus, qualitative research presents a picture of people’s real lives and the events in their lives. Miles and Huberman (1994) characterised and advocated qualitative research as the “best way for discovery”:

What is important about well-collected qualitative data? One major feature is that they focus on natural occurring, ordinary events in natural settings, so that we have a strong handle on what “real life” is like.(Miles and Huberman, 1994:10)

The data of qualitative research are normally words or descriptions that are given by the people who had experience or are experiencing some events in their life. Their descriptions of events or feelings involve more than yes, no and numbers. All these descriptions make the context meaningful and normally include reasons. Wellington (2000:133) described some important features of qualitative research that serve the needs for this part the data presentation:

-it is usually an exploratory activity;
-data are usually collected in a real-life, natural setting and are therefore often rich, descriptive and extensive;
-the human being or beings involved are the main research ‘instrument’;
- the design of a study emerges or evolves ‘as you go along’ - sometimes leading to a narrowing or sharpening focus;
- the typical methods used are observation, interview, collection of documents and sometimes photography or video recording.

No systematic data offering an insight into students’ decision making process exist in Taiwan currently; however, according to my teaching and living experience in Taiwan, I was convinced that a qualitative approach would provide a better in-depth insights. Therefore, in-depth interviews needed to be carried out in order to have deeper insight rather than using a quantitative approach.

4.3.1. Using more than one method

*Interviewing has a strong claim to being the most widely used research method. This collection brings together in one place all the key articles on interviewing, making it an invaluable and unrivalled resource for students and academics in the social and behavioural sciences and for applied social researchers and market researchers who use interviews and focus group discussion in the course of their work. (Fielding, 2003:1)*

In this research, several methods of data collection were employed. An open-ended questionnaire was used to investigate students’ attitudes toward school science, real science and reasons of their attitudes; Focus group discussions were employed to understand students’ perception of school science and real science; Group and in-depth interviews were held in order to explore the factors that influence their choice of study group. Each method employed was chosen for its appropriateness and served different purposes in relation to the objectives set for this research.

4.3.2. Validity and reliability
The validity of the data and the reliability of the methods used in this research are both very important. Validity, means the ability to produce accurate findings during the data collection (Sarantakos, 2003). In this research, different groups of participants were included to test the validity of the data collected. Student, parents and teachers’ points of view were collected to cross-check the accuracy of the data.
Reliability means the ability to produce consistent findings whenever the data collection is repeated. To ensure that the data collected from the students were reliable some students were included in more than one data collection process to test the reliability of the research methods. The approach is a form of triangulation. Sarantakos (2003:169) suggested that using triangulation allows the researcher, 1) to obtain a variety of information on the same issue; 2) to use the strengths of each method to overcome the deficiencies of the other; 3) to achieve a higher degree of validity and reliability; and 4) to overcome the deficiencies of single-method studies.

Individuals are all different and even when talking about the same event, different people may express a contrasting interpretation. The purpose of using triangulation was to insure that the data collected are authentic. Even if there are no conflicts in the statements that were given by different groups of interviewees, the researcher still has to be very careful with the data and make a decision to explore and present the real story or to puzzle out the whole picture from three different sources because it might be that some people are not telling the truth or the situation is far more complicated than the researcher could imagine. Or it is simply the same thing but just people interpret it in different ways. For example, teachers may state that they have provided some information and experience for their children but the children might say they are told to do something by their parents. The resolution of such apparent disagreements – if it is possible – requires sensitive probing and subsequent analysis on the part of the researcher, who should also remember, however, that there may not in fact be a single ‘truth’ about an event, but rather a set of different interpretations by different participants.

Another advantage of using triangulation in this research are that different perspectives towards the same topic can be expressed from different angles, with some statements being verified again from a different group of people. Through descriptions given by different sources, the researcher can obtain a clear picture of the decision-making process. In most of the cases, triangulation can serve purposes of “confirmation” and “completeness” of the data collected (Denzin, 1970; Jick, 1983; Bogdan and Biklen, 1982; Cohen and Manion, 1994; Miles and Huberman; 1994; Neuman, 2006). For example, in this research, students may tell the researcher that
they all had made their decision themselves, while the teachers may state that most of the students made the choice based on their parents’ preferences.

However, limitations and conditions of triangulation have also been discussed by various researchers (Denzin, 1970; Jick, 1983; Bogdan and Biklen, 1982; Cohen and Manion, 1994; Miles and Huberman; 1994; Neuman, 2006). For example,

1. Triangulation and single-method procedures can be equally used if they are based on wrong conditions and wrong research foundations;
2. Triangulation can be used as a way of legitimising personal views and interests;
3. Triangulation is difficult to replicate;
4. Triangulating per se is not more valuable than a single-method procedure, which can be more suitable, useful and meaningful to answer certain questions;

Understanding how students make their choice when they are facing the point of having to make a decision, may be difficult and complex. Thus, it is important to have multiple sources of information, to attempt to approach this complexity. Therefore, mixed-method design is used for different objectives in this research as well as to investigate different aspects of the same issues. For example, open-ended questions were employed to investigate students’ attitudes and the reasons for formation of their attitudes and focus group discussions were used to understand students’ perceptions of real and school science.

Furthermore, approaching research questions from different angles and bringing together a range of views has the potential to generate new and alternative explanations, ones that better capture the social complexity explored by the fieldwork. If the different types of data lead us to similar conclusions, we may see triangulation as a form of reliability check, increasing our confidence in the data. And even if some data are inconsistent, it is possible that investigation will reveal reasons for the discrepancies when the data are processed. Given this possibility, divergent results can be equally fertile for theory-building, policy and practice. (Jick, 1983)

Disadvantages of using triangulation in this research were: it was time consuming and created a huge amount of replicated conversation. However, this was the necessary part of the research process because it provided the data with greater validity and
reliability.

4.3.3. Ethical issues

All the participants were informed with firm oral and written ethical consent agreements before the interviews took place. Although none of the participants, including teachers, students, and parents expressed a special concern on this issue, codes and pseudonymous names are also given to every participant. A few concerns about ensuring confidentiality in this research are: Firstly, the name of the participating schools. Although most of the head teachers of the participating schools were friendly and helpful, one of the head teachers did not wish to reveal the name of his school. Therefore, pseudonymous names for all the participating schools were created and used throughout this research to show respect and to protect the head teachers and participating schools.

The second ethical concern is for the teachers. The concern is that if the opinions of the teacher are considered to be against the school, parents or students, from their point of view, the teacher might not want to speak freely or they might have problems dealing with the school, parents or students. The teachers were assured of the confidentiality so they could feel confident in talking freely. Their names are coded, i.e. teacher1-10.

The third concern is for the students. Although none of the students who participated in this research was contacted through their science teachers (half of the students were not studying any science subject any more), it was a concern that some students might not feel free to speak what they felt was the truth related to the school or teachers, or that they might feel insecure after speaking the truth. Therefore, different coding for the participating students were created to protect the students and also to encourage them to give their genuine opinions. In order to distinguish the school and which study group the student was from, the coding of students includes the name of the school and numbers, for example, students from Hsi-Hen Senior High School are coded as “ssh1-12” and students from Taoying Senior High school are coded as “sty1-12”. Although I was anticipating a completely voluntary participation from the students, there is also another ethical issue with some of the students who participated because a few of them mentioned that they were asked by their teachers to come.
Such actions, although well meaning are difficult to anticipate. Thus, it was unclear if some students felt forced to attend, when they were asked/invited. Therefore, in order to reduce the worry and risk of ethical problems, I had asked all students for their consent again, prior to recording, after explaining the purpose of the research and the use of all interview material. However, whilst being aware that some participation may not be fully voluntary, the inclusion of any ‘passively voluntary’ participants may add more strength to this research as their views would not be included if they had not been chosen by the teachers. Parents who attended interviews were also advised of the ethical issues around interviewing and were asked for their consent before the interview stated.

4.3.4. The three stages of data collection

4.3.4.1. Data collection stage 1: Students’ attitudes toward school science and real science
A small scale survey of attitudes towards school science and real science, and factors that shape their attitudes was conducted in two secondary schools. From the results, comparisons are made between attitude and school subject choice. Instrument used in this stage was open-ended questionnaire.

Although many researchers have endeavoured to develop instruments to measure attitudes toward science, no one instrument has received overall acceptance. This includes one of the most famous and earliest science attitudes inventory, based on the five-point Likert scale constructed by Moore and Sutman (1970). Gardner (1975) surveyed instruments to measure students’ attitudes and highlighted some methodological problems in this field. These problems still remain today in some instruments. His criticism of the rating scales for measuring attitudes and human characteristics (1996) is derived from the fact that they “commonly consist of numerous items whose scores are summed to yield a total score.” The underlying assumption of the technique used is that the items in the scale reflect a common construct. Also, the answer might be only a response to the question not actually reflecting the attitude to certain topics, for example, rating the statement of “I would enjoy being a scientist” on a scale does not necessary mean that the person does not like science when he/she gives a low point on the scale. It could, indeed, just reflect
an opinion towards that occupation. These concerns have always caused controversial debate about measurement of attitude. For example, Munby (1983) criticised and argued that attitude cannot be separated from beliefs and affection; and he suggested that attitude is not only affective, but also cognitive and therefore cannot be measured by the level of affection. Thus the degree of the attitudes in every sub construction is even more subjective, and can hardly be measured by any kind of instrument. For example, researchers can look at the sources of influence by asking their participants to tick the boxes but how sources affect and interact with students might not be completely the same with the measuring in the instrument. The summed score from the scales may overlook students’ attitudes when they just merely agree with the items in the instruments. Moreover, the degree of agreement with the item asked may be hugely different from individual to individual and thus attitudes cannot be measured by the same instrument.

In view of the methodological problems and other concerns, including the definitions of key terms like validity and reliability of the questionnaire, a semantic approach is another alternative for understanding students’ attitudes toward science. (Munby 1983; Schibeci 1984; Oppenheim 1992; Pell and Farvis 2001). Open-ended questions seemed to be a good way to understand attitudes in this case. However, the disadvantage would be if the person does understand himself or has a poor skill in expressing himself, the responses might be very limited.

Despite the long contentious discussion over the attitude measurement inventory, many studies still adapt the scale to measure students’ attitudes with their own modification and purposes (Munby, 1983; Oppenheim 1992; Moore et al, 1997; Bennett 2001; Pell and Jarvis, 2001). Furthermore the inventories have expanded to other areas, such as technology (Page, 1979), and attitude inventories developed from other areas, such as mathematics, were also modified for the use of attitudes toward science (Bennett, 2001; Bennett et al, 2001). There are still different opinions when planning to investigate students’ attitudes. Perhaps, a new strategy of investigating students’ attitudes can be employed, adopting both questionnaire and constructed questions, to overcome or minimize the problems that occur in scale measuring.
A design of qualitative method has been employed in this study. Open-ended questions were conducted with students to understand the attitudes students had at different stages of school science, and the factors that changed their attitudes, if a change occurred. The interviews were designed to explore the depth of attitude changes throughout the life learning experience. For all the questions that needed to be answered with a detailed description, students were allowed enough time to answer the question in full.

The questions cover specific topics which may be summarized as:
1. Background variables: The background variables in the pilot questionnaire included school, class, gender, group option, hours of science class, hours of received tutoring class and hours of study science.
2. Attitudes towards elementary school science: Students were asked about their attitude towards school science they experienced when they were at elementary school; reasons why they liked or disliked school science.
3. Attitudes towards high school science: Students were asked about their current attitude towards school science and reasons why they liked or disliked school science.
4. Attitudes towards real science: Students were asked about their attitude towards real science and reasons why they like or dislike general science.
5. Change of attitude: Students were asked if they had experienced a change of attitude, and if appropriate, were asked the reasons and time of attitude change.
6. Suggestions to improve their attitudes.
7. Individual performance in class: Students were asked about their science performance in class divided into three groups: good, fair, and poor.

The questionnaires were piloted and tested by some students before the actual data collection. The purpose of the pilot study was to test the validity and appropriateness of the questions that were going to be issued in the main questionnaire session. It was a small scale replica and rehearsal of the main study that sought to discover possible weaknesses, inadequacies, ambiguities and problems of the research (Sarantakos, 2003). Inappropriate questions or direction of the research could then be modified to fit into the research questions, these corrections being made before the actual data collection took place. A small-scale study of this research was made on December 2003, to test the appropriateness of the questionnaire. The final questionnaire used for exploring students’ attitudes toward school science and real science is shown in
Appendix 5.

Several secondary schools in the populated central Taiwan were asked to participate in the first stage of the research. Two medium size secondary schools, Sho-Shi Junior High School and Hsi-Hen Senior high school (pseudonymous names), both located in central Taiwan, agreed to participate in the first stage of the data collection. I also had contacts in both schools that would assist me with the research. Sho-Shi had 60 classes in total, 20 classes in each year. Hsi-Hen had 45 classes, 15 classes in each year. Both had approximately 2000 students. Both schools are positioned in the middle of the school league table, and so the academic level was thought to be of ‘average’ Taiwanese students. A total of 729 students from the two schools took part in researching students’ attitudes towards school and real science. The students were from grade 7-12, aged between12 and 18 years. Full consent was obtained from the teacher and students before the sessions took place, and a promise of confidentiality was printed at the beginning of the questionnaire.

Figure 4-2 Location of Sho-Suei Junior High School and Hsi-Hen Senior High School

4.3.4.2. Data collection stage 2: Perceptions of natural science and social studies
In the second stage of data collection, more profound questions were generated to explore the influences beyond the attitudinal concerns that influence students’ decision-making. Focus group discussions were conducted to understand students’ perceptions of school science and real science.

1. Choosing schools for data collection
As my living and working experience in Taiwan, I was able to have different contacts with some schools through friends, colleagues and family connections. However, due to the constraints of time, energy and funding, it was not possible to carry out an overall research to all schools in Taiwan or all the schools I could get in contact with. Also, according to the Ministry of Internal Affairs, Taiwan (2007), about 90% of the population in Taiwan live on the west coast of Taiwan.

The majority of the population in Taiwan inhabit the plains and basins of west Taiwan. Very few people live on the east coast. In order to present the attitudes of average high school students in Taiwan, data collection of this part of the study was conducted in four senior high schools across the populated west coast of Taiwan (as shown in
Figure 4-3). Both study groups, SSP and NSP, in each school were involved to allow a balanced analysis of views. Eight groups with a total of 49 students participated in the study. The interview session with each group includes a discussion, lasting around 40 minutes.

It should be noted that individuals come from different backgrounds and have different life histories. Ideally, everyone’s opinion should be taken into account and factors that shape their decision should be understood. However, only a small number of participants were included, compared to all of the students in Taiwan, due to the limited resources and time.

Approaches to schools sometimes were straightforward, but nevertheless could be difficult. Different contacts in different schools had different ways of handling affairs, thus, the routes for accessing participants were all different, depending on the arrangement of the initial contact. The initial contact in each senior high school was normally from my personal “guanxi” (‘network’ in Chinese). Basic information about the school and a brief description of how the schools were approached are described below (with pseudonymous names):
Table 4-1. Entry score of each participating school, by score in 2003

<table>
<thead>
<tr>
<th>Score Range</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>295-250</td>
<td>Cheng-Kao</td>
</tr>
<tr>
<td>240-230</td>
<td>Hsi-Hen</td>
</tr>
<tr>
<td>230-210</td>
<td>Hu-Wen</td>
</tr>
<tr>
<td>200-170</td>
<td>Taoying</td>
</tr>
</tbody>
</table>

(The full score of the exam is 300)

1. North of Taiwan: Cheng-Kao Senior High School
This school is located in the centre of Taipei, largest city in Taiwan. The school has 3047 students in total (year 10-12). 1007 students are in the second year of high school. The academic level of the students in this school is very high and homogenous because of the furious competition in the entrance exam.

2. Middle of Taiwan: National Hsi-Hen Senior High School
Hsi-Hen Senior High School is a new state bilateral senior high school. The school is located in the middle of Taiwan near the edge of the suburban area. In 2004, a total of 1857 students enrolled in this school. 549 students were in the second year programme.

3. Middle of Taiwan: Hu-Wen Senior High School
Hu-Wen Senior High School was founded by combining two old boy-only and girl-only senior high schools. The school is located in the rural area of central Taiwan. The school has 1841 students divided into 42 classes, including 39 ordinary classes, 3 athletics talented classes and a science talented class. 674 students were in the second
year programme.
4. South of Taiwan: Taoying Senior High School
The school was a boys-only junior high school for a long time and changed into a bilateral senior high school lately. The school is near Kaoshung City, second biggest city in Taiwan. The school has 2075 students in total and 685 students in the second year programme.
Contact with students normally started through a teacher whom I knew from work and their friends and the link stretched out to the first contact teachers who worked in the prospective schools. The network within that school was then extended to the headmaster or director of study. Students were to be added directly or indirectly by the teachers after approaching the headmasters. From students, the connection then extended to their parents. A simple chart below illustrates the basic routes to approach the interviewees (see ). However, situations were all different in each school. Further details of problems and difficulties encountered while approaching to the participants are discussed in Appendix 6.

2. Method used for exploring students’ perceptions of science
Students’ perceptions of science were conducted using the method of focus group discussion. It was decided that an activity (described below) would help me to understand the students’ perceptions of school science as well as help them to express
their ideas better. This was because I had never met the participating students before the interview session and with audio and video equipment being used during the discussions and interviews, having some form of activity was thought to help students feel less pressured. Focus group discussions were chosen to serve both the purpose of understanding students’ perceptions of science and to help individuals feel more relaxed giving talks in front of others and recording equipment.

Researchers have claimed that focus groups can serve several purposes. Sarantakos (2003:181) suggested:

- As a pre-research method it can help to prepare the main study by providing sufficient information about the study objects, about operationalisation by defining indicators and about preventing possible errors.
- As a post-research method it can explain trends and variances, reasons, and causes, through the views of the respondents.
- As a main study it offers information about group processes, spontaneous feelings, reasons and explanations of attitudes and behaviour as adequately as any other method.
- In one form it can bring about changes in the group and its members as a result of the direction and intensity of the discussion.
- In another form, group discussion allows expression of attitudes and opinions.

Using focus group discussion in this research serves the purpose of understanding opinions, feelings, attitudes, behaviours, and explanations, as well as encouraging engagement in the discussion. Furthermore, it was considered a more practical way than the use of individual interviews of obtaining the views of a sufficiently large group of students. Therefore, the instrument used in this part of the study is to understand a student’s point of view from a broader and macro vision. The activity helps create a discussion on whether subjects from a provided list of 21 items are a science (see Appendix 5).

While focus group discussions aim to encourage people to express their opinions and interact with other group members, there are also problems and conditions for using the method. For example, the group conditions might make people hide their real
views especially when it is personal. There is the danger of domination of the group by some people, causing others to remain silent in the discussion. It is important for the interviewer to keep the discussion on track, to counter any tendency for the discussion to be misled by the members, or manipulated by the leader. (Bogdan and Biklien, 1982; Cohen and Manion, 1994; Sarantakos, 2003). I was aware of these pitfalls and tried to avoid the above situation as much as possible. However, there were still difficulties during the data collection. Problems and difficulties experienced during fieldwork are discussed later in this chapter.

For the initial activity, a list of human activities that were variously, science, non-science or potentially ambiguous in nature was provided at the beginning of the session. These will be referred to as items, for the remainder of the chapter. Students were given time to decide individually whether each of the items was a science or not. The purpose of this exercise and subsequent group discussion was to, 1.) Make students feel more relaxed and comfortable when speaking in the presence of other students, video camera, audio recording, and the researcher; 2.) Understand students’ perceptions of science, especially the way they define a science; and 3.) Generate more discussion of the generic differences between science and social studies as understood by the students. Whether students’ responses to the items are ‘correct’ is less important than understanding reasons why they justify the item as science or not.

4.3.4.3. Data collection stage 3: Factors that influence the students’ decision making process
Students, science teachers, and parents were interviewed to explore the factors that influence their decisions of subject choice. Interviewing different groups of people served several purposes: Firstly, to explore views of significant others with different social positions/roles and ages; secondly, to explore the possible relationships of the influences from these different groups of people; thirdly, to triangulate the data collected to check/ascertain their validity, reliability and credibility (Cohen, 1994; Miles, 1994). It is important to have different sources of data to understand the issues from different perspectives and also to a basis for cross checking.

1. Group interviews of students
Each school had two group interviews, each formed from six students from each study group, giving a total of four NSP and four SSP student groups. All the interviews were audio and video recorded with the participants’ consent and students were informed of their right to withdraw their participation at any time during or after the interview.

2. Interviews of teachers:
Two science teachers, with different teaching subjects, were interviewed in each school. A total of 8 teachers were interviewed. Mostly the science teachers were physics and chemistry teachers. However, one of the science teachers from Cheng-Kao Senior High School was a biology teacher.

Also, two of the counsellor teachers from Hsi-Hen Senior High School, volunteered to give their views when one of the participating teachers mentioned my visit. One of the counsellors was the head of the counselling department because she felt that it would be more appropriate for her to express the school’s point of view instead of the young and new counsellor who originally volunteered to be interviewed. The conversation was also recorded with their consent, given on the understanding that it was to be used in this research only.

3. Interviews with parents:
Students were asked to leave their home telephone number voluntarily, if they would like their parents to be interviewed. Most students were cooperative and supplied their home telephone number. Only one interview with a parent from the Hu-Wen Senior High School was held at his work place, whilst others were telephone interviews at the parents’ convenience. A total of 16 parents, of two students from each study group in each school, were interviewed. Audio recording was employed during the interview session with the parents’ consent.

4. Individual in-depth interviews
Further individual in-depth interviews with some selected students were also made in order to present a rounded and complete information, in relation to the sources of influence, in the case studies presented in the latter chapters. A total of five students took part in the individual interviews, chosen on the basis of the contrasting
characteristics of their stories, students’ initiative and convenience.

Interviews are a powerful method used to understand people’s perceptions, attitudes, and definitions of situations and construction of reality (Bogdan and Biklen; 1984; Miles and Hubberman, 1994; Fielding, 2003, Sarantakos, 2003; Gillham, 2005). Different types of interviews suit different situations, and can be used to obtain details of situations (Burgess, 1984). For example, if a researcher would like to understand the life history of a teacher, it is more likely for the researcher to obtain live information by using interviews.

There are three types of interviews: structured, semi-structured and unstructured. Denzin and Lincoln (2003) described that structured interviews might result in a more limited set of response categories, due to the pre-established questions. Unstructured interviews might cover irrelevant topics and hence require more time to reveal the core problems. The highly structured interview technique is not suitable for this research, as decision-making might be a complex process which might be beyond my knowledge and the qualitative nature of this research. Pre-established questions may have less flexibility in exploring situations and consequently may restrict the answers. Semi-structured interviews are more suitable because they enhance the opportunities for the participants to express their experiences, attitudes, views, and offer me richer information. Hence, data from this type of interview may help researchers gain a deeper understanding of the participants’ perspective on the research topic (Becker and Bryman, 2004:268). In this research, semi-structured interviews are used throughout the dialogues because it has been expected that the questions might help to understand the real reasons of the decision making, as well as starting good conversations during the interviews. Students were encouraged to talk about why and how they chose their study group.

Although interviewing is a popular tool for gathering rich data in social science, understanding the meaning of some answers may be difficult and complex. Denzin and Lincoln (2003) pointed out that apart from the ability in expressing of the interviewees; there are other concerns of interpreting the data. No matter how carefully the researchers and interviewees use words to describe their views and opinions, and how carefully the researchers interpret the responses from the
interviewees, the spoken and written words might still have a residue of ambiguity. In other words, even if interviewees are fluent in the language of the researcher, different ways of describing ideas because of various styles of the language and cultural manifestations might result in different interpretations. As a result, misunderstandings can occur. In order to reduce the misunderstandings, the interviewers should contact the interviewees to confirm the information that they have provided, after they finish the interviews. In order to understand the situation when students were making their choices of study groups, full and detailed descriptions of their own stories were needed to construct the whole picture of decision making.

4.4. Data Analysis

The data analysis occurred in two stages. The first stage analyzed the 729 questionnaires gathered from two secondary schools, for investigation into students’ attitudes towards school science and real science. The second stage analyzed the data collected through discussions and interviews, which provided greater insight into how and why students’ choose their study groups. All the data collected were transcribed in the original language and some of them were translated from Mandarin to English. There were some elements of interpretations built into the translations in order to enhance the meaning of the dialogues.

4.4.1. Questionnaire data analysis

All questionnaires with answers were read carefully and marked by highlighter pens when an opinion was expressed in the answer. Themes were noted down while reading through all the answers. The questionnaires were read again and the frequencies of same/similar responses were counted so that the theme is also presented with its frequency of answering.

The responses were first grouped according to the questions asked in the questionnaire, such as positive, negative and ambivalent: Background information, such as gender, study time for each science subject, and academic performance with students’ attitudes were also examined in order to ascertain trends or inclinations between certain groups of students. Because there were more than 700 participants in
this part of the study, quotations from different students are number co-ordinated, for example (# 289 or # 566)

Because of the descriptive nature of the answers, the use of a quantitative analysis programme such as SPSS programme did not seem to be appropriate for this type of information gathering. The data needed to be examined and handled carefully by an analyst who is familiar and sensitive with the language, culture and the context. By using manual systematic analysis I was enabled to remain sensitive to all aspects of the data content. As an example, a couple of students stated their attitudes to school science in the form of a positive response. However, their reason for liking school science was given as being because they no longer had to study any science class. Such a sarcastic way of describing views will not be recognised by computer software. Many students’ expressions were written using slang or tones that could only be sensed by native speakers. The process of coding and processing seemed to take more effort after a few trial. Therefore, manual analysis proved to be the best option for data analysis at the time

4.4.2. Discussion and interview data analysis

The data presented in this thesis are organised in a way that I and the readers can easily identify the school and study group that the students were from; for example, students from the various groups may be recognized by a prefix to the student identifier, for example, students from Hsi-Wen are marked as shw. Numbers 1-6 were students from the natural science groups, whilst numbers 7-12 were social study groups, apart from Cheng-Kao school which had 7 students in the science group.

Due to the lack of data for this particularly topic on Taiwanese education, and also to avoid bias, it is important to keep an open mind but remain impartial when examining data. Therefore, the analysis and interpretation of the interview data might be most appropriately engaged with using a grounded theory approach. Strauss and Corbin (1998) stated the following characteristics of a grounded theorist:

- The ability to step back and critically analyze situations.
- The ability to recognize the tendency toward bias.
- The ability to think abstractly.
• The ability to be flexible and open to helpful criticism
• Sensitivity to the words and actions of respondents.
• A sense of absorption and devotion to the work process.

Grounded theory is an approach to describe relationships where little is known in advance or to provide a fresh take on existing knowledge. It is an approach that is shaped by data, as well as by the researchers (Denzin and Lincoln, 2003). Grounded theory methods consist of systematic inductive guidelines for data collection, and data analysis to build theoretical frameworks. In the process of research, grounded theorists are able to develop analytic interpretations of their data, thus allowing more attention to further data collection, which they use in turn to inform and refine their developing theoretical analyses. The main point of this method is to identify emergent categories from empirical data, by using qualitative data analysis methods (Glaser and Strauss, 1967).

The rigour of grounded theory approaches provides qualitative researchers some guidelines to build explanatory frameworks that specify relationships between concepts. Although grounded theory methods do not detail data collection techniques, they organise steps of the analytic process towards the development, refinement, and interrelation of concepts. Denzin and Lincoln (2003:251) point out the strategies of grounded theory as:
• Simultaneous collection and analysis of data.
• A two-step data coding process.
• Comparative methods.
• Memo writing aimed at the construction of conceptual analyses.
• Sampling to refine the researcher’s emerging theoretical ideas.
• Integration of the theoretical framework.

Theoretical categories are developed from the analysis of the data collection and the categories explain the data they subsume. Any existing concept has its value in the analysis. A grounded theory also has to provide a useful conceptual rendering, and ordering of the data, that explains the phenomena. The relevance of a grounded
theory derives from its offering of analytic explanations of actual problems, and basic processes in the research setting. A grounded theory is also durable because it accounts for variation. What is more, it is flexible because researchers can modify their emerging or established analyses, as conditions change or as further data is gathered.

With reference to this project, all interviews were audio recorded with full consent from the participants. Students’ group discussions and interviews were also video recorded to help with the transcribing, which took place in the later stage. All interview content and field notes were transcribed into the original language so that I was able to analyse the data, according to the original words of the interviewees. A number of interviews are translated into English completely due to the results being presented in the discussion chapters. Due to the volume of the information gathered and the number of participants, the interview data is first grouped by the various themes and groups of participants.

Systematic analysis of the interview data was completed using Microsoft Word documents, by applying different highlight colours on the text passages to illustrate and identify the participant’s points of view. The points were then pulled out as threads that represent participants’ views. The threads are then coded numerically on a list of codes that are then matched with specific colours in order to aid the process of identifying the corresponding passages. The passages were read and marked again with the corresponding colour and coding. After coding of all the collected data, themes were created among the threads. The data collected was vast and the process of analysis was long and tedious, however, the systematic and detailed analysis of this kind provided a deeper insight into participants’ opinions and related issues.

I was aware that some newly developed computer software, such as NU*DIST and NVIVO, might assist me to analyze the interview data with greater efficiency, in terms of time and labour. However, the programmes were not developed at the time, to work with the Chinese language. In addition, the interviewees used many ways to communicate. They spoke in one or two languages, slang, auxiliary words and speculative tones that could only be recognized by a native speaker. Therefore, it was decided to handle and analyze the data manually, thus allowing sensitive detection of
any “strange expressions” or to understand any obscure meanings within the conversations.

The criteria used for selecting the illustrative quotations for the group discussions, has also been taken into consideration because some participants are more articulate than others or they might speak on behalf of others. However, these quotations do not only serve as the views of the speakers but also the acknowledgements of those who support or approve the idea in the group, as observed in the video recording. At times some people remained quiet or nodded their heads in agreement with the person who was speaking. For those who spoke up more, their dialogues might have higher frequency of appearance in quotations.

In chapter 8 and 9, I will present a couple of individual personal stories as ways of illustrating key theoretical points. Although this research was not designed to engage with case study, using presentation similar to case studies shows a clear picture of how factors and influences shape a student’s decision making in the real life.

>The general design of a case study is best represented by a funnel. The start of the study is the wide end: the researchers scout for possible places and people that might be the subject or the source of data, find the location they think they want to study, and then cast a net widely trying to judge the feasibility of the site or data source for their purposes. (Bogdan and Biklen (1982) cited by Wellington, 2000:90)

Since some data was collected based on different group of participants, it was hard to portray all the influences/pressure that individual had when he was making a decision. With personal stories, readers are expected to understand better from an individual’s own view.

### 4.5. Summary

The process of deciding on a study group seems to be a complex issue among Taiwanese students and might involve different ‘actors’ around the specific individual who ultimately has to make the decision. For example, parents and teachers might
provide suggestions for their children and students or other influences from friends or relatives. It is important, therefore, to examine not only individuals but also the possible influences of these other actors and their points of view when investigating the concerns that were taken into account during the process of decision making. As a result, students’, teachers’ and parents’ views were included when designing this research. This is in the expectation that with a broader, more inclusive data collection base, different and detailed parts of the puzzle can be revealed to illustrate the process as completely and clearly as possible. Different data collection strands were employed in this research in order to achieve different research aims. Questionnaires were administrated to the students to reveal and understand their attitudes toward school and real science; focus group discussions were employed to gather students’ perceptions of school and real science; group interviews techniques were applied to understand students’ decision making in general and in-depth interviews of students, teachers and parents were carried out to elucidate a clearer and more complete picture of the concerns and process of decision making. These various approaches can be seen as a progression from identifying broad, more descriptive data to more a more detailed examination allowing in-depth understanding at the individual level.

This research has utilized several research approaches, due to the various objectives of the research and fieldwork situation. Although, some difficulties were encountered during data collection, most of the people approached by me were helpful and willing to provide additional information. The research design allows me to examine issues from different points of view and data collection methods. Most important, the design of this research has aimed to optimised the validity, reliability and credibility of this research.
CHAPTER 5. SUMMARY OF PERCEPTIONS OF SCIENCE

5.1. Introduction

Science is a truth-seeking, problem-solving, method of inquiry. The reliability of its scientific method depends on the correctness of three ancient philosophies that science uses: empiricism, rationalism, and scepticism. (Schafersman, 1997)

The aim for this part of the study is to understand the perceptions of school science as a whole, by Taiwanese students, rather than their knowledge of science. It is anticipated that understanding students’ perceptions of science may help us to understand their attitudes toward school science and thus, identify and clarify the underlying influences on students’ subject choices. This chapter will first focus on students’ perceptions of school science, but to understand the bigger picture of students’ attitudes and choice this is not to be not confused with the perceptions of real science and social studies, which are dealt with later in the chapter.

Data collection for this part of the study was conducted in four senior high schools across the densely-populated west coast of Taiwan (as shown in Figure 4-3). A total of eight groups, 49 students, participated in this part of the data collection. The four participating schools were different in their academic level and location. Their order of academic level from high to low is school 1 (Cheng-Kao, 295-250), school 2 (Hsi-Hen, 240-230), school 3 (Hu-Wen, 230-210), and school 4 (Taoying, 200-170). School 1 was one of the top senior high schools in Taiwan and the entrance requirement for school 4 was near the lowest requirement to study in the state senior high schools.

Although these were worries when planning methods to collect the data from students, students were not afraid to have confrontations with others throughout the group discussions if they had a very different point of view and no particular student tried to dominate or impose their views on others. It was found that the approach to data collection used in this part of study helped students generate conversations about how
they perceive science.

In addition to the perceptions of science, the perceptions of social studies was also gathered from the discussions to give more support of how one’s cognitional system is formed in the perception and behavioural model in Figure 6-7.

In this section, discussions in each group will be briefly summarised to give a general view of each group from the four different schools (4 NSP and 4 SSP groups)

5.1.1. School 1 (in North Taiwan): Cheng-Kao Senior High School.

5.1.1.1. Group1 (science study group)
Students judged whether an item was a science by judging if it required logical thinking, calculations, experiments, hands-on work, and numerical data or had its proof of existence in the real and material world. Items that could not meet these criteria were normally not qualified as science. However, on several occasions, students were not sure if the items were science, but they did not ask for explanations except for ‘spiritualism’ and ‘economics’. There was a willingness to share ideas when they knew something about the item, but there was limited discussion if they did not understand. Students stated they were familiar with most of the items from television but because they were not clearly explained, they could only guess at their status. Students thought social study required a lot of memorizing but one student thought it also included logical thinking and one thought that social studies required much oral communication.

5.1.1.2. Group2 (social study group)
Students were relaxed but also active and enthusiastic in expressing their opinions as well as discussing with each other. Although not every item on the provided list was understood, they were willing to guess and express their opinions. They also mentioned some familiarity with items from daily life, but did not understand or had not tried to understand the true nature of those items. Despite their studying in the SSP, most students stated a clear procedure of scientific research methods taught in the first year of junior high school. After discussing two items, they realized a basic problem. They noticed that there should be differences between technology and
science and gave different definitions and criteria to the two categories. Interestingly, plumbing was suggested to be a science because it involved calculation and fluid physics. However, items that sounded more abstract or involved emotions, such as Psychotherapy and Lie Detection were not considered to be science.

5.1.2. School 2 (in Middle Taiwan): National Hsi-Hen Senior High School

5.1.2.1. Group3 (science study group)
Little knowledge and familiarity about the items were expressed and students could not generate much discussion. The ability to express themselves was poor and students could not give or describe their reasons even if they thought they knew the items. Students were reluctant to guess any answers for items that were unfamiliar because they were not confident in themselves and did not want to make mistakes. They could barely present a clear picture of what science was to them because contradictory concepts appeared frequently. Two frequently mentioned criteria for science were “theories and experiments” and the students were confused and annoyed at the end of the discussion. Students also did not demonstrate curiosity or enthusiasm in exploring new items they did not know.

5.1.2.2. Group4 (social study group)
Students in this group happened to be all girls and the discussion was lively and smooth without constant queries or any need for encouragement. Although some of the items were not known to the students, each student was willing to give her views and would guess, if not known. They thought that science was something involving “experiments, detailed calculations, logical thinking, and required the use of equipment”. However, because a lot of the items were not clearly known to the students, they also guessed the items by the implicit meaning of the item in Chinese.

5.1.3. School 3 (In Middle Taiwan): Hu-Wen Senior High School

5.1.3.1. Group 5 (science group)
Many items were not known by the students and the discussion stopped recurrently. Only items that were mentioned or taught in the school science curriculum were clearly identified as science, about which they had no doubts. Other items were not seen to be science. The two characteristic features of science for this group of
students were “logical thinking” and “experiments”.

5.1.3.2. Group6 (social study group)
Students in this group were willing to express themselves but always waited for the interviewer to ask for their opinions. They were not confident with their own ideas or were worried that they would give an incorrect answer and they preferred to ask the interviewer about the item, rather than guess first. They admitted that they did not pay much attention to science because their chosen subjects were social studies.

In defining science, this group answered that it involved “numbers, calculations, logical reasoning, experiments, natural phenomena, measuring and equipments”. Also, things mentioned in science textbooks were science. The idea of a distinction between science and technology emerged although the conclusion became confused, which in turn, confused the discussion on the remaining items.

5.1.4. School 4 (in South Taiwan): Taoying Senior High School

5.1.4.1. Group7 (science study group)
Students in this group were all boys. Their perceptions of science were that science included “observation, mechanics, experiments, mathematics and using evidence as proof”. Apart from one student, all the students stated firmly that items or activities involving human emotions or activities, such as psychology, were not science. One student thought that psychology was a science because his father had a degree in psychology and was told psychology involved experimentation. Four students thought that plumbing was a science because it involved measuring and fluid dynamics.

Students in this group believed it unnecessary to understand the nature of real science at this stage because they would have time to learn more about science when they went to university. However, none of them has decided what subject they would like to study in the university. They stated that their main focus was to get high scores for the Entrance examination and go to “any” university first. They were reluctant to guess any answers to items and expressed lack of motivation to understand more about science, apart from what had been taught at school because that was the basic requirement for going to university. They stated that TV and newspapers had provided much of their information about new science and technology.
5.1.4.2. Group8 (social study group)

Students in this group had all been planning to take up science a year ago. The whole class was originally set up as a preparatory class for science study when they first entered the school. One year later, more than half of the students changed their subject to social study, so the school turned the whole class into a social study class. According to these students, the physics teacher’s teaching was the key reason why they lost their faith and confidence in studying science. The perceived difficulty of the science curriculum was another factor why students chose to change from studying science.

Students thought that the nature of science demands accuracy and proof through evidence. They discussed passionately but were not confident with their answers because many of the items were unknown to them. Their judgement about science was normally based on the subjects taught in the school, TV advertisements, and information from friends. However, they stated that science and technology are different subjects, for example “Technology is generated by the need of human beings and science is the base of it, which also makes technology better”.

5.2. Perceptions of Science: Is this a Science?

The results of students’ opinions about whether or not each of the items provided on the list are shown in Table 5-1.
Table 5-1. Students' opinion of "Is it a science?"

<table>
<thead>
<tr>
<th>Is this a science?</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>88%</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>Creationism</td>
<td>8%</td>
<td>29%</td>
<td>63%</td>
</tr>
<tr>
<td>Water divining</td>
<td>84%</td>
<td>10%</td>
<td>6%</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>39%</td>
<td>41%</td>
<td>20%</td>
</tr>
<tr>
<td>Spiritualism</td>
<td>18%</td>
<td>29%</td>
<td>53%</td>
</tr>
<tr>
<td>Theory of relativity</td>
<td>92%</td>
<td>8%</td>
<td>0%</td>
</tr>
<tr>
<td>Psychotherapy</td>
<td>41%</td>
<td>33%</td>
<td>27%</td>
</tr>
<tr>
<td>Nuclear Physics</td>
<td>96%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Computing</td>
<td>84%</td>
<td>12%</td>
<td>4%</td>
</tr>
<tr>
<td>Theory of evolution</td>
<td>80%</td>
<td>16%</td>
<td>4%</td>
</tr>
<tr>
<td>Astrology</td>
<td>14%</td>
<td>35%</td>
<td>51%</td>
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<tr>
<td>Plumbing</td>
<td>73%</td>
<td>16%</td>
<td>10%</td>
</tr>
<tr>
<td>Space exploration</td>
<td>98%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>96%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Automobile design</td>
<td>59%</td>
<td>18%</td>
<td>22%</td>
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<tr>
<td>Physiotherapy</td>
<td>78%</td>
<td>14%</td>
<td>8%</td>
</tr>
<tr>
<td>Meteorology</td>
<td>86%</td>
<td>10%</td>
<td>4%</td>
</tr>
<tr>
<td>Herbal medicine</td>
<td>37%</td>
<td>43%</td>
<td>20%</td>
</tr>
<tr>
<td>Economics</td>
<td>22%</td>
<td>20%</td>
<td>57%</td>
</tr>
<tr>
<td>Electronic communication</td>
<td>82%</td>
<td>12%</td>
<td>6%</td>
</tr>
<tr>
<td>Lie detection</td>
<td>53%</td>
<td>35%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Their responses can be grouped in several groups based on the majority of students’ response (50%):
1. Items that are viewed as science (more than 50% of the student agreed that it was a science) are: Astronomy, Water divining, Theory of relativity, Nuclear Physics, Computing, Theory of evolution, Plumbing, Space exploration, Biochemistry, Physiotherapy, Meteorology, Electronic communication, Automobile design, and Lie
2. Items that are viewed as non-science (more than 50% of the students disagree that it is a science) are: Creationism, Spiritualism, Astrology, and Economics.

3. Items where students were unclear whether it was a science (items that did not gain more than 50% of agreement or disagreement to be a science) are: Acupuncture, Psychotherapy, and Herbal medicine.

Their criteria for judging a science are discussed below.

5.2.1. General criteria for science from discussions

Perceptions in this section will be discussed separately from knowledge and value of science, based on the model (Figure 5-4) presented in the previous chapter. The model has cast various components, such as knowledge, perception and value in one’s cognitive system, which are the basic guidelines of one’s behaviour.

Students appeared to have some criteria in mind when deciding the item because some statements appeared frequently when students were giving explanations of their decision. However, when students were expressing their reasons most of them did not realise they had a system of criteria for science; items not taught in the school or not heard elsewhere were confusing to many students. Some students merely decided that particular items were not a science because they have not heard the item in any connection with science.

Although students did not draw any diagrams or state any procedures for deciding a science, the judging process can be categorised by their responses and the order of the responses. Four basic stages of consideration emerged, when they were deciding whether an item is a science or not, in their discussion. They tended to draw on their existing science knowledge from schools and life experience and try to apply these criteria to the items that were asked during the discussion (see Figure 5-1)

Shw2: Meteorology...hum...I think it is a science because you know in Earth Science we have to learn when there is a change in the weather, like how does a typhoon form, something like that.

And

Sck3: Something you receive from everyday life, like the textbook of earth science, and things that we learned before. These can all be used to judge whether it is a science or not.....but it might not be correct because we did not learn everything in details...
However, it was also observed that when students were judging an item, the aspects they took into accounts were numerous. Psychotherapy is a good example. Many students found it confusing. No students had experience in psychotherapy or understood it well but the words “psycho” and “therapy” seemed to belong to different subject groups: *psycho is about people’s minds so it should be a social study and therapy is a kind of medication so it should be a science (shh3)*. Psychology was not a science to most of the students because many students thought it was a kind of study that looks into human beings’ emotional reactions and emotional reactions were not considered a science. However, psychology was a choice for science students at university which added to the confusion. The semantics of the language played an important role in influencing students’ perceptions when they did not actually understand the content of the item.
Figure 5-1. Process of judging if it is a science

Firstly, when stating their reasons, students’ immediate responses were regularly
related to the items that were mentioned or taught in the science class, such as Astronomy, Theory of relativity, Nuclear Physics, Theory of evolution, Space exploration, Biochemistry, and Meteorology or theories related to famous scientists. They did not give deep thought about the item if it was mentioned in the science textbooks. This could be because of the convenience for answering or it could be they were not taught to be sceptical about things in the textbooks. For example,

Sty8: Earth Science class has taught us some things in Astronomy. Yeah, they can’t be teaching us non-science in the science class.

And

Sck1: “Theory of relativity? It is a science. It is in the textbook.
Sck6: “Yeah, Einstein said it, didn’t he? Secondly, if the item was not clearly mentioned or implied in textbooks, students would judge the wording of the item. For example, Water divining, and Physiotherapy were not included in the science curriculum but most of the students still think that they might be a science because of the words, “divining”, “physio-“ and ”therapy”.

Sck1: What reason? (Water divining) Because it says ‘divining’ on the word! Hum...there should be some specialised technique or theories. You know using a lot of related knowledge. So I think it should be a science”

And

Shw9: Physiotherapy should be a science because it has the word’ physics’. They would not call it physio if it is not related to physics.
Shh12: Yeah, also it is therapy, so it should be a science.

(The translation and semantic issues in the data collection are discussed in 5.6.)

This also happened when students already felt that the item might be a science, especially those items that have included science related words, they would also seek out for confirmation, for example, electronic communication.

Interviewer: Why do you think that electronic communication is a science?
Sty9: “Electronic!” That is why?
Interviewer: What do you mean?
Sty9: You know, electronics is a science. So, electronic communication should be a science.

Thirdly, when the item is studied at university and belongs to a possible degree choice for science students or for social study students in particular, students then related the item to the university subject group. For example, Economics is a choice for social study students at university so many students understood this not to be a science.
Shh3: Economics...What is economics? [Looking at the interviewer]
Interviewer: What do you think it is?
Shh3: I don’t know what it is.
Shh1: I think it is a kind of analysis for human finance activity.
Shh4: I have got no idea what it is.
Shh5: Should have a lot of statistics in it...
Shh3: It is the choice for SSP students any way. So it is clear that it is not a science.
And

Interviewer: Economics?
Sty2: No, no.
Sty4: But isn’t it about maths.
Sty1: Yeah, maths.
Sty2: It. I don’t think it is maths..no, it[economics] is not definitely a science.
Sty1: why?
Sty2: Some sciences need some mathematical calculations.
Sty3: Economics...do not think it involves with maths...
Sty5: yeah, basically economics belong to choice of SSP students.
Sty6: Economics belongs to social study group.

Fourthly, if the item might relate to the methods of science, then it is likely to be considered a science by students. This involves terminology of science. Terms frequently used during these discussions to describe a science are: “observation”, ”hypothesis”, “experiments”, “using standard tools or equipments to measure”, “numbers” “mathematical calculations”. “testing”, “theory building”, “stimuli and response”, “Medical science”, “nature”, “evidence proving”. When students were judging a science at this stage, they tended to adopt many criteria to prove their point. However, there was no hierarchical order among different criteria.

Sck9: Does Water divining use equipments to find water?
Interviewer: What do you think?
Sck10: I think it should be like treasure hunting. You know using those metal detectors...
Sck 13: But that is sensing the metal...this is water.
Sck 12: Doesn’t yang mean south of a mountain and north of water, yin means north of the mountain and south of water. There were ways to find water in old China. That should mean it is a science.
Sck11: I think science...experience.. like five meters below ants’ nest is water...this is experiments and hypothesis.

In general, both science and social study students’ perceptions of science seemed to emphasise the instrumental aspect of science and its relation to school science. For example, every group of students mentioned things that involve calculations, measuring, observation, experimenting, reasoning, and theories for science. These were the tools and activities that are commonly used in school science classes. The
criteria that students used throughout the conversations are shown to present the way they perceive science.
The causal relationship between stimuli and responses is an important characteristic of science.
Science is about measuring with tools and equipment.
Science involves with numbers and calculations.
Science is about doing experiments
Science involves logical thinking.
Science involves observations, questioning, hypothesis and theory building
Science has regularity and predictability.
Science is about observations and understanding the phenomena of the nature.
Science can be seen by people or proved by evidence.
Things that involve practical/hands-on work are thought to be science.
Medical practice or treatments on human bodies are science.
Things suggested/stated/established by scientists are science.
Science is accurate and precise.
Science is a recent field of study in human history.

Students tended to decide whether it was a science within the first three criteria and then picked up more criteria to justify their answers. Items such as Astronomy, Water divining, Theory of relativity, Nuclear Physics, Computing, Theory of evolution, Space exploration, Biochemistry, Physiotherapy, Meteorology, Electronic communication were strongly perceived as science by most students.

However, not all items have a clear boundary and they found it difficult to answer when items seem to bridge science and non-science. For example, when they came to an item that has scientific words in it and is taught as a subject in the school but not within the science class, they were confused. Computing and electronic communication were good examples because they seemed to be shown in textbooks as applications of science. However, they are not taught as part of the science curriculum. Theories of electrons, electricity and electronics were taught in physics but electronic communication was practiced in the craft classes. Five groups of students also noticed differences between science and technology. They concluded that science is the theory that explains what things are and how they work, while
technology is the application of science.

Svy2: It is difficult to distinguish them [science and technology] in this way because I think computing is based on some scientific theories but it is an application. Can applications of science count as science? I don’t know...
Svy4: Of course it is a science if it is based on scientific theories. It is like the Nano-technology. You use the things you discover in science and make them into products. Without the theory, you will not have the technique or products.
And

Sck2: Hum...to be honest, I am not very sure as well, because I feel it looks like a kind of technique. So I feel um...you know make it more convenient to use. Yeah, make communication more convenient. But I am still not sure.
Sck1: Yeah, yeah, that’s why I am not sure, either.
Interviewer: why do you think it is a science?
Sck5: it applies some scientific theories.
This also raises the issue that there might be a need for school teachers and curriculum development to provide a wider and more creative view of science.

5.2.2. General criteria for non-science

Apart from criteria for science, there were also criteria for non-science so that students could make sense of their decision when the item was not a science to them.
Reasons for thinking items may be non-science were:
1. Something that only involves human activities and historical events is not science
2. Something that is created by human imagination is not a science.
3. Something that relates to social events or phenomenon is not science.
4. Something that involves emotional reactions is not science.
5. Something where proof of existence has not been made by scientific experiments is not a science.

Most of these criteria seemed to be related to their school education because there were only three subjects, physics, chemistry and biology taught in the NSP and two subjects, history and geography, taught in SSP. Some items were clearly not science because they were not included in the science curriculum and were not widely proved by scientific experiments. For example, students thought that Economics and Spiritualism were not science because they were human activities, had historical records, were social events, and were mentioned in the History class.

Sck1: I don’t think so...it shouldn’t be. It is not proved (Creationism).
Sck2: Not sure.
Sck1: And you cannot see it. (What do you think the ‘it’ refers to here?)
Sck3: and it is more abstract.

And
Sck9: Astrology is someone who collected some data.
Sck12: Statistics.
Sck9: Yeah, and find the mean
Sck11: But don’t you feel very strange that if you connect a few stars and give them names...it is a kind of self imagination! I can draw the lines again and again and make them into different shapes too. Everyone can do it. There is no fixed standard.

And
Shw3: Because I think the ups and downs of currencies do not follow scientific theories or method. The reason why it goes up is because of human factors. For example, someone buys in the stock market and it will go up. It is something more related to the social aspect. So it is not very related to science.
Interviewer: Is social science a science?
Shw3: Social science is seeing the world from a human’s point of view. It means that the market, will not necessary go up or down, if I use a certain theory.
Shw1: I think social science is more romantic and physics and science are more rational.

Creationism and astrology were not science because they were the constructs of the human imagination not proved by scientific experiments.

Sck3: I am not an expert in spiritualism
Sck2: It sounds very abstract
Sck1: It does not have any actual shape
Sck3: you cannot see or hear it.
Sck4: there is no direction to do research
Sck6: I...I...am just interested in it...there are some photos on the internet. Those strange things in the photos....I think this is a kind of proof; a scientific explanation like science have reasons.

And
Sty11: But there are some people researching this now (spirits).
Sty8: But there is not result yet.
Sty7: There is. Souls have weight. 0.6, 0.6 g!
Sty8: Really?
Sty7: The news said about it.
Sty7: They put one man in a transparent coffin and when he died there was white gas escaped. That is the thing they are researching now: spirit.

Because most of the items on the provided list were not included in the science curriculum, students sometimes have different views because of their criteria of what counts as science. This sometimes generated some interesting discussions, such as about Acupuncture, Herbal medicine and Psychotherapy.

Sck6: I feel that acupuncture....is about stimulating points. But stimulating points is something passed down by the ancestors...hum..a kind of accumulated knowledge but there is not scientific proof for it. So I am not very sure if it is a science.
And

Sck4: “This is what I feel: acupuncture is a traditional practicing technique, people did not notice about it until recently after the beginning of 20th century. The western scientists did not believe in acupuncture in the beginning but they found out the real practical value of it later. I think maybe we just haven’t discovered its practical value. I think give it a little bit more time; it should be a very potential (potent?) item. So I think it is a science”

There were some interesting discussions when some students felt that the item did not satisfy the science criteria. For example, items associated with technology were confusing to students because they seemed to be scientific applications, which are developed or manufactured based on scientific theory, yet they also seemed to be a non-science because they were not taught in the science class or were not subject to precise calculation, such as electronic communication, automobile design, lie detection. Another type of discussion was that some items seemed to be non-science but they involve some scientific measurement, physics theories or statistics, such as astrology and plumbing.

Shh5: I think so because it is about a machine monitoring your heart beat, blood pressure...stuff like that (lie detection). You see it has got “detection” within the term as well.

Shh6: But it might not be correct because people’s heart beat might still go up when there are questioned any way.

Shh2: Yeah, that is not very reliable and precise.

Sck2: Plumbing does not sound to be a science...not sure...
Sck1: Of course it is a science! You need a lot of things like measuring and planning and you also need to know hydraulics and physics
Sck2: But they don’t really use that much science when they are connecting the pips.

Students’ discussions showed that they might share similar criteria for judging science and non-science, but not all of them will decide the item in the same way; this might be because the way they interpret the criteria or their knowledge of the item were different. This could be related to the subjects they were studying or life experience. The differences in different study groups will be discussed in section 6.6.

5.3. Source of influences and information

Cognition depends upon the kinds of experience that comes from having a body with various sensorimotor capacities, and, second, that these individual sensorimotor capacities are themselves embedded in a more encompassing
biological, psychological and cultural context. (Varela and Rosch, 1991:173)

Perceptions do not occur without our senses (Malim and Birch, 1998; Gross et al, 2004). The process of cognition is essential in forming perceptions. However, elements that are involved in the cognitive process can all play important roles in shaping the final products: perceptions. Students are living in a world in which they have to be independent individuals as well as playing different roles in different social relationships. The many connections and interactions they have with individuals, family and other people, means they receive different information and signals. Their perceptions of science are the result of physical and psychological activity that develops under the influence of other people/actors. This process is embedded especially in its cultural context.

Sck3: Something you receive from everyday life, like a textbook of earth science. And things that we learned before can also be used to judge whether it is a science or not.....

Although the sources of students’ perceptions were not deliberately focused on in this part of the study, students were asked where they obtained their information when they expressed their views. The students claimed they were mostly influenced from various sources of information in their daily life: school, media, friends and sometimes parents.

5.3.1. Influence from school

In sections 5.2.1 and 5.2.2 students’ criteria for distinguishing science and non-science illustrate the direct and important influence of school science in determining students’ perceptions. Experience of school science seemed to be the main source of students’ knowledge and perceptions of science. Students also stated that school science is the main source of information for their science learning rather than self reading or extra-curriculum activities.

5.3.2. Influence from the media

Media, such as TV, the internet, newspapers and magazines, also have a certain level of influence on students’ perceptions of science. For example, the slogan from the “Centrino” advertisement “Technology is always from humanity”, was mentioned in 4 discussion groups. Two groups of students applied the slogan to their criteria in distinguishing science and non-science. Things that entail human usage and need
were also identified as a science by those who advocated the slogan.

Sty7: The stuff appears because of the improvement of science (electronic communication)
Sty 8 : What is Nokia’s something?
Sty9 : Technology is always from humanity!
Sty8 : yes yes yes yes. [Laughter]
Sty 12 : Why does that have something to do with it?
Sty9 : You created it because you needed it. So technology goes with science.
Sty 12 : What you mean is?
Sty9 : This is science.
Sty7 : yeah, hum..right... how should I say it...as long as it is good for human and human body, it is a science.
Sty9 : That depends....

Also, many students mentioned watching science related TV channels and cartoons and many stated that their images of scientists were from cartoons. Terms like” nano technology”, “chitosan”, and “placenta”, used in commercial products, were symbols of science to the students. Although students did not acknowledge they learned a lot of knowledge about science outside school science, using these terms from advertisements shows that their daily life and experience also have an influence on their perceptions of science.

5.3.3. Influence from parents

Two students (sck1 and sty2) stated that they understood a “little bit more” about science because their parents have some science background. As a consequence, both students studied science.

Sck1: My dad works for Tai Power Company. He always shows me some figures and measurements from work. That is why I know science is about a lot experiment and numbers.

And

Sty2 : Because my dad studied in psychology.
Interviewer : Oh? You said he is a insurance salesman.
Sty2 : Same like you. He had to do a lot of experiments. But everyone has a different point of view for one same thing.
Sty3 : Is it a kind of trick to use the psychological vulnerability of other people and then...
Sty2 : No...
Sty3 : And then tell people to buy insurance?
Sty2 : No, he didn’t tell me a lot about psychology so I don’t understand it very well. However, because my dad studied it and he also told me it is related to science, so I think it is a part of science.
These parents produced some influence on their children’s perceptions and attitudes of science, compared with those with no science background. However, parents’ educational backgrounds were not specifically investigated in this research and not all students mentioned their parents’ educational background. It was not clear if parents who have a different educational background would provide a similar influence.

5.4. Differences between Schools

Students’ answers were collected after the discussion. Their answers are shown in
Table 5-2. Generally, the percentages showed some consistency across each school, only school 4, tended to have the same difference in their answers compared with others.

The results across the four schools did not seem to be very different, although students did have different levels of ability in expressing their opinion. Students with higher academic achievements seemed to have more confidence in their opinions. For example, students in schools 1&2, for both the science and the social study group, were clearer about the criteria they used when judging the items. As the criteria became familiar, the boundary between science and non-science was easier to express, thus, the same criteria could be applied to many items; students in schools 3&4 had a less clear opinion of science, and were less articulate when describing items. Hence, students with high academic achievements seemed to be more assertive and could generally relate unknown things to their existing knowledge. Hattie (2003) claims that students’ academic achievements and perceptions are related, and they are also linked to teachers and school factors. This may explain why higher achieving students have a clearer idea of the meaning of science, compared to others in this research.
Table 5-2. Decisions on “Whether it is a science?”, by schools.

<table>
<thead>
<tr>
<th>Item</th>
<th>Agree (%)</th>
<th>Not Sure (%)</th>
<th>Disagree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sch1</td>
<td>sch2</td>
<td>sch3</td>
</tr>
<tr>
<td>Astronomy</td>
<td>77</td>
<td>92</td>
<td>100</td>
</tr>
<tr>
<td>Creationism</td>
<td>8</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Water divining</td>
<td>85</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>38</td>
<td>42</td>
<td>25</td>
</tr>
<tr>
<td>Spirituality</td>
<td>23</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Theory of relativity</td>
<td>92</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td>Psychotherapy</td>
<td>77</td>
<td>42</td>
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<tr>
<td>Nuclear Physics</td>
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<td>100</td>
<td>100</td>
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<tr>
<td>Computing</td>
<td>85</td>
<td>67</td>
<td>92</td>
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<tr>
<td>Theory of evolution</td>
<td>85</td>
<td>92</td>
<td>83</td>
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<tr>
<td>Astrology</td>
<td>0</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Plumbing</td>
<td>85</td>
<td>83</td>
<td>67</td>
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<tr>
<td>Space exploration</td>
<td>92</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Biochemistry</td>
<td>85</td>
<td>100</td>
<td>100</td>
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<td>Automobile design</td>
<td>69</td>
<td>33</td>
<td>75</td>
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<tr>
<td>Physiotherapy</td>
<td>62</td>
<td>100</td>
<td>75</td>
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<tr>
<td>Meteorology</td>
<td>85</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Herbal medicine</td>
<td>46</td>
<td>33</td>
<td>50</td>
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<tr>
<td>Economics</td>
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<tr>
<td>Electronic</td>
<td>77</td>
<td>67</td>
<td>83</td>
</tr>
<tr>
<td>communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lie detection</td>
<td>77</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Despite showing more competence in their knowledge, the high achievement students often decided an item without taking a second thought. Their storage and
reactivation of perceptual symbols operated at a perceptual level rather than just the semantic level. For example, items mentioned in the science classes were thought to be science because of the students’ familiarity with the subject not just by the meaning of the words. Interestingly, sometimes the high achieving students have more difficulties deciding whether the item is a science or not because of their very rigid criteria for science.

5.5. Differences between Different Study Groups

5.5.1. Perceptions of science

Both of the study groups seemed to use very similar criteria in judging an item (see 5.2). Many students used words like Physics, Chemistry, calculations, theories, symbols, observations, experiments, etc, to describe science, strongly echoing their own school science experience.

However, some items did produce greater differences between the two study groups. For example, more than 20-40% of the science students, compared to social study students thought that Astronomy, Acupuncture, Automobile design, Physiotherapy, Meteorology, and Herbal Medicine were science.

Science students seemed to insist more on the operational aspect of science compared to the social study students; for example, they focused more on measuring, equipment, experiment, calculation and scientific theories. Words like detection, therapy and divining, sounded more science to science students than social studies students.
Table 5-3. Decisions of “Whether it is a science?”, by study groups.

<table>
<thead>
<tr>
<th>Item</th>
<th>Agree Science group</th>
<th>Agree Social study group</th>
<th>Not sure Science group</th>
<th>Not sure Social study group</th>
<th>Disagree Science group</th>
<th>Disagree Social study group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>100%</td>
<td>75%</td>
<td>0%</td>
<td>17%</td>
<td>0%</td>
<td>8%</td>
</tr>
<tr>
<td>Creationism</td>
<td>8%</td>
<td>8%</td>
<td>32%</td>
<td>25%</td>
<td>60%</td>
<td>67%</td>
</tr>
<tr>
<td>Water divining</td>
<td>92%</td>
<td>75%</td>
<td>8%</td>
<td>13%</td>
<td>0%</td>
<td>13%</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>60%</td>
<td>17%</td>
<td>36%</td>
<td>46%</td>
<td>4%</td>
<td>38%</td>
</tr>
<tr>
<td>Spiritualism</td>
<td>8%</td>
<td>29%</td>
<td>28%</td>
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<tr>
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<td>Meteorology</td>
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<td>Herbal medicine</td>
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<td>40%</td>
<td>46%</td>
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<td>Economics</td>
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<td>8%</td>
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<td>Electronic communication</td>
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<td>8%</td>
<td>17%</td>
<td>8%</td>
<td>4%</td>
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<tr>
<td>Lie detection</td>
<td>56%</td>
<td>50%</td>
<td>32%</td>
<td>38%</td>
<td>12%</td>
<td>13%</td>
</tr>
</tbody>
</table>

The perceptions of real science that Taiwanese students have seem to reflect similar characteristics to those of Schafransm’s definition:

*Science is a truth-seeking, problem-solving, method of inquiry. The reliability of its scientific method depends on the correctness of three ancient philosophies that science uses: empiricism, rationalism, and scepticism. (Schafransm, 1997:20)*
Some other studies also suggest that students’ perceptions of science are deeply influenced by school science (Barsalou, 1999; Solomon & Barsalou, 2001; Barsalou, 2003; Vermeulen, 2007). In this research, it is not completely clear how students’ perceptions of science were formed (see 5.3), but because science classes are compulsory to all students in Taiwan up to the age of 16 the core perception/criteria would not be very diverse between different groups of students at this stage, given this central influence of school science.

5.5.2. Differences in the valuing of science

During the discussions, the concept of the value of science also emerged. Both science and social study students expressed a belief in the “value” of the function of science and technology, and they thought science was beneficial to human society; for example:

“Science can benefit and improve human life.”
“Science is about theories and technology is the application of science which can provide convenience to people.”
“Technology helps people to understand scientific theories.”

However, this valuing of science did not necessarily carry over into their attitudes towards school science, although science students expressed positive attitudes towards school science more often than the social study students. For example, students thought that science subjects were “livelier” and “more fun” than social studies and social studies were boring, needed a lot of memorising, and dead.

“School science is not practical in daily life.”
“Science is too hard and cold.”
“Scientific symbols do not make sense.”
“Social studies are more relevant to people and their daily life.”

The difference in students’ valuing of school science may be an important factor to explain why some students did not choose NSP. Since students’ basic perceptions of school and real science were similar in both groups, their perceptions of the value of school science held may be important indicators of their choices.

However, because these discussions took place after the students were already studying in their study groups, their views of school science were from a more retrospective point of view. Hence, students’ statements might contain elements of defence or justification for their choices. Their valuing or devaluing of science and
social studies might be over stressed in this case.

5.5.3. Different abilities in interpreting a science

The social study students were generally more articulate and better at expressing themselves than the science students. They were more willing and able to guess and talk about how they decided an item was a science or not, while science students were more cautious and reluctant to make a guess if they were unsure about the item.

Although both science and social study students used similar criteria to judge a science, the different interpretations sometimes produced different answers. For example, some students thought Astrology was a science because it involved statistics, although other students did not think it involved calculations. Both groups of students agreed science involved mathematical calculations but their interpretations were seen to be different. Here, for example, are comments from one SSP group:

_Shh11: I think astrology is a science because it is a kind of statistics. So it should be a science._
_Interviewer: why?
_Shh11: Because it is a statistics of people’s birthday and personality._
_Shh 12: So sometimes it might not be 100% right, but it is still a kind of science because of the maths involved. [Silence for 3 seconds]
_Interviewer: what do you (other group members) think?
_Shh7: hum....not sure...
_Shh8: Yeah....it is a statistics but I just do not feel it is a science...
_Shh9: I don’t know...I think half half.
_Shh 11: We just said that mathematics is the mother of science, right? So if astrology is a result of statistics, then it is a science. [shh12 nodded]
_Shh 9: hum....Sounds reasonable...

Even within these different study groups, however, we should recognise the importance of individual differences. Individuals are different in their way of acquiring, receiving, absorbing, selecting, organising and interpreting, which is built into an individuals’ sensory system. The insight or comprehension of an object is different from individual to individual.

The main focus of this section is to present and understand the differences between different groups of students, based on the key facts they expressed in the discussion. These include subtle mind interactions embedded in the individuals’ physical environment and cultural context. However, all these various arguments meet the
objective for this part of the study: understanding the perceptions of science.

5.5.4. Different perceptions and values of social studies

Although not asked specifically on the provided list, perceptions of social studies were discussed by most of the groups during the development and expression of their own criteria for science and non-science. However, due to fewer social study items being on the list, less discussion took place about social studies:

Sty3: It might not sound true but social studies relate to matters recorded by ancestors and scrutinised to prove its validity over the years. So it should be a kind of science.
Sty2: Yeah, I agree with that but I think that is science. It is like...something happened in the history, a war or something and they recorded. It is a fact, so they cannot denied it and it happened all the time...I don’t think this is science. Science should be a kind of research that provides universal findings.
Sty3: Yeah, isn’t that validity proving?

Hence, the data gathered were more than students’ perception of real and school science. A considerable proportion of the discussion was also related to social studies and the value of science. These data were analyzed for differences between the two study groups. The main points are listed in Table 5-4.

Table 5-4. Perceptions and values of social studies, by study groups

<table>
<thead>
<tr>
<th>Perceptions of social studies</th>
<th>Science group</th>
<th>Social study group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social studies need a lot of memorising and they are meaningless.</td>
<td>Social studies are not only about reciting but also making sense of everything.</td>
<td></td>
</tr>
<tr>
<td>Social studies are about expressing feelings.</td>
<td>Social studies do need a lot of memorising.</td>
<td></td>
</tr>
<tr>
<td>Social studies involve emotions and affections.</td>
<td>Social studies are things that were recorded by the ancestors, then scrutinised and proved by people after that for its validity.</td>
<td></td>
</tr>
<tr>
<td>Social studies are too complicated as they involves many human factors.</td>
<td>Social studies explore human activities.</td>
<td></td>
</tr>
<tr>
<td>Social studies do not need to be proved by scientific evidence.</td>
<td>It takes less effort to study social studies than natural</td>
<td></td>
</tr>
</tbody>
</table>
Things that do not belong to science are social studies. Social studies also need logical thinking (only one student). Social studies are dead/rigid. Social studies are boring.

科学。
你必须在社会科学研究成为律师，会计师。
社会研究的有趣和揭示人类真实生活的原因，因为他们更相关。

| Value of social studies | Social studies are not useful in the future. Discussing or memorising human activities is not very valuable. |

As with science, students’ perceptions of social studies are often inseparable from those of school social studies and some of the comments seem to be referring to social studies as a discipline or field of intellectual activity, others seem to be about the experience of social studies as a school subject.

“Subjects that were not science should be social studies.”
“Social studies need a lot of memorizing, “
“Social studies are about exploring relationships between human activities and thoughts, etc. “

Many science students gave negative views about social studies, and suggested social study subjects were too rigid and required much memorizing. Some students claimed subject matter may be easy but very boring, tedious, and not useful for the future. Some also assumed that studying social studies required self expression, and mentioned their difficulty in voicing opinions. The science students seemed to have a more resistance towards the learning process of social studies in this study.

Social study students view social studies as records of human activities and agreed with the science students that they needed a lot of memorizing, although they needed
to make sense of what they were memorizing. Only one science student thought that studying social studies required logical thinking. Thus, the learning process of social studies in Taiwan tends to be seen to involve more rote learning than learning science in general. Some science students expressed a dislike for this learning method, and that it was one reason to choose science as their study group.

5.6. Problems Encountered in This Research

5.6.1. Problems during the interviews
Because all the interview sessions were arranged by the contact teachers and schools, the interview session was my first meeting with the students. Some students seemed shy at the beginning, and so it was important to make everyone feel comfortable and at ease. Chatting about daily life with the students helped them relax. It was stressed that their opinions and answers would not be marked or assessed. However, a few students still changed their answers during the discussion after they had discussed with other members in the group. They advised that the discussion gave them better ideas about the items.

5.6.2. Ability in analysing problems and articulating ideas
Generally, the students were not very good at expressing their opinions. They could not continue arguments or did not complete their sentences in a comprehensible way, for example, incomplete sentences. According to the teachers who participated in this research, students’ ability in writing and making sentences was poor and is thought to be a recent, common problem among Taiwanese students. All the students expressed difficulties in voicing their ideas, not only because they were unfamiliar with the items provided on the list but also because they had not previously been asked about their opinions elsewhere and were unaccustomed to this type of debate.

Shw2: I don’t know...
Shw1: Hum...this is hard.
Interviewer: What do you mean it is hard?
Shw2: Well, we did not learn everything on the list and I just feel that electronic communication, automobile design, lie detection, stuff like those just sound science to me.
Shw1: Yeah, we never thought about the questions of what science is and what is not.
Shw4: We were not asked these before.

The social study students were more proficient in explaining their reasons and ideas
during the discussion, compared with their counterpart. They appeared comfortable when articulating their points of view, while the science students’ answers were more simple and direct.

The lack of opportunity to have introspective thoughts, in the learning process seems to hinder students’ ability to question, especially among science students. In my own working experience in the Taiwanese schools, sceptical attitudes were not necessary acquired in most of the classes; the way of teaching and the huge amount of content to cover in all classes did not provide much opportunity for students to explore a question and express themselves to others. These seem to contribute to the poor communication skills of the students, in the opinion of a teacher who once worked in that environment and is able to reflect on these educational processes from a distance.

This also highlights the underpinning problem when exploring students’ perceptions of science. As a consequence of students’ limited ability in expressing their views, the pictures received by me from the discussions might not be the same picture that the speaker is addressing. The ideas the speaker wants to describe might be restricted by their ability in verbal expression. When the receivers get the message sent by the speaker, they construct the image in their mind, based on their own logic. The final picture for the receiver can be very different or incomplete, compared with that communicated and intended by the speaker.

Such concerns over how well students can express themselves, and the closeness of their expression to their perceptions, may be a limiting factor in this study. However, in this respect, the group discussion was a useful approach to understanding students’ perceptions of science. If the individual students find it difficult to express themselves, a group discussion offers the advantage of allowing them to say something and then, through discussion, to extend and clarify what they have said. However, the issue of ability in expressing and articulating emerged in this research here may suggest a useful recommendation to Taiwanese educators. There would appear to be a need to give students’ more opportunity and training to develop sceptical and independent thinking.
5.6.3. Issues with the semantics

As mentioned chapter 4, the initial attempt was to provide a wide range of items to generate discussions. Confusion and contradiction were expected during the discussion to understand the students’ perceptions of science. Many students were unable to judge the status of some items simply because they were outside their experience, and tried to guess in which category they belong from the wording (see 5.2). This is an advantage for Chinese students when they are trying to identify terms that they do not know well because the Chinese language itself can help the students to identify the item. Each Chinese character has a vague meaning and sometimes students can roughly guess by the wording used in the phrase, although they could also be misled. For example, some items have “study” in their Chinese translation, students then tend to link it with a semi-science because most of the terms in science have the word “study” within the term. If the other part of the translated item sounded like a practical work students tend to categorise the item as a science. Also, some students interpreted the item as a science when the item wording included “design”, “detection”, ”-ism”, “electro”, “physio”.

Therefore, both English and Chinese translations were provided on the discussion list, although not all the terms could be understood in English. This, however, still raises an issue for science education in Taiwan. Although the science curriculum in Taiwan is heavily influenced by the western science textbooks, people from different cultures or languages might not have the same perceptions after the translation because the element of cultural background and the original context might not be translated or transformed at the same time. This is an issue in science education but is not part of the focus of this research and will not be discussed further here.

5.6.4. Bias from cultural and knowledge backgrounds

All the items that were provided initially by the researcher were translated using an English to Chinese dictionary. However, it was later discovered that there was a concern over cultural differences when interpreting some items. For example, many students thought that water divining was a science because the Chinese translation for ‘water divining’ means ‘water detection’. During the discussion, students described
this item as if the action needed an advanced high technology machine. The researcher thought the same when translating the item from the dictionary. However, the researcher later discovered, through discussion with an English native speaker, that water divining was quite different from what the researcher and the students were picturing. Furthermore, the method used in the English context does not exist in the Chinese context.

5.6.5. Bias from students’ socio-economic backgrounds
Although this research aims to have a cluster of representative samples, it was difficult to achieve such an ideal goal because the selection was voluntary. Therefore, the participants were not completely random. The issue of students’ socio-economic background was first noticed soon after the interviews took place in the first school (school 3). Half, (six out of twelve), of the students’ parents were civil servants or school teachers. The remaining schools had a lower percentage of parents who were civil servants or school teachers, although had a high percentage of white-collar workers. A total of 18 students had at least one parent working as a civil servant or school teacher, 18 students had a least one parent working in offices (stock broker, car salesman, manager, staff, etc) and 13 students’ parents were manual workers.

This suggests that students from a white-collar socio-economic background might have more support from their families as it is relatively competitive to enter a state high school in Taiwan. Studies have shown that parental involvement and socio-economic class were identified as one of the important factors that influence students’ academic achievements (George and Kaplan, 1988; Breakwell and Beardsell, 1992). Observation from the interviews suggests that students from higher socio-economic backgrounds are more confident in expressing their views, have a high aspiration for study and are more curious about unknown items.

5.7. Conclusion
In this study, the perceptions and criteria for natural science and social studies seemed to be similar among different schools and study groups. Students’ criteria for science tended to focus on the operational aspect of the natural sciences and science students appeared to have less imagination and flexibility than social study students when
judging the items because their criteria of science were stricter than those of the social study students.

Some criteria for social studies were mentioned by students during the discussion of science. Generally, historical events and human activities were categorised as social studies because of the subjects taught in the SSP. Some students also associated non-science items with the studies. This seems to be related to the subject grouping system because there were only two study groups in high school and subjects that do not fit in the science group are normally grouped in the social study group.

The source of influence on their perceptions of science mentioned in the discussion included science classes, parents and media and students expressed that information came through their everyday life. However, TV advertisements seemed to have considerable influence on their images, applications and occupations relating to technology and science.

Students with higher academic achievements tend to state a clearer definition for science and were more proficient to relate unknown things to their existing knowledge science. However, they were more reluctant to categorise an item as a science if the item did not meet all the criteria.

From the data, the value of school science seemed to be different between the two study groups. Students from NSP praise science more and have more negative opinions of social studies as school subjects and their usefulness in the future. Considering students from both study groups make similar criteria for science, the perceptions of science does not seem to have a significant impact on their choice of study groups. The valuing of school science seems to have a stronger connection with their choice of study groups. Findings in this chapter give some solid evidence of factors that might shape students’ attitudes and thus influence their decision making when choosing their study groups.

From the findings in this chapter, it seems that students’ perceptions may not be the most important concern when choosing their study group, in contrast to findings from western literature. There seemed to be more factors and influences linked to the
decision making process, that have not been investigated in this part of research. A further exploration is therefore necessary in order to uncover all factors and influences on the students’ decision making process. The following chapter will provide a further insight into the influence of attitudes on students’ subject choice.
CHAPTER 6. SUMMARY OF STUDENTS’ ATTITUDES TOWARDS SCHOOL SCIENCE AND REAL SCIENCE

6.1. Students’ Attitudes towards School Science

The perceptions of school science and real science of Taiwanese students were explored in the hope of providing some insight into fundamental differences between the two groups of students (SSP and NSP) and their choices. 729 students were surveyed in a junior high and a senior high school on the west coast of central Taiwan. Rather than ticking boxes on questionnaires, students expressed their direct and authentic feelings. As a result, however, some of their statements were not definite and clear. Responses were grouped into three different categories according to the following principle:

1. Students who like school science: e.g., yes, I like it.
2. Students who have negative attitudes toward school science: e.g., no, I don’t think so, not really.
3. Students whose attitudes are equivocal or are between liking and disliking school science: e.g., So so, alright, ok, yet ok, maybe, a little bit, I only like part of it, half half, no special feeling, I only like Biology, I only like Chemistry, I only like Physics, I only like earth science, barely ok, not so much, a little bit like, should be yes...but..., not really...some...some, maybe.

There were only 3 cases in which the students’ attitudes are identified as negative, from their otherwise positive answers because of the contradictory and sarcastic nature of those answers. For example, a SSP student states that he likes school science because there are no science classes now. An example from #216:
1. Do you like school science? (You can describe your opinions if you have different attitudes toward different subjects) Why? Or why not?
Yes, because there are no science classes now.
3. If your attitudes have changed, when was it? Why?
First year in senior high school. I failed Chemistry.
4. In general, do you like real science? Why? Or why not?
Yes, if there is no pressure from marks, real science should be interesting.

The answer needed a further justification because it was not a coherent answer for someone to have a positive attitude when he/she was happy without having to learn the subject. Due to other questions on the questionnaire, the answer required to be evaluated based on the context of all the answers. Another example was an NSP student who stated that he liked Physics because “I can sleep right away if I feel tired”. These were rare cases when students said they like school science but actually meant the opposite.

Students’ attitudes were analysed across several dimensions: age, study group, academic performance and gender. Reasons for disliking school science and a change of attitudes are also discussed in this chapter.

6.1.1. General situation in different school years
The results of the students’ responses are shown in
Figure 6-1. The ages of school year 7-12 students were approximately from 12 to 18 years old. Year 7-9 students were in the lower secondary schools (junior high schools), and years 10-12 were in the upper middle schools (senior high schools).
Figure 6-1. Students' attitude toward school science in general

(Year 7-12, n=729, 724 valid answers)

The percentage of those who did not like school science (the yellow column) increased as their school year (age) increased; the percentage of those who had positive attitudes decreased as their age increased. Thus, indicating that enjoyment in school science decreases, as the students’ age increases. Similarities are to be found in the UK and USA (Dulski, 1991; Bennett, 2001; Pell and Jarvis, 2001; Osborne et al, 2003) where students’ enthusiasm for school science declines progressively alongside their age.

6.1.2. Attitudes in different study groups

Students from the second year of senior high schools (year 11) in Taiwan commence their differentiated courses (NSP and SSP) at the age of 17. Most students continue their study programme into the next year of senior high school (year 12) because the curriculum is designed to be connected in year 11 and 12 (Ministry of Education, R.O.C., 2007).

Students' attitudes towards school science in year 11 and 12 by different study groups
Only a small proportion of students in both study groups stated that they liked school science (around 10%). The majority of students in both groups had mixed feelings and stated both liking and disliking some parts of school science, while 30%-42% of students advised they disliked school science. The percentage of those who did not like school science was three times to four times more than those who liked school science. Moreover, about 30% of those who were enrolling in the NSP group stated that they did not like school science at all. This phenomenon raises the question, as to why there is a high take-up rate of science programmes in senior high schools in Taiwan, when negative attitudes prevail towards school science for secondary school students. Furthermore, why did the SSP students who liked school science abandon studying science? Therefore, this survey raised numerous questions related to students’ attitude towards school science and their reasons for choosing their subjects.

Figure 6-2 shows students’ negative attitudes by their year and study group. Noticeably, negative attitudes toward school science increase with an increase in age. The percentage rises every year and reaches 36.9% by the end of senior high school
education. Viewed separately by study group, the percentages of students who do not like school science in the SSP and NSP groups are 42.0% and 31.3%, respectively. This indicates that nearly one third of NSP students do not enjoy learning science.

Figure 6-2. Students' negative attitude towards school science, by age and study groups.

![Percentage of disliking school science in different study group](image)

(Year 7-12, n=729, 724 valid answers)

Although these negative attitudes showed a gradual increase, there was a marked rise between year 7 and 8, and between year 10 and 11. This might reflect a change in science curriculum at specific transition points. In year 7, the science curriculum only covers Biology. Basic Physics and Chemistry are introduced from year 8 onwards. Earth Science is added in year 9 as a minor subject, with only two hours per week. The science curriculum in year 10 included Physics, Chemistry, Biology and Earth Science. In year 11 and 12, Physics and Chemistry are compulsory for NSP students, and Biology is optional (Ministry of Education, R.O.C. 2007)

According to current research literature, biology is widely considered the most favoured amongst science subjects (Gardner, 1975; Schibeci, 1984; Chen, 1998; Williams et al, 2003). In this study, the rise in students’ negative attitudes at
curriculum change points coincided with the introduction of Physics and Chemistry. Both subjects were considered most unpopular and difficult to understand amongst students.

6.1.3. Relations between performance and attitude in different study groups

Attitude and performance seemed to be related according to the data. Students’ attitudes were analysed by their academic performance in order to understand the relationship between academic level and attitude. The term “performance” here is defined by students’ average monthly exam results. Students were asked for their academic performance on the questionnaire: top (first 25%), middle (25-75%) and lower 25% in the class. In Taiwan, each class produces a table of exam results after each monthly exam. Each student’s exam results for every subject are listed on the table and the total score shows each individual’s relative position in the class. Exam results are posted to parents advising them of their child's performance. Some junior high schools and most of the senior high schools also produce a performance table that includes everyone in the same year. As a consequence, most students know their performance bands. The results were shown in Table 6-1.

Table 6-1. Students' attitudes towards school science and academic achievement in year 11 and 12

<table>
<thead>
<tr>
<th>Level of academic Performance in the Class</th>
<th>Like school science</th>
<th>Equivocal towards school science</th>
<th>Do not like school science</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 25%</td>
<td>15.7%</td>
<td>66.9%</td>
<td>17.4%</td>
<td>0%</td>
</tr>
<tr>
<td>25-75%</td>
<td>12.1%</td>
<td>44.9%</td>
<td>34.3%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Lower 25%</td>
<td>4.9%</td>
<td>35.0%</td>
<td>58.2%</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

(n=326, 322 valid questionnaires)

Students who gained higher scores seemed to have more positive attitudes towards school science classes whilst the low achieving students had negative attitudes. Nevertheless, there were students who achieved well in the monthly exams but did not say they liked school science. For example, student (#428) who was in the top 25% of the class did not like school science and said, “There are too many things to memorize and calculate. I spend a lot of time doing these. It is just annoying....”
Vice versa, not all students who have low marks dislike science classes, for example, “I quite like science because it is interesting but Physics is too difficult for us now, if the Physics teacher can help us....” (#148). However, students who have negative attitudes do not always give up studying science.

6.1.4. Relationship between gender and attitude towards science.

The proportion of boys who expressed a positive attitude towards school science was higher than the proportion of girls, except in the first year of junior high school (year 7) and first year of senior high school (year 10) (See Figure 6-3).

Figure 6-3. Attitudes toward school science by gender

Results from western research suggested that girls normally have less positive attitudes toward school science than boys, except towards Biology (Becker, 1989; Weinburgh, 1995; Keys and Fernandes, 1993; Hendley, 1996; Parkinson et al., 1996; Campbell, 2001; Giles, 2002; Leach et al., 2002; Wallace and Louden, 2002; Medhat, 2003; Williams et al., 2003; Miller et al., 2006). However, the differences in each of the three categories of attitudes was always small - less than 10%. Despite these small differences in attitudes, only 32.3% of the students in NSP were girls (see Figure 6-4).
This implies that female students might have other considerations, when choosing their study groups. Hence, further analysis of the reasons is required.

Figure 6-4. Percentage of students in the SSP and NSP (year 11 & 12)

Reasons for students to dislike the various school science subjects are examined with regards to gender (Table 6-2 to...
Table 6-5). However, not all students stated reasons for every subject. Therefore, the responses are marked as their frequency of mentioning.

Table 6-2. Reasons for different attitudes toward Physics

<table>
<thead>
<tr>
<th>Reasons for negative response towards Physics (frequency of the answer)</th>
<th>M</th>
<th>F</th>
<th>Reasons for positive attitude towards Physics</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>I could not understand the teacher(s).</td>
<td>36</td>
<td>32</td>
<td>Interest.</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>It is too difficult to understand.</td>
<td>15</td>
<td>37</td>
<td>It is related to daily life.</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>There are too many calculations involved.</td>
<td>11</td>
<td>31</td>
<td>It is easier (comparing to other science subjects)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Too much to memorize.</td>
<td>4</td>
<td>19</td>
<td>I enjoyed the experiments.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>It is boring.</td>
<td>2</td>
<td>12</td>
<td>Not so much memorizing.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>It is not related to daily life.</td>
<td>4</td>
<td>7</td>
<td>It is interesting/fun.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Too much to study.</td>
<td>1</td>
<td>4</td>
<td>The teacher is interesting.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>The teacher does not let us do experiments.</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too abstract.</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad marks.</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not interested.</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the case of Physics, both sexes complained about being unable to understand the teacher(s), but more than twice as many girls complained about perceived difficulties, too many calculations, too much memorizing, the subject is boring, not related to daily life and too much to study. Although positive responses were far fewer then negative ones, more than twice as many male students thought that physics was more attractive to them, was related to daily life, was easier, involved enjoyable experiments, required less memorizing and was more interesting.

Table 6-3. Reasons for different attitudes toward Chemistry

<table>
<thead>
<tr>
<th>Reasons for negative attitude towards Chemistry (frequency of the answer)</th>
<th>M</th>
<th>F</th>
<th>Reasons for positive attitude towards Chemistry</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Too much to memorize.</td>
<td>18</td>
<td>36</td>
<td>We have a good teacher.</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>2. It is too difficult to understand.</td>
<td>14</td>
<td>27</td>
<td>It is practical and related to daily</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3. There are too many calculations involved.</td>
<td>4</td>
<td>34</td>
<td>It is interesting/fun.</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4. I could not understand the teacher(s).</td>
<td>5</td>
<td>15</td>
<td>Interest.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5. The teacher was boring.</td>
<td>3</td>
<td>10</td>
<td>I like to do experiments.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>6. Too much to study/It takes a lot of time to study.</td>
<td>3</td>
<td>13</td>
<td>It is easier (comparing to other science subjects).</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. The teacher does not let us do experiments.</td>
<td>6</td>
<td>3</td>
<td>Not including so many calculations.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8. It is not practical/ not related to daily life.</td>
<td>2</td>
<td>6</td>
<td>Get good mark as only as you spend time memorizing it.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9. Not interested.</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Bad marks.</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I don’t like experiments.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. It is boring.</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With regard to Chemistry, more than twice as many girls thought that Chemistry had a lot to memorize, was too difficult to understand, involved too many calculations and too much to study, was not practical, as well as having difficulties with understanding the teacher and thought the teachers were boring. Slightly more male students expressed that they liked chemistry because they had a good teacher, the subject was practical, interesting, part of their interest, enjoyed doing the experiments, and there were not many calculations. Again, however, the number of comments is too small for statistically valid conclusions to be drawn.

Table 6-4. Reasons for different attitudes toward Biology

<table>
<thead>
<tr>
<th>Reasons for negative attitude towards Biology</th>
<th>M</th>
<th>F</th>
<th>Reasons for positive attitude towards Biology</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher was boring.</td>
<td>2</td>
<td>5</td>
<td>It is practical and related to the world we are living in.</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>Too much memorizing.</td>
<td>4</td>
<td>2</td>
<td>It is interesting/fun.</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>It is difficult.</td>
<td>1</td>
<td>1</td>
<td>Interest.</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Comment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>It is boring.</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It explains the living creatures.</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is not practical.</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We have a good teacher.</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is easier.</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like the visual aids (documentaries).</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No calculations.</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the case of Biology, both sexes had fewer negative points of view compared to Physics and Chemistry. More positive comments were given, and the most frequent comment was the value and the link of the subject to the real world. Both sexes found Biology more interesting than Physics and Chemistry but the teaching method also played an important role. The most frequent negative feedback from both sexes was bad teaching, although some people stated they like Biology because of having a good teacher. This suggests that biology teachers can play a significant role in attitude formation.
Table 6-5. Reasons for different attitudes toward Earth Science

<table>
<thead>
<tr>
<th>Negative reasons for Earth Science</th>
<th>M</th>
<th>F</th>
<th>Positive Earth Science</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is boring.</td>
<td>2</td>
<td></td>
<td>Interest.</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Too much memorizing.</td>
<td>2</td>
<td></td>
<td>It is related to the world we are living in.</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Not interested.</td>
<td>2</td>
<td></td>
<td>It is interesting.</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>It is too difficult to understand.</td>
<td>2</td>
<td></td>
<td>I like the visual aids (documentaries).</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>I am scared of insects.</td>
<td>1</td>
<td></td>
<td>We have a good teacher.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>It is easier.</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

For Earth Science, fewer students gave reasons for liking or disliking Earth Science compared to other subjects but there were more positive comments than negative ones. Very few students, of both sexes, found it boring, had too much to memorize, and was difficult to understand. More students thought it interesting, related to daily life and enjoyed watching documentaries during the class. In addition, girls had more positive attitudes towards Earth Science compared to boys.

Overall, the main reasons expressed by both sexes for disliking science subjects were bad teaching, perceived difficulties, and a high workload. However, more girls than boys complained about the perceived difficulties, memorizing and calculations in both Physics and Chemistry, while more boys than girls thought that Physics was more interesting and involved less memorizing. Biology and Earth Science appears to be more favoured by both sexes, with less criticism compared with Physics and Chemistry. Generally, girls gave more appraisals of Biology and Earth Science than boys.

It was found that girls were more willing to express their opinions than boys and more criticisms were given of each subject. However, boys were more forthcoming with appraisals toward Physics and Chemistry compared to girls. A similar pattern was found in the UK for Key Stage 3 students (Hendley, 1996). The responses from this survey provide a good overview and some detailed opinions of why students like and dislike school science. However, the results also implied that students’
perceptions and values of the subjects might also be important factors influencing subject choice.

6.1.5. **Summary of why students did not like school science**

The most frequently mentioned reasons for students disliking school science are presented in Table 6-6.

**Table 6-6. Reasons why students dislike school science**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are too many things to memorize, such as theories, formula, functions, etc.</td>
<td>73.1%</td>
</tr>
<tr>
<td>There are too many calculations involved.</td>
<td>70.4%</td>
</tr>
<tr>
<td>I could not understand the teacher.</td>
<td>66.4%</td>
</tr>
<tr>
<td>It is too difficult to understand.</td>
<td>53.4%</td>
</tr>
<tr>
<td>Bad scores always make me really frustrated.</td>
<td>50.9%</td>
</tr>
<tr>
<td>It is not practical and not related to daily life.</td>
<td>49.6%</td>
</tr>
<tr>
<td>There are too many exams every day.</td>
<td>45.9%</td>
</tr>
<tr>
<td>There is not enough practical work or we do not do experiments.</td>
<td>35.6%</td>
</tr>
<tr>
<td>Not interested/ I just do not like it.</td>
<td>21.7%</td>
</tr>
<tr>
<td>It is boring.</td>
<td>12.0%</td>
</tr>
<tr>
<td>It requires a lot of thinking and I am too lazy to think or I don't like to think so much.</td>
<td>8.9%</td>
</tr>
<tr>
<td>It takes a lot of time to study/ too much to study.</td>
<td>8.4%</td>
</tr>
<tr>
<td>My mathematics is not good enough to understand/do science.</td>
<td>8.1%</td>
</tr>
<tr>
<td>It is too annoying.</td>
<td>5.3%</td>
</tr>
<tr>
<td>It is too abstract.</td>
<td>4.0%</td>
</tr>
<tr>
<td>It is too detailed.</td>
<td>3.3%</td>
</tr>
<tr>
<td>I do not like to go to the laboratory/ I do not like experiment sessions</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

(n=729, 700 valid questionnaires)

*This question was open-ended. Some students gave more than one reason for their negative attitudes. The percentage of each answer being answered by the total number of students shows a sum total percentage, greater than 100%.

These reasons relate to several topics: interest, perceived difficulties, teacher and teaching methods, curriculum design and assessments, reinforcement of exam results
and gender difference. Many responses appear to be final conclusions of students’ rejection, such as too much memorizing and calculations might cover several aspects, for example personal interest, perceived difficulties, quality of teaching, curriculum design, assessment, gender differences. Therefore, some responses will cover several topics in the following analysis.

6.1.5.1. Interest
There were a few replies from the participating students that relate to personal interest, such as
-No interest/ I just do not like it (21.7%).
-It is boring (12.0%).
-It is too annoying (5.3%)
-I do not like to go to the laboratory/ I do not like experiment sessions (1.1%)
-There are too many things to memorize, such as theories, formula, functions, etc (73.1%).
-There are too many calculations involved (70.4%)
-It requires a lot of thinking and I am too lazy to think or I don't like to think so much (8.9%).
-It takes a lot of time to study (8.4%)

The first four answers were direct responses and may be interpreted that school science simply did not attract the students. Some students expressed that going to the laboratory was a nuisance. These responses match closely to some factors that influence students’ attitudes towards science in the UK, the USA, Canada, and Australia, where it has been identified that lack of interest is a key factor in forming negative attitudes (Care and Nylor, 1984; Elsworth et al, 1999; Benett, 2001; Lyons, 2006).

The responses given for reasons for disliking school science from the first four answers, listed above, appear to be more related to personal commitment, such as too much to memorize, too many calculations, too much effort and time to study, etc. Lack of motivation and personal commitment seems to be a key factor that forms part of students’ negative attitudes towards school science because more than 70% of the
students stated that there was too much memorisation and calculations required and more than 8% of the students thought that school science demanded too much effort and time to study and understand the subject matter. Furthermore, these statements not only relate to personal interest but also to other aspects, such as personal ability, curriculum design, teaching and assessments. However, not all students specifically addressed the exact motives of their rejection of school science, nor did they discuss the relationships between the causes and their lack of motivation and passion; for example, students who stated that school science involves too much memorizing could mean that they do not have enough time, were unable to memorize or both. Hence, these responses may cover several aspects.

6.1.5.2. Perceived difficulty
Several studies have shown that difficulties in understanding the content of school science is a key problem, and results in a negative outlook towards school science (Havard, 1996; Hendley, 1996; Woolnough 1994a; Osborne et al, 2003). This perceived difficulty is reflected in my data, with statements such as:
-It is too difficult to understand (53.4%).
-My mathematics is not good enough to understand science (8.1%)
-It is too abstract (4.0%).
These show clear expressions of perceived difficulties in learning school science, with additional statements, such as too many equations and formula to memorize and calculate.

6.1.5.3. Teachers and teaching

Teachers and teaching methods are found to be the most influential factors of students’ negative attitudes in some studies (Brown, 1976; Mayers and Fouts, 1992; Nott and Wellington, 1999; Woolnough, 1994a). Woolnough (1994a) stressed that an effective science education relies on the effectiveness of teaching and assessments. The results of this survey also show that teachers and their ways of teaching have a very significant effect on students’ attitude towards school science. 66.4% of the students stated that they disliked science because of their science teachers or their
teaching. Among these students, there are a few frequent responses that relate to this
topic: I can/could not understand the teacher (36.3%); the teacher was only reading
the textbook (10.6%); the teacher only writes a lot of text on the blackboard (8.3%);
the teaching was really bad (4.1%); and the teacher was boring (3.4%). Most
responses are related to the effective and appropriateness of teaching but there are
some students who pointed out that the personality of a teacher is also important, for
example, 7.1% of students suggested that science teachers should be more humorous
in class and 3.7% suggested that teachers should be more caring and proactive in
helping students.

To some students, the teacher seems to be an important factor in the formation of
their attitudes towards science. It was noticeable that about two thirds of the students
from one class mentioned their Physics teacher. They highlighted problems they
experienced in understanding their teacher and some thought their teacher was not
trying to help them. Even accomplished students may become frustrated with their
learning, especially when they need to rely on themselves or seek help from other
resources; for example:

“Physics: I do not know what our Physics teacher is talking about. It is a waste of
time sitting having the Physics class. I have to study by myself all the time…” (#
135).

“No hope for the Physics class. Going to the cram school is the only way to save
ourselves, though I really do not like to go” (#151).

Some students who had low marks did not feel that they wanted to learn the subject at
all, for example:

“I do not enjoy it because I cannot understand anything in the Physics class. “ (#145)
“I think if our Physics teacher can try to help us to understand it, we will like it
more.” (#148)

“It is a waste of time if you do not understand anything.” (#167)

Although the teacher and the quality of teaching, are not found to be the most
important factors in this survey, they becomes crucial when many students state that
they are unable to understand the subject matter. It is essential, although this tends to
be taken for granted, that teachers should be capable of delivering a comprehensible
Some reasons stated by students might also relate to other aspects, for example, the statement “I cannot not understand the teacher” and “the teacher was boring” might not be due completely to the teaching but also perceived difficulties and the curriculum design. According to the responses, the science curriculum in Taiwan would seem to contain a great amount of memorizing, calculation and not enough experiments Hence unsatisfactory teaching might well be a consequence of inappropriate curriculum design.

6.1.5.4. Curriculum and assessment
Many responses to this survey seem to be related to the curriculum design and assessment. The responses given below appear to have closer relations to the design of the science curriculum in Taiwan:

- There are too many things to memorize, such as theories, formula, functions, etc (73.1%)
- There are too many calculations involved (70.4%).
- It is too difficult to understand (53.4%)
- It is not practical and not related to daily life (49.6%)
- There is not enough practical work or we do not do experiments (35.6%)
- It is boring (12.0%)
- It takes a lot of time to study (8.4%)
- My mathematics is not good enough to understand/do science (8.1%)
- It (school science) is too annoying (5.3%)
- It (school science) is too abstract (4.0%)
- It (school science) is too detailed (3.3%)

Again some reasons might cover several aspects, for example, it cannot be clearly identified whether the statement, it is too annoying, means they are not interested in school science or it is the content of the teaching that makes students feel annoyed.

Most of the reasons seem to be the results of several factors acting on students and
possibly mixed feelings or frustration cloud an explicit response. However, it should be noted that a number of factors will generally shape a students’ attitude towards any subject, including school science.

Numerous examinations and assessments have made students feel particular pressure, for example, there are too many exams every day (45.9%). Examinations may also have a counter effect, especially when students are not satisfied with their marks, for example, bad scores always make me really frustrated (50.9%).

Studies have also stressed the importance of a good science curriculum, to create enjoyable learning in schools (Nott and Wellington, 1999; Jenkins, 2000; Osborne and Collins, 2000; Bennett, 2001). Various useful suggestions have been made, such as increasing the proportion of practical hands-on experiments, introducing topics that are more appealing to students, designing a curriculum that is more related to everyday life, a good curriculum to bridge different key stages. Sunberg et al (1994), based on their research, also concluded that reducing the content of the Biology curriculum improves the comprehension and attitudes towards the subject, for first year university students.

6.1.6. Change of attitude
A very important concern about attitude change is its timing and causes. Examining these factors can help us understand the key factors that cause the change of attitudes, thus, providing empirical information for educators and curriculum designers.

Attitudes may change at any time. These are difficult to identify, particularly at the time the change occurs. The answers provided have only been collected for years 11 and 12 because students have been through a substantial period of science education and have clearer thoughts about their attitudes towards school science, after their decision making stage.

A total of 20 % of the male students in year 11 and 12 stated that their attitude towards school science changed in the direction of a decrease in liking it when they were in junior high schools, 52% stated that their positive attitude lessened in high
school; 32% of the female students stated that their attitude towards school science reduced when they are in junior high school, 27.7% of them changed their attitudes to less positive when they are in high school. These responses show a tendency for girls to change their attitude towards science earlier than boys, when they were learning science in junior high school. However, many boys changed their attitude later in senior high school. Almost every student changed his/her attitude because of the difficulties in learning science, difficulties in understanding the teacher or low exam results. This suggests that girls appear to have difficulties in learning school science earlier than boys.

The results show a trend for attitudes to change from positive to equivocal or from equivocal to negative. Thus, it should be noted here that there was one direction only for attitude change, which was to become more negative. Furthermore, it would appear that change of attitude towards school science, for these students, was irreversible.

One issue was raised by a SSP student (#186). She mentioned that her family cannot afford to pay for extra private tuition and as a result she could not keep up with the curriculum and her science marks went down. This was the reason for her attitude change. Two other SSP students (# 45 and #213) advised that their negative attitude for school science was because they disliked “cram school”. From the basic information provided by students on “how many hours of private tuitions for each subject per week?”, 39 out of 144 NSP students advised they have private classes after school for at least one science subject, and 38 of them have private tuition in Physics. This suggests that many NSP students might choose private tuition after normal schooling, to improve their performance. Furthermore, there is a possibility that those who cannot manage to do well in the science subjects by themselves or afford to have private tuition may choose the SSP group.

6.2. Students’ Attitudes towards Real Science

6.2.1. Attitudes in different school years

Real science is the science that exists in daily life, and includes school science (Wymer and Finegold, 1997; Glaser, 2006). The boundary of “real science” might
vary from student to student, for example, it might include the concept of development of high technology in modern society.

Since attitude towards school science and real science are differentiated in some literature (Gardner, 1985; Breakwell and Beardsell, 1992; Ebenezer and Zoller, 1993; Osborne, 2003), attitudes towards school science and real science are treated as potentially being different in this survey. The survey data of students’ attitudes towards real science are shown in Figure 6-5.

Figure 6-5. Student's attitudes towards real science.

![Bar chart showing attitudes towards real science across school years.](image)

(n=729, 727 questionnaires valid)

In contrast to school science, students’ attitudes towards real science are seen to be more positive. Most of the students (74%-81%) in all school years expressed a positive attitude towards real science. Comparing attitudes towards school science
Figure 6-1) and attitude towards real science (Figure 6-5), with negative attitudes towards school science growing from 12.2% to 36.9%, students’ relative positive attitudes (like and partly like) towards real science remained at 80%-90%. The results show that those disliking “school science” may not necessarily dislike “real science”. Also, contrary to the large proportion of mixed attitudes (those between like and dislike) for school science (27.0-52.7%), there are much fewer students (only between 0-10%) who have equivocal attitudes towards real science.

6.2.2. Reasons why students do not like real science
The percentage of negative attitudes towards real science, in each school year, is not very high compared to those of school science. Students tend to have clearer feelings about real science compared to school science. Reasons why students do not like real science are listed below:
Table 6-7. Reasons why students do not like real science

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is too difficult to understand</td>
<td>11.1%</td>
</tr>
<tr>
<td>2. I am not interested in it</td>
<td>6.4%</td>
</tr>
<tr>
<td>3. It is too complicated</td>
<td>4.4%</td>
</tr>
<tr>
<td>4. Because I need to think</td>
<td>4.3%</td>
</tr>
<tr>
<td>5. Because I can never learn well in the school</td>
<td>3.4%</td>
</tr>
<tr>
<td>6. There are too many things to learn (in real science)</td>
<td>3.1%</td>
</tr>
<tr>
<td>7. I am too lazy</td>
<td>2.6%</td>
</tr>
<tr>
<td>8. I don’t like calculations</td>
<td>2.4%</td>
</tr>
<tr>
<td>9. It’s boring</td>
<td>2.1%</td>
</tr>
<tr>
<td>10. It is a cold/rigid subject</td>
<td>1.4%</td>
</tr>
<tr>
<td>11. I don’t feel that what I know is going to be very useful</td>
<td>1.1%</td>
</tr>
<tr>
<td>12. I don’t like experiments</td>
<td>0.9%</td>
</tr>
<tr>
<td>13. Everything we learn is all for exams</td>
<td>0.4%</td>
</tr>
<tr>
<td>14. Our school does not do experiments</td>
<td>0.3%</td>
</tr>
<tr>
<td>15. I don’t like to be locked in the labs</td>
<td>0.3%</td>
</tr>
<tr>
<td>16. I don’t want my hair to fall off</td>
<td>0.1%</td>
</tr>
<tr>
<td>17. It gives me headache</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

(n=729, 700 valid questionnaires)

A wide range of answers are expressed by students who do not like real science in this survey. The reasons cover areas such as interest (including personal commitment), perceived difficulty in real science, the content and nature of real science, influence from school science education, and the image of scientists. The answers are discussed in the following sections.

It is interesting to see that some students’ views are influenced by school science or vice versa. For example,

“I don’t like it because I always do not understand it and the results from the exams are so bad…..”(#113)

“Sometimes it (science) does raise my interest in it, like Biology, but sometimes it is so boring……because I have to do calculations everyday.”(#269)
Hence, negative attitudes towards real science may be caused by the frustration of studying school science, which is closely related to the way science is taught and assessed in the school. Some students also expressed their lack of interest in real science and the disconnection of real science to their life, for example:

“I have to force myself to accept it (science) and put it in my brain for the sake of my future. I guess I don’t like it and also, studying something can’t be used is just like spending money on something you don’t like.” (#92)

“Because I don’t think it is going to be useful for me or my future” (#501)

Natural science students as well as those taking social studies made similar comments, leading one to ask why they remain in the science group when they do not like the subject. In addition, how can we expect a positive attitude from the general public, if even science students do not like real science? The responses from these students underpin a significant problem for science education in Taiwan: attitudes towards science are not highlighted as an important aspect for science education.

6.2.2.1. Influence from school science education

Although some studies show different perceptions and attitudes towards real science and school science (Breakwell and Beardsell, 1992; Ebenezer and Zoller, 1993), some research suggests the promotion of public understanding in real science, and that these same methods may be used to promote students’ attitude towards school science (Woolnough, 1991b; Woolnough, 1994; Wymer and Finegold, 1997). The answers in my research data show a considerable percentage of students disliking real science because of their learning experiences from school. For example,

- Because I can never learn well in school (3.4%).
- I don’t like calculations (2.4%).

Thus, my data shows that perceptions of real science for some students’ are not easily separated from school science. Those who do not have the opportunity of real life experiences of science, might possibly only relate this subject to school science. Perceptions toward real science and its relationship with school science are discussed in the following section.
6.2.2.2. Interest
Reasons why students do not like real science, which are related to personal interest in this survey are:
- I am not interested in it (6.4%)
- Because I need to think (4.3%)
- There are too many things to learn (in real science) (3.1%)
- I am too lazy (2.6%)
- I don’t like calculations (2.4%)
- It’s boring (2.1%)
- It is a cold/rigid subject (1.4%)
- I don’t feel that what I know is going to be very useful (1.1%)
- I don’t like experiments (0.9%)
- It gives me a headache (0.1%)

Some answers inform us of a person’s interest directly, for example, I am not interested in it, I don’t like calculations, It’s boring, It is a cold/rigid subject, I don’t feel that what I know is going to be very useful, I don’t like experiments, and It gives me headache. However, other answers expressed low aspiration towards real science, although related with personal interest, for example, I need to think a lot, There are too many things to learn, I am too lazy.

Generally, many reasons are similar to those given for disliking school science. Some students just feel both school science and real science are not attractive, boring and require too much study.

6.2.2.3. Perceived difficulty
For this part of the survey, a considerable number of students gave their reasons for disliking real science. The main factor is that it is perceived as too difficult to understand. The answers that related to perceived difficulties towards real science in my data are:
- It is too difficult to understand (11.1%)
- It is too complicated (4.4%)
In addition, answers like “because I need to think (4.3%)” and “I do not like
calculations (2.4%)” might also be indications of perceived difficulties.

6.2.2.4. Image of scientists
The image of scientists first appeared, in this survey, in connection with real science. Some students seem to have negative attitudes towards real science because of the image of scientists and their work. The descriptions of this negative image of scientists in this survey are:
- I don’t like to be locked in the labs (0.3%).
- I don’t want my hair to fall off (0.1%).
6.2.3. *Reasons why students like real science*

Reasons why students like real science are listed below:

Table 6-8. Reasons why students like real science

<table>
<thead>
<tr>
<th></th>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Real science fulfils my curiosity of the natural world</td>
<td>36.0%</td>
</tr>
<tr>
<td>2.</td>
<td>I like the sense of achievement when I understand things about nature</td>
<td>27.0%</td>
</tr>
<tr>
<td>3.</td>
<td>It is what the world is made of and is more related to daily life</td>
<td>20.4%</td>
</tr>
<tr>
<td>4.</td>
<td>It is a way to develop and modernise human life</td>
<td>18.3%</td>
</tr>
<tr>
<td>5.</td>
<td>Because it is different from school science</td>
<td>17.4%</td>
</tr>
<tr>
<td>6.</td>
<td>I like it (interest)</td>
<td>12.1%</td>
</tr>
<tr>
<td>7.</td>
<td>I like experiments</td>
<td>10.9%</td>
</tr>
<tr>
<td>8.</td>
<td>I like living creatures</td>
<td>10.4%</td>
</tr>
<tr>
<td>9.</td>
<td>There is no exams for real science</td>
<td>10.4%</td>
</tr>
<tr>
<td>10.</td>
<td>I admire those great scientists, they have great contributions to human beings</td>
<td>6.9%</td>
</tr>
<tr>
<td>11.</td>
<td>Because Discovery Channel makes the real science looks so interesting</td>
<td>3.4%</td>
</tr>
<tr>
<td>12.</td>
<td>I always like to read science magazines</td>
<td>3.0%</td>
</tr>
<tr>
<td>13.</td>
<td>I like space exploration</td>
<td>2.4%</td>
</tr>
<tr>
<td>14.</td>
<td>It doesn’t need a lot of memorizing</td>
<td>2.3%</td>
</tr>
<tr>
<td>15.</td>
<td>I had a good science teacher and he helped us to understand things that are not in textbooks</td>
<td>1.6%</td>
</tr>
<tr>
<td>16.</td>
<td>It makes you (feel) smarter</td>
<td>1.1%</td>
</tr>
<tr>
<td>17.</td>
<td>Because it is more useful than social science</td>
<td>0.7%</td>
</tr>
<tr>
<td>18.</td>
<td>I can be rich (find a job) if I can master it.</td>
<td>0.7%</td>
</tr>
<tr>
<td>19.</td>
<td>I want to be a scientist in the future</td>
<td>0.1%</td>
</tr>
<tr>
<td>20.</td>
<td>I like Physics</td>
<td>0.1%</td>
</tr>
<tr>
<td>21.</td>
<td>I like earth science</td>
<td>0.1%</td>
</tr>
<tr>
<td>22.</td>
<td>It is more interesting than English</td>
<td>0.1%</td>
</tr>
<tr>
<td>23.</td>
<td>I attended science camp before and really enjoyed it</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

*(n=729, 700 valid questionnaires)*

These responses provided more understanding as to why students’ attitudes towards
real science differ from that towards school science. The first and second reason, “Real science fulfils my curiosity of the natural world” and “I like the sense of achievement when I understand things about nature” are more related to students’ personal interest and achievement, when understanding new things. The other three reasons in the top five, show how students feel personally connected to real science, for example, “It is what the world is made of and is more related to daily life”, “It is a way to develop and modernise human life” and “Because it is different from school science”. Students are not directly expressing their feeling about real science but describing more of the value and importance of real science, from their point of view. This suggests that students’ attitudes towards real science are shaped by what they perceive and value with real science; for example, some students like real science because they see it as “science of the living world”. It may be envisaged as a general overview of science with links to improvement and modernisation. Similar results are found in other research (Schibeci 1984; Shapiro, 1988; Bennett, 2001; Osborne, 2003).

Some reasons seem to be related to experiences in school science; for example reasons in points 7, 9 and 14 show their interest in doing experiments, and that there are no exams and no memorizing in real science. Hence, the feeling of inadequacy and excessive pressure for school science tends not to be evident for real science. Some students (1.6%) mention science teachers generating interested in real science, which indicates that some still make a connection between real science and school science. Knamiller (1984) acknowledged Livingstone’s finding in Chinese science education, which suggested the incorporation of Mathematics, Physics, Chemistry, Biology, and Economic geography, covers all relevant elements in learning skills and procedures. Perhaps this is why it is not easy to separate students’ perceptions of school science and real science. The relationship between school science and real science shown in my data implies that, good teaching methods and a more suitable curriculum can improve attitudes towards school science, so that it creates the same sense of achievement and liking, as those feelings shown for real science. Much of the attitude towards school science relates to the ‘school’ component – examinations, etc – suggesting it is this component that needs attention, rather than the ‘science’, which is more positively perceived.

However, some students (17.4%) think that they like real science because it is
different from school science. One student explained his different attitudes towards school science and real science.

“I always take science classes and the content of the textbook as tools for meeting the requirements for examinations, that’s why I am not interested in it” (#283)

Another student made an interesting metaphor to explain.

“Even if you don’t like to calculate the speed of an airplane, it doesn’t mean you don’t like airplanes.” (#237)

Both students show negative attitudes towards school science but positive attitudes towards real science. Although school science and real science were seen as different levels of science, this was only clear when the two subjects were addressed separately. Again, this shows the conflation of school science and real science.

Other interesting reasons given for liking real science include, for example, 6.4% of the students stated they like real science because they have watched or read interesting things on the Discovery Channel and from science magazines. In addition, 6.9% of students were interested in achievements of some famous scientists and one student expressed a desire to become a scientist. Ten students (1.4%) think that real science is more useful than social studies and might be helpful for their future career.
### 6.2.4. Gender difference in real science

Reasons why students like or dislike real science, expressed by different genders are listed:

Table 6-9. Reasons liking or disliking real science, by gender

<table>
<thead>
<tr>
<th>I like real science because</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. real science fulfils my curiosity of the natural world</td>
<td>32.6%</td>
<td>39.4%</td>
</tr>
<tr>
<td>2. I like the sense of achievement when I understand things about nature</td>
<td>21.4%</td>
<td>32.6%</td>
</tr>
<tr>
<td>3. it is what the world is made of and is more related to daily life</td>
<td>18.6%</td>
<td>22.3%</td>
</tr>
<tr>
<td>4. it is a way to develop and modernise human life</td>
<td>18.3%</td>
<td>18.3%</td>
</tr>
<tr>
<td>5. it is different from school science</td>
<td>21.1%</td>
<td>13.7%</td>
</tr>
<tr>
<td>6. I like it (interest)</td>
<td>12.3%</td>
<td>12.0%</td>
</tr>
<tr>
<td>7. I like experiments</td>
<td>14.0%</td>
<td>7.7%</td>
</tr>
<tr>
<td>8. I like living creatures</td>
<td>7.1%</td>
<td>13.7%</td>
</tr>
<tr>
<td>9. there is no exams for real science</td>
<td>10.3%</td>
<td>10.6%</td>
</tr>
<tr>
<td>10. I admire those great scientists, they have great contributions to human beings</td>
<td>4.9%</td>
<td>8.9%</td>
</tr>
<tr>
<td>11. Discovery Channel makes real science looks so interesting</td>
<td>3.1%</td>
<td>3.7%</td>
</tr>
<tr>
<td>12. I always like to read science magazines</td>
<td>3.7%</td>
<td>2.3%</td>
</tr>
<tr>
<td>13. I like space exploration</td>
<td>3.1%</td>
<td>1.7%</td>
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<tr>
<td>14. it doesn’t need a lot of memorizing</td>
<td>2.9%</td>
<td>1.7%</td>
</tr>
<tr>
<td>15. I had a good science teacher and he helped us to understand things that are not in textbooks</td>
<td>1.7%</td>
<td>1.4%</td>
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<td>16. It makes you (feel) smarter</td>
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<td>17. It is more useful than social science</td>
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<tr>
<td>18. I can be rich (find a job) if I can master it.</td>
<td>1.4%</td>
<td>0.0%</td>
</tr>
<tr>
<td>19. I want to be a scientist in the future</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>20. I like Physics</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>21. I like Earth Science</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>22. it is more interesting than English</td>
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<td>0.3%</td>
</tr>
<tr>
<td>23. I attended science camp before and really enjoyed it</td>
<td>0.3%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

(n=729, 700 valid questionnaires)
<table>
<thead>
<tr>
<th>I do not like real science because</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is too difficult to understand</td>
<td>6.9%</td>
<td>15.4%</td>
</tr>
<tr>
<td>2. I am not interested in it</td>
<td>4.3%</td>
<td>8.6%</td>
</tr>
<tr>
<td>3. It is too complicated</td>
<td>4.0%</td>
<td>4.9%</td>
</tr>
<tr>
<td>4. Because I need to think</td>
<td>4.3%</td>
<td>4.3%</td>
</tr>
<tr>
<td>5. Because I can never learn well in school</td>
<td>2.3%</td>
<td>4.6%</td>
</tr>
<tr>
<td>6. There are too many things to learn (in real science)</td>
<td>2.6%</td>
<td>3.7%</td>
</tr>
<tr>
<td>7. I am too lazy</td>
<td>2.9%</td>
<td>2.3%</td>
</tr>
<tr>
<td>8. I don’t like calculations</td>
<td>1.1%</td>
<td>3.7%</td>
</tr>
<tr>
<td>9. It’s boring</td>
<td>1.7%</td>
<td>2.6%</td>
</tr>
<tr>
<td>10. It is a cold/rigid subject</td>
<td>0.9%</td>
<td>2.0%</td>
</tr>
<tr>
<td>11. I don’t feel that what I know is going to be very useful</td>
<td>0.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td>12. I don’t like experiments</td>
<td>0.3%</td>
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</tr>
<tr>
<td>13. Everything we learn is all for exams</td>
<td>0.6%</td>
<td>0.3%</td>
</tr>
<tr>
<td>14. Our school does not do experiments</td>
<td>0.6%</td>
<td>0.0%</td>
</tr>
<tr>
<td>15. I don’t like to be locked in the labs</td>
<td>0.0%</td>
<td>0.6%</td>
</tr>
<tr>
<td>16. I don’t want my hair to fall off</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>17. It gives me a headache</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

(n=729, 700 valid questionnaires)

Both sexes think that real science is relevant to the living world and is beneficial to human society. However, girls appear to have more motivation to understand the world, and as a consequence, value real science more than boys, for example:
- real science fulfils my curiosity of the natural world (32.6%; 39.4%)
- I like the sense of achievement when I understand things about nature (21.4%; 32.6%)
- it is what the world is made of and is more related to daily life (18.6%; 22.3%)

But girls also seem to have more difficulties in understanding real science (6.9%; 15.4%).

Both sexes’ perceptions of real science are linked with school science, either by conflation or by using one as a contrast to the other, for example,
- There is no exam in real science
- I had a good science teacher and he helped us to understand things that are not in textbooks
- Because I can never learn well in the school
- It is a cold/rigid subject
- I don’t like calculations
- Everything we learn is all for exams
- Our school does not do experiments

But in some responses boy’s attitudes seem to be more influenced by school science, for example,
-it is different from school science (21.1%:13.7%)
-I like experiments (14%:7.7%)

In conclusion, gender does not seem to be a key issue for likes or dislikes about real science because the majority of reasons are shared by both sexes, although some differences are observed.
6.3. Suggestions from Students for Improving Attitudes towards Science

Students were asked in the survey to comment and make suggestions on ways to improve attitudes towards school science and maintain motivation for learning science. Students’ responses are shown in Table 6-10. For simplicity, these have been categorised into several topics: teachers, teaching and assessment, career inspiration, autonomy, extracurricular activity, and others.

Table 6-10. Students’ suggestions for improving attitudes towards science, with response frequencies

| Teacher | Interesting teacher 24 |
|         | A teacher who is passionate and caring 14 |
|         | Good looking teacher with clear intonations 8 |
|         | A teacher who does not fail students 3 |
|         | Change the teacher 2 |

| Teaching and assessment | Make the teaching more interesting 36 |
|                        | Make the teaching more flexible and variable 12 |
|                        | Slow down the teaching speed 2 |
|                        | Visual and multi-media aided teaching 12 |
|                        | Teaching more concepts than calculations 4 |
|                        | More group discussion 12 |
|                        | More heuristic ways of teaching 6 |
|                        | No exams 28 |
|                        | No homework 4 |
|                        | Not just write Physics on the blackboard 3 |
|                        | Less memorisation 7 |
| Curriculum                         | Make it more related to daily life 60  
|                                  | Make the curriculum more interesting 38  
|                                  | New inventions or new science 25  
|                                  | Make the curriculum easier to understand 17  
|                                  | More experiments 17  
|                                  | Anything easier than English 3  
|                                  | Make experiments simpler 3  |
| Extracurricular activity         | Read science books or magazines 45  
|                                  | Watch science TV channels or documentaries 43  
|                                  | Trips to the nature and countryside/More observations of nature 39  
|                                  | Attending science camp 16  
|                                  | Do more exciting things 14  
|                                  | Attend science projects or watch other science projects 11  
|                                  | Visit science museums 9  
|                                  | Attend cram schools 6  |
| Career aspirations               | The job market is better for science students, when I think that I can make money from it. In the future I will study it. 36  
|                                  | When I think of going to a good university I will study hard. 16  
|                                  | I want to become a medical doctor 6  
|                                  | Imagine yourself becoming a Nobel prize winner 3  |
| Self autonomy                    | Keep myself interested 28  
|                                  | When my mark has improved 21  
|                                  | Always be curious 19  
|                                  | Discuss with friends 14  
|                                  | To explore new stuff yourself 10  
|                                  | The pressure of not to fail 12  
|                                  | Learning from others science projects competitions or robot inventions exhibition 7  
|                                  | More competition 4  
|                                  | Hypnotise myself 3  
|                                  | Ask teachers questions to understand more 5  |

175
| Others | Some help from any other resources 2  
Have high expectations of teachers and parents 5  
Read social study books that require a lot of memorizing 4  
Discuss with brothers or sisters 4  
Study in the USA 1 |  |

Most suggestions for improving attitudes towards science are related to the teachers’ character, teaching, assessments and curriculum design. These are direct responses to the students’ reasons why they dislike school science and real science. The extracurricular activities seem to be another area in which teachers, and maybe parents, can develop more to improve students’ attitudes, for example provide more science books and magazines for students to read, organise more trips to the countryside and museums, show more documentaries to raise interest, attending science camps or projects.

A new area not previously mentioned in the reasons why students like or dislike science, was career aspiration. Some points made are not suggestions but comments reflecting students’ worries and anxieties towards the future, for example, ‘when I think of the future/good university, I will study hard’. These remarks address concern about future personal development at high school level. Either the internal or external goals for future career prospects may drive the motivation or need to learn school science, as acknowledged by some students. More intriguingly, not many students express their intrinsic interest towards science.

For this survey, some students suggested ideas for their own actions, not asking for others to do things; for example, discuss with friends, explore new things yourself, learning from other’s projects, having the pressure not to fail the subject, ask the teacher questions. Some of these responses are not very useful - such as “keep myself interested”, “always be curious”, “when my marks have improved” and “hypnotise myself” - but may confirm indifference for learning science.

Other suggestions which were more attentive than those detached answers above,
included, more help from other resources, thinking of parents’ and teachers’ high expectation, discuss with brothers or sisters. There was an interesting suggestion which implies the USA a better place to study science.

6.4. Summary

From the data collected from 729 students, aged 12 to 18, it may be seen that students’ attitudes towards school science decline as the school years progress (see section 6.1.1). Boys generally expressed more positive attitudes than girls, except in year 7 and 10. Biology might be the reason for the higher positive attitudes and comments by girls. Earth Science was a favoured subject for both sexes, especially girls in year 11 and 12. However, more investigations are needed as the difference between the percentages of enrolment is higher than the attitude difference between the two sexes (see section 6.1.4.). Reasons for disliking school science, especially Physics and Biology are more related to teaching, assessment, perceived difficulties, too much memorizing, too many calculations, exam pressure, and negative reinforcement. The reasons for liking school science are good teaching, interest, relevance to daily life (see section 6.1.5). More girls changed their attitudes toward science during junior high school stage than boys, whilst boys tend to change their attitude in the senior high school (see section 6.1.6). In both cases, changes were always towards a more negative view of school science.

More students have positive attitudes towards real science than school science. However, these positive attitudes slightly decline through school years (see section 6.2.1). Fewer reasons were expressed for disliking real science from both sexes and most of the negative comments are related to perceived difficulties and the learning experience from school science (see section 6.2.2). Reasons for liking real science are personal interest, relevance of real science to daily life, values of real science towards human life, etc (see section 6.2.3) In addition, more girls expressed their opinions although they tended to be more critical. Fewer boys gave opinions compared with girls but boys seemed to value real science highly.

The most frequent negative answers towards Physics, the least popular subject, are: bad teaching, perceived difficulty, too many calculations, too much memorizing and
lack of interest. However, students who have positive attitudes towards Physics and Chemistry think that the subject is interesting, related to daily life, easier, a personal interest, and have less memorizing. This shows the perceptions of the subjects and personal differences might be important reasons for the diverse attitudes.

In summary, students’ attitudes towards school science are influenced by various factors including their perceptions, values, and knowledge of science as well as their learning experience in the school. Schools tend to be the main source for students to receive their knowledge of science and the most influential. This fact is coincident with the latest reports about Taiwanese students’ science concepts in biology (Wang et al, 2007). Furthermore, poor teaching seems to have a more noticeable negative effect on students’ attitude towards school science than a positive effect resulting from a good teaching. Based on students’ suggestions of how to improve their attitudes and interests towards school science, students need to be provided with more science related material; teachers need to be interesting and caring, have well trained teaching skills and adequate facilities, and different assessment criteria; schools need to provide more extracurricular activities and more resources available to students; and the authorities need to develop a better designed curriculum and exam system.

6.5. Constructing a Model of “Behaviour for School Science”

Based on the Findings

The model of “Pro-environmental behaviour” by Kollmuss and Agyeman (2002:256), based on the work of Fliegenschnee and Schelakovsky (1998) who were in turn influenced by Fietkau and Kessel (1981) (see Figure 3-3), illustrates different internal and external factors that form pro-behaviour towards the environment. Both positive and negative factors are included in the model. Negative factors are the barriers that stop one developing a pro-environmental behaviour. These negative factors are represented in the figure as black boxes.

As displayed in the model, the internal factors are displayed in the upper grey box, which consist of one’s personality traits and value system. These include areas such as knowledge, emotional involvement, and values from one’s environmental
consciousness. One’s attitude, together with knowledge and values, are the basic guideline for one’s behaviour. A pro-environmental consciousness is the sum of all these guidelines which is then internalized into one’s value system. Within the internal factors, there are barriers such as lack of knowledge, emotional blockages, existing knowledge and values, that prevent the formation of the whole environmental consciousness.

External factors (lower grey box), such as infrastructure, political, social and culture factors, economic situation, are factors that exist outside an individual’s cognitive system. These external factors are also important because they contribute to the final outcome of individual’s behaviour. They can also interact and influence consciousness, which is also characterised as part of the value system in individuals. The external factors, for example social, cultural, and economic variables, were not discussed in great detail in this model, neither in its original presentation nor in Chapter 3 of this thesis, although without this exploration the discussion is incomplete and leaves scope for other research to investigate these influences on the process of pro-behaviour or decision-making. Moreover, the process of the formation of the pro-environmental behaviour can also demonstrate the formation of the con-environmental behaviour or potentially other types of behaviour, such as choosing to study science.

The internal factors that form one’s personality traits and value system together with the external factors help shape one’s pro-environmental behaviour. However, during the process of inducing the pro-behaviour, there are also barriers on the path to the formation of pro-behaviours. When the pro-environmental behaviour has formed, it may also feed back into the personality traits and values system.

Based on this model, and using the elements of “attitudes” defined in Chapter 3 (see 3.1.1) (Page, 1979; Hogg and Vaughan, 2005) but treating behaviour as an independent element outside attitude (see 3.1.1), a model of pro-science behaviour can also be constructed with the findings that are grounded in the data collected in this part of the research. Factors that shape students’ attitudes towards science are initially categorised as the internal and external factors. Factors that are involved in the process of forming one’s cognitive system towards a positive attitude are the
internal factors, such as knowledge of school science, perception/belief of real science, and value of science. Factors that lie outside one’s cognitive system are the external factors, such as teachers, teaching, curriculum. Factors that have negative effects on forming positive attitudes are seen as barriers, such as lack of interest and lack of incentives.

From my data, there are three cognitive domains that exist within the internal system of a person which relates to one’s attitude towards school sciences: knowledge of school science, perception/belief about real science and the value of science. School science classes seem to be the major and direct sources of students’ knowledge about real science. The knowledge of school science first enters a student’s cognitive system as input of information and it acts as the lowest level in one’s cognitive system. For example, some students mentioned that they learn about animals or plants in biology class; some think that school science is about formula and equation memorizing; others think that school science involves a lot of memorizing and calculation. Also, what they learn about science is shaped by other factors, which directly or indirectly influence their attitudes towards school science. These factors play important roles when attitude towards school science is forming, especially the learning experience through school science classes, such as teachers’ characters, teaching style, assessments, perceived difficulties, and rejections caused by physical and emotional fatigue. Gender differences and lack of interest are also an important factor that has negative influences on students’ attitude. These factors might become strong resistances during the formation of a positive attitude. In other words, these factors are barriers that hinder students from liking school science, as shown in Figure 6-6 (red boxes).

The second level of one’s cognitive system is the perception of real science. This includes what one knows about real science and what one assumes real science to be. For example, some students think real science provides a ‘true’ account of the way the world operates (‘the world is run by real science’ would be a literal translation of the students’ comments) and it is more related to daily life (20.4%) and some think that real science is the science which is about the living creatures on the earth (10.4%). More students have positive attitudes towards real science compared to school science (see
Figure 6-1 and Figure 6-5). This suggests that school science and real science are different and should not be treated as the same concept, when looking at students’ attitudes. However in this survey some students appear to confuse real science with school science because some students think that real science is about calculation, memorizing, exams, etc, which is what they learn from school science (6.2.2). These statements show that perceptions of real science can also be influenced significantly by students’ learning experience in the school science class when they do not have other sources of information or knowledge. Students’ perceptions/beliefs of real science are also shaped by other factors, such as interest, gender differences, physical and emotional rejection, perceived difficulties, and lack of real experience/practical work.

The third level of one’s internal cognitive system is his/her valuing of real science. Many students mentioned their reasons of liking real science because of its value, for example, real science fulfils my curiosity of the natural world (36.0%). I like the sense of achievement when I understand things about nature (27.0%), it is a way to develop and modernise human life (18.3%), I admire those great scientists, they have great contributions to human beings (6.9%). Students expressed their appreciation and values of real science. However, there are some factors that deter students’ valuing of real science, such as lack of interest, perceived difficulties, physical and emotional rejection, negative image of scientists, and lack of real experience.

The three domains of science cognition, value of real science, perceptions of real science and the students’ knowledge, can clearly be distinguished and yet, whether strong or weak, they are sometimes overlapping, linked or influenced by each other. For example, students’ perceptions of real science might be influenced by their learning experience from schools and those who think that real science is difficult and complicated seem to have lower values of real science. These relationships are shown in the model (Figure 6-6). Based on students’ responses in the survey, their internal cognitive system involves many factors interacting with each other at the same time. The diagram might, however, only illustrate a simplification of complex processes, in which one internalizes the information gathered and knowledge learned, and then transforms it into one’s cognitive and value system. The interacting and linking process of all these cognitive elements might be even more complicated than a
diagram can show because the processes of internalization cannot be seen, only behaviours can be observed.

Apart from the factors that act in one’s internal system when the positive attitudes towards science are forming, there are factors that exist outside an individual’s cognitive system and control. Examples could include the reasons students have given for their attitudes towards school science in the survey (see 6.1.3): some students express the view that teachers and their teaching have a big influence on their attitudes towards school science, some feel that the content of the subject is too difficult to understand, some state that there is too much to calculate and memorize, some complain about the quantity of exams, some think that there is insufficient hands-on work to help them understand the subject, some think that the curriculum is not practical and not related to daily life, some chose not to do science because of their ability in doing mathematics, some have different attitudes according to the subject, some express their interests are inspired by scientific television programmes and magazines, some feel that learning science is going to be useful for their future career. These reasons are categorised into several wider topics in the external factors which play an important part in the formation of positive attitudes towards school science. They are: teachers and teaching, design of curriculum and assessment, subject difference, educational system, access to information, and future incentives.

These external factors also seem to have an effect of shaping one’s internal system, for example, the inappropriate curriculum design produces perceived difficulties of one’s cognitive system which might be based on gender difference and also generate physical and emotional rejections and affect one’s knowledge absorbance, beliefs and values. Vice versa, the internal system of individuals sometimes might also influence the external factors. The information or restricted conditions from the external factors might be filtered and channelled into one’s internal system because of the existing cognitive and personal constraints. For example, some students expressed that bad teaching and assessments affect their motivation of engaging with science learning. Some students also think that science television programmes and magazines inspire their interest in learning science. Therefore, from an individual’s point of view, the internal and external factors, although from different sources, may seem to have influences on each other, during the formation of attitudes.
While both internal and external factors play very important roles in forming individual’s positive attitudes, there are also other factors that might have negative effects on the formation of positive attitudes. These are the barriers which block the formation of positive attitudes, shown as the red boxes in Figure 6-7. An individual might lose his internal interest or external incentive on the pathway to construct a positive attitude towards school science, even if he thinks that science is good and valuable, and has a good teacher in the school. In addition, low marks are a very prominent factor that hinders students from liking school science. In my data (6.1.3), students who have poor exam results seem to have much higher negative attitudes towards school science and many students, including those who have good or fair marks, express their frustration when they receive a low score from exams. These are negative feedbacks which might occur unexpectedly, and might block the formation of positive attitudes.

According to the pro-environmental model, once positive attitudes are formed individuals should be more likely to continue to take up SSP and those who have adopted negative attitudes, are most likely to abandon the choice of NSP. There are some evidences showing the link between attitudes and choice from this research (see 6.1.2 and 6.2.1). In my modified model (Figure 6-6), factors and paths of one’s forming positive attitudes towards school science are illustrated as well as the likely inclination of positive attitudes..
Figure 6-6. Pro-school science behaviour
However, a model that includes the formation of both attitudes is probably more useful for our understanding of the real situation rather than only presenting the pro-attitude. The formation of negative attitudes can be added and constructed by the same procedure. Thus, the pro-school science behaviour model might be expanded and constructed to a model, which includes both attitudes and their likely choices.

The model in Figure 6-7 illustrates clearer factors that shape students’ attitudes towards school science, and shows the two resultant attitudes, with two different behaviours linked with the attitude. The positive and negative attitudes can exist separately or simultaneously according to the description of students in this study, therefore there is a link between these positive and negative attitudes. In addition, students’ attitudes are not unchangeable, even when they have formed an attitude previously (see 6.1.6). However, all responses gathered from the questionnaires that describe the change of attitudes, are one-directional: from positive to negative. It seems to be more difficult to keep a positive attitude than to develop one from a negative attitude. There tends to be a greater probability for positive attitudes to turn towards the negative side, than negative attitudes towards positive ones. Therefore, the likely developing direction for attitudes is a one way arrow from the grey box of positive attitudes.
Figure 6-7. Model of behaviour for school science

- **Internal Factors**
  - Knowledge of School Science
  - Perception/Belief of Real Science
  - Value of Real Science
  - Lack of incentives
  - Lack of interest
  - External Factors
    - Teachers & teaching
    - Curriculum & Assessment
    - Subject difference
    - Educational system
    - Access to resources
    - Future incentives
  - Poor scores

- **Pro-School science Behaviour**
  - Positive Attitudes toward School Science
  - Lack of resources & support
  - Con-School science Behaviour
  - Shapes

- **Influences**
  - Cognitive System
The models of behaviour for school science (see Figure 6-6 and Figure 6-7) show the influence of a “belief about science” relates to their choice of study group. The research also highlight a significant difference in the effect of attitude on choice between the Taiwanese and western schools. However, students’ attitude does not seem to be the only concern when students choose their study group of subject because not all the students who chose NSP like school science and the attitudes in different study groups did not seem to hugely different from each other. A considerable number of students who do not like school science continue with science studies. Around 30% of those who chose NPS in year 11 and 12, do not feel they like school science and yet, they still carry on the same study group. Both my findings, and the related studies (Huang, 2001; Wang, 2006), strongly suggest that link between attitude and choice of study group is weak and students might not choose their subject solely depending on their whether they like the subject or not. The final decision-making process might include more than their attitudes towards the subjects.

An important thread from this study, is that some students mentioned career aspiration when they were asked how to improve their attitudes towards school science (see Table 6-10). Therefore, the next part of the research will be exploring students’ decision-making for their study groups, including particular forces or factors that influence students. Students, parents and teachers are interviewed, in order to give a clearer picture, of how students in Taiwan make their decisions when choosing study groups.
CHAPTER 7. FACTORS THAT INFLUENCE STUDENTS’ DECISION MAKING

In this chapter, students’, teachers’, and parents’ concerns will be discussed to investigate possible factors that might influence students’ decision when choosing their study groups.

Influences and factors affecting students’ decision-making were also examined in the same four schools. Interviews with students, school teachers and parents were conducted. The objectives of this part of the study were:

• To interview students in order to explore and analyse the concerns they take into account when making their decision of choosing study groups.
• To interview parents in order to understand their points of view thus shedding light on their children’s decision making process.
• To interview teachers on how they think students’ decisions are influenced or made from teachers’ point of view.

Although there were clear goals for the purpose for me to understand the factors and influence that shape students’ decision, in the actual interviews/conversation, most of the interviewees did not have clear and systemized reasons for their reasons. Most of the factors seemed to be inter-related during the interviews. For example, pursuing high social status might be linked with material rewards, life security, social norms or parental expectations, and vice versa. However, these also reflected the situation in the real life. The factors and influences presented in this chapter are organised in a clearer way so that readers can have a better understanding of the whole picture.

7.1. Concerns from Students’ Points of View

Identifying factors that students consider when choosing their study groups, illustrates their positions in the process of decision making, and the roles/source of influences exerted on the students. The concerns expressed by students, form two groups. The internal concerns, for example personal interest, attitude, and learning experience formed their personal emotional and cognitive system; and the external factors are from the outside world surrounding the students, such as parental expectations or
educational structural constraint. The interpretations of and responses to the external influences are also mediated by their personal cognitive and emotional systems, it is why there are different decisions by people with similar experience or external influences.

In this part of the research, different groups of influential people are described as actors, who may directly or indirectly influence an individual’s decisions.

7.1.1. Internal concerns
When students expressed their concerns, they were not usually clear and concise. Often, reasons given were vague and covered several topics. Therefore, the reader must bear in mind that in reality, students may not have an organized, analytical way of thinking and answers may be sporadic and scattered, during the discussion.

7.1.1.1. Interest and attitudes
Reasons given for subject group choice were normally closely related students’ interest, emotion and cognitive system followed by those related to their future and other people. A frequent response from students was that they were “more interested” in some subjects.

Interviewer: Why did you choose social study group?
Std6: Show business, entertaining stuff.
Std8: Public communication.
Std 7: yeah, public communication or Japanese.
Interviewer: Why Japanese?
Std 7: Because..
Std6: because she can be an interpreter.
Std 7: no... I like Japan and I used to watch some
Std6: Japanese drama [laugh].
Std 7: Cartoon and stuff like that. So I became very interested in it and then I knew a few words.
Std 6: A FEW words!
Std 7: So I spoken to some Japanese when I went to Japan and they told me I was really good. That’s why I have a high self esteem.
And

Interviewer: So why did you choose to study science?
Std 1: Because I hate those things you have to remember in the social study group. I like to learn by understanding it.
Std 2: I like maths more so I chose the science group.
Interviewer: So you are better at maths?
Sty 1: Yeah, his maths is better.
Interviewer: So is because of your interest or your mark that you chose to study science?
Sty 2: I do like biotechnology and am thinking of going for that direction.

However, the “interest” they expressed in their answers seemed to be similar to the attitudes described in chapter 5 and 6, because the interest students explained, involved their learning experiences, academic performance and their affective responses towards the subjects. Therefore, “interest” as used by students in the discussion, seemed to be a joint concept with “attitude”. Similar to the pro-school science behaviour model constructed in chapter 5 (see Figure 6-6), students tend to choose the group to which they had a more positive attitude or avoided the one that was associated with negative attitudes. The initial stage of the decision-making process seemed to involve weighing and comparing the attitudes towards different subjects.

shh3: I just feel that those things like history and geography need a lot of memorisation. They are annoying. I did not like to study them.
Interviewer: Annoying?
Shh3: Yeah. There were lots of thing in the subjects that needed to be memorised, so I feel that numbers are more interesting.

And

Schk12: I think I am less interested in physics and chemistry and I feel that I would rather work with people than with machines. I like the interactions between me and other people. I do not think it matches with my interest if I go into the research or inventing.

In many cases, the weighing of interest did not seem very difficult, because there were only two choices for study groups. When one does not have a relatively positive attitude towards either study group, the study group that is less disliked it would be preferred.

Sck5: I don’t particularity like or dislike any subjects but I think it is annoying to do a lot of memorising in social studies. So I just chose science.

There were cases presenting the contradictory views, with consideration of interest and future prospects. Some students stated that interest was the first important reason for choosing to study science and their ultimate aim was to choose a subject that might lead to a well-paid job. However, this contradicts the finding that science
students did not necessarily have a positive attitude towards science.

*Sty2: If the decision can cover your interest and future, that is the best thing. I would rather choose something I like. If you like it you will enjoy doing it even if you are poorly paid. I think interest is more important.*

*Interviewer: So are you thinking of becoming a mathematician or scientist?*

*Sty2: No, I don’t think so*

*Interviewer: Never?*

*Sty2: No*

*Interviewer: Why?*

*Sty2: It is not easy to make money if you are a scientist.*

From the various contradictions in what the students stated, it seems that most of the students did think about their interest and attitude when they first face the choice. They might choose one study group because they like it better or dislike it less, however, interest and attitude might not be the most important or only reason they choose their study group. Other reasons, such as jobs and material rewards, seemed to direct their choice.

7.1.1.2. Perceived difficulty

Another important factor when choosing a study group was “perceived difficulty” of the subjects. However, as described in chapter 6, perceived difficulties are related to several factors, such as teaching, curriculum design and student ability. Students also used their perceptions of difficulty as an indicator for their own capability, and as the criteria for choosing their subject. For example, some students noted their choice limitation because they felt inadequate with some subjects.

*Shw7: It was quite obvious that my scores in the science subjects were not good and there was not much point for me to study science.*

Difficulties in learning a subject, together with poor exam results, often create an emotional rejection of a subject. Therefore, students would naturally seek an alternative subject to study. Some made the selection by choosing the subject they disliked least. With only two choices of study groups at high school, for some students the dilemma seemed to be choosing the one that was felt to be less difficult.

*Sck11: We... We... hahaha [joking with other students] I am more familiar with social studies and do not like physics and chemistry. I feel great pain when I see those strange symbols. So, actually, I think it’s rather tiring to keep thinking. It is faster to just try to remember things. You do not have to use too much of your brain.*
7.1.1.3. Life experience
Experiences in life and work will affect viewpoints for study group choice. Some students attended extra curricular activities, for example, science exhibitions, science competitions and summer camp at universities, and these experiences allowed a greater understanding of the subjects, as well as encouraging more positive attitudes. However, most summer camps were science or technology orientated, for example, physics, chemistry or mathematics summer camps. Only one student mentioned attending a summer camp about spiritualism, which made him assume spiritualism was a science.

_Sck4:_ I attend some science summer camps before. I think that helps. We had a lot of observation and experiments. Urm...although I don’t really want to become a scientist, I understand better what science students might be doing in the future.

Also, students who had part time jobs, gained additional information from the real world, other than knowledge taught at school. Their work experiences helped to give a clearer picture of the outside world and contemplate their future. These experiences had some influence on their attitudes towards different subjects. In the example below, the student talks of gaining a wider, ‘public’ perspective of science, beyond his own personal view.

_Sty3:_ I think working helps people to see and think in different ways because we don’t have a lot of opportunities to see the outside world when you are a student. But I think the people outside do think that science is better and more useful than social studies.

7.1.1.4. Perceptions of the disciplines/ fields of study
Students’ perceptions of various disciplines of study is a further important factor. Students generally had stereotypical views of subjects, which tended to shape their attitudes (see Chapter 5). Their perceptions and values are also indications of their preference in the decision making process (Chapter 6). Science was generally seen as lively and useful in the future even for some of those who did not choose NSP.

Students voiced a diverse range of views about social studies. Some thought it was ‘dead’, while others regarded it as more ‘human’. Science students often argued social studies to be more difficult and complicated, due to the complex relationships among different human issues. They also pointed out that social study subjects require a lot of memorizing and skills in speaking and expressing personal opinions.
Social study students suggested social studies revealed the “real human activities” which explore and focus on human beings’ feeling and daily life, rather than just learning theories less close to humans. The personal interpretation of these fields of study, in relationship to personal interest, seemed to show fundamental difference between the different groups of students. Student’s viewpoints were also shaped by personal characteristics and interest, during the decision making process.

Shh2: Yeah...I know it is easier to study social study subjects because you only have to remember things but it is annoying...I just don’t like to memorise so many things. They are not practical and useful...
And

Shw7: I don’t know. I just feel I have no love towards those cold and rigid subjects [science]...they are not for me.

Perceptions of scientists and their work was another factor that students took into account.

Sty9: No...I don’t want to be locked in the lab for a long time and look like a crazy scientist.
And

Sck13: hum.. I always like to be with people. I know I am not suitable for being a scientist or even just to work in the lab for a long time. So I just gave up.

Thus, stereotypical views of work, especially the work of scientists, may influence a student’s choice.

7.1.1.5. The reinforcement of academic achievement

Students’ academic performance provides important feedback and is taken as an indicator of their capability. Good marks make students feel more encouraged with the subject, while bad marks bring frustration and negativity in their study. Results from exams, either positive or negative, re-affirmed students’ choice and gave proof of ability to study the subject. However, the performance may also be associated with perceived difficulty.

Shh3: I am never good at expressing my feelings. I just can’t do it. And my marks [in the social study subjects] showed me that it is really not the direction I should go for.
And

Shw 10: Well, I don’t particularly like either group. In fact I was in the science group but my results from the exams tell me which study group I should choose, ha ha.
7.1.1.6. Learning environment

Learning environment, including the teacher, teaching and curriculum, played a vital role in reinforcing student’s choice. Bad learning experiences may have a greater influence on student’s choice, causing the student to seek an alternative subject. For example, students from group 8 had chosen science at the start of senior high school but all changed their minds due to the teacher’s teaching ability and style, which they agreed had resulted in poor performance. The complaints from those with bad experiences, shows a great negative impact on their final choice of subject.

Sty7: The teacher was a big influence; even it was only a few lessons.
Sty 10: He will tell you to write down what he had taught.
Sty 7: Like copying a sutra.
Sty10: yes, he will ask you.
Sty8: This is what we call ‘stew for the chicken soup’. Then he will ask you to write some important notes. Then he will give you a test next time in the class. So we lost our interest completely.
Interviewer: How about other subjects?
Sty10: The chemistry teacher just kept teaching and teaching.
Sty7: Basically I never felt I have had a real lesson.
Sty8: He just kept writing and writing and told us to keep copying and copying his writing.
Sty12: Because if you keep writing and writing you will not talk and make a noise.

And

Sck11: although science is useful in daily life, it is too vast. We do not come in contact with science too much everyday. The thing we learned in the school is not too much compare to the whole knowledge of science. So it means that we are not learning too much science in the school any way.

7.1.1.7. Gender role

Although, there was no direct mention that subject choice was influenced by gender, the significance of students’ gender roles was implied. For example, boys seemed to have more pressure to take up science.

Shh 3: I feel that a lot of boys who do social studies are sissy.
And

Interviewer: Have you thought about choosing social studies?
Sty1: no...
Interviewer: Why?
Sty1: I just feel that boys should learn something more useful.
And

“Yeah, people always think that boys should study science and have more pressure from the family than girls.” (shh4, shh5, shh6)
It seemed to be that studying science is a prestige among all students and boys have more pressure to choosing science. Girls have less pressure in choosing science because the stereotype is girls are suitable for social studies. However, if a girl wants to choose to study science, she might be well encouraged by others.

Shw3: *I think it is ok for girls because normally many girls will choose social studies, but if you want to choose science, no one will stop you.*

Shw 4: *Yeah, and then people say that you are really great. It’s not fair. People think that boys should take science and they don’t think we are so great.*

As one would expect, the issue of gender is also related to jobs and family responsibilities. This will be discussed in a later section.

7.1.2. **External concerns**

7.1.2.1. Access to universities

The common goal of everyone who participated in the research was to go to university. The wish to achieve more and gain entry to university was commonly expressed among students in the middle and lower levels of academic performance. These students tended to consider the study group for which there are more vacancies in the university or one that accepts a lower result for university entry. Securing a place at any university was the first priority. It was a bonus if the university had a high ranking position in the national league table.

Sty 8: *They are speculative[opportunistic].*

Interviewer: *Why?*

Sty 8: *Because it is easier to get ANY university if you study science.*

Sty 10: *Yeah.*

Interviewer: *Why?*

Sty 8: *They only need a very low score to get in a lowest university. The competition is not as furious as in the social study group.*

Sty 10: *Yeah, they just want to go to A university. You know ANY one.*

Sty 8: *That’s why they are lazy and just being speculative.*

Delicate calculations seem to be being carried out to increase the possibility of continuing education at university. All the students in this research stated that there were more university vacancies for science students. Amongst the middle and lower ranking students, natural science seemed to be the most popular choice, following the complicated tactics, factors weightings and priorities which need to be taken into account for the decision process.
Students were aware of their possible positions in relation to other students in different study groups. For students with higher academic performance, securing a place at university was less worrying because they were confident of their ability to gain entry to university. Their main concern was the quality of the department and the reputation of the university.

Sck5: I think that getting into “a” university does not worry me too much. The problem is how to get a good major in a good university.

According to the statistics department at the Ministry of Education (2007), in the school year 2006, more than 80% of the 18-year-old high school students continued their education at university. However, only one in four could study at a public university due to limited vacancies in these universities. Students and parents generally prefer education at public universities because they have a lower tuition fee, a better ranking and reputation, better research resources and better network connections for employment. Hence competition for these universities is high. There is a strong force in society pulling students to obtain a higher degree.

Shk62: If you do not study hard, you either not be able to go to a good university or a good major. My dad said I will have to help [tuition fee] if I go to a private university.
Shh2: Yeah, my parents said that too because it is a great difference between the public and private universities.
Shh6: So we have to study hard because although it is not difficult to go to just a university but everyone wants to go to a public university.

7.1.2.2. Access to Jobs
Another important concern when choosing a study group is access to future jobs. Participants for this research had taken this concern seriously. However, different students had their own personal focus for their future prospects. There were four main factors emerge from students’ consideration in contemplating their future jobs: security, material rewards, status and family responsibility.

1. Security
Security seemed to be the most fundamental concern for all the students’ reasons and having a university degree (at least) was seen to be the basic requirement for employment.
Shh4: Yeah, of course. You need to have a job. That is the minimum requirement.
Interviewer: Why?
Shh4: You have to survive first. It is important to support yourself before you think of anything else. Yeah, this is the basic requirement for the future, when we grow up.

Students’ view of employment/unemployment rate also reinforced their caution in preparing for future career. The view was, however, more linked with the media through daily life. Students also felt a need to find employment otherwise their family would worry about them. So students tried their best, either study hard or make a choice that provides a higher opportunity, to obtain a good job.

Sty11: Of course you need to have a job so that you can support yourself and your family. My parents will kill me if I just hang around and do not have a job. Well, I don’t think I will hang around and have nothing to do but this is the reason our parents spend so much money raising us.

And

Shw3: Well, it is not really that easy. These days you hear the news saying that it is so difficult to get a job all the time.
Interviewer: do you think it is true?
Shw3: I think it is true if you are bad (low competence). And that is why we have to study hard. It is just too furious (competition) out there.

Three out of four groups of social study students pointed out that some students with a lower performance in science subjects still chose science because there is a greater possibility of getting a job.

The insecurity felt by students may relate to the Taiwanese economic situation and social welfare system because job market competition is high and there is little social support. Therefore, students were all aware of the need to support themselves in the future.

2. Material rewards
Part of the high aspiration in getting a job was the income that comes with the job. A good income is also a good support of a security life.

Interviewer: Apart from easier to find a job, what other aspects were you thinking when you chose science?
Shw 3: Well, getting a job first and then it is better to be a secure and easy job. Of course, it would be even better if it pays well.

3. Social status
A higher social status in society was also desired by students. Most students seemed to have in mind an ideal type of job in each study group and these jobs seemed to
signify a higher social status. For example, medical doctor was deemed as the best choice in the science group whilst lawyers and accountants were thought to be the best choice for social studies. These aspirations might be tempered by an awareness of harsh realities, however:

Sck11: *hum...I am just thinking that I can do better than an engineer....you know something like lawyers or business. Being a medical doctor will have a high social status and income but it is much more difficult to become a medical doctor if you study science.*

7.1.2.3. Parental expectation
Although all the interviewed students claimed they had chosen their study groups by themselves, some also mentioned that their parents had given their views. They all mentioned they had received some degree of pressure from their families. The parental influence seemed to be critical in the aspect of career aspirations, and in many cases, the study group choice actually seemed to be same as their parents’ opinions. For example, none of the science students stated their parents disagreed with their choice, because the parents thought that studying science was a good idea.

Shw4: *I think they are happy about it. They want me to choose science any way.*
And

Sck6: *My parents suggested science but they did not force me to choose it. They just said that it is better for the future.*

However, the students interviewed all claimed that their parents left the last decision to them, so their decisions were not made by their parents. The extent of the parental influence could be according to the teachers and students’ information about their parents’ opinions. Moreover, many students pointed out that there were people who they knew whose parents made their decision for them or students who were forced to choose their parents’ preference.

Sck11: *Many people choose their study group because their parents told them to.*
Interviewer: *Why do they listen to their parents instead of choose what they really like?*
Sck11: *Because first they don’t really know what they really like and second, sometimes you just have to listen to your parents when they give you the suggestions.*
And

Interviewer: *Why did your parents tell you to choose science?*
sty8: *I think it was just because they think that is better for them.*
Interviewer: *What do you mean?*
Sty8: *because if we have a good job in the future than they will feel they have the face.*
sty9: *yeah, parents are like that.*
Sty10: *they don’t really care if we like it or not. They just want us to do what they feel is*
better. It is not fair. Adults are all gold diggers. They just like to compare all the time. Sty8: Yes. They like to compare with each other and even compare whose child is doing better. It is disgusting. Why is it so ugly in adults’ world?

Medical doctor seemed to be the best ideal job for many parents. Engineering type jobs, though, is not as good becoming a doctor but it is one of the good choices.

Sty7: I think it is because their parents want them to choose to study it [science].
Sty8: Medical doctors!
Ssty7: To become..
Sty8: Medical doctors.
Sty11: Yeah, medical doctors or electronic engineering, and
Sty7: Because everyone wants to be them.
Sty9: I don’t think so. I think some parents think that people always thought that people who chose to do science were smarter. So they will tell their children to study science. My mum is like that.

Seven out of nine participating teachers pointed out that most of the students conform to their parents’ opinions. Two participating teachers from the first school in the capital city said that students nowadays “discuss” their opinions and choices with their parents.

Teacher3 : Yes. Should be huge (Influence of parents on children). They obey what their parents tell them,
Interviewer: But the students said that their parents do not restrict them.
Teachers 3 : They always say that, but in fact, parents have a huge influence on their children. They always listen to their parents’ opinion first.
Teacher 4 : Yeah, they always do.
Teacher 3 : Some of the students do study hard by their own will.
Teacher 4: oh really?
Teacher 3: Like students in my class are very obedient to their parent.

All the students from different backgrounds had similar pressure from their parents to go to university and get a good job in the future. However, students with parents who are manual workers were found to experience more pressure for upwards social mobility from parents who are more anxious about their children’s future. Such parents, if not their children themselves, were aware of the uncertainties of the current labour market.

Parent 6: We don’t want him to do the same job like his father. His parents have been unemployed for 6 months. That is why they moved back with us. It is not stable if you are a labourer and it is hard work if you have a make your living using your labour.

All parents expressed their expectations of their children, however, parents from manual working background particularly expressed that they did not wish them to
become manual workers. They all suggested that gaining better jobs required “studying a lot”. These parents believed that increased education provided more opportunity and competence for their children. Students from this background had high pressure to obtain a stable job and their aspirations in studying appeared to be high as well. However, similar to the concept of cultural reproduction (Bourdieu, 1990), they were also at a disadvantage position because their parents were less able to help with much educational information and support. Nevertheless, most of their parents still tried to provide financial help if they could afford it to enable their children to get extra classes. That is also why it was not difficult to find students from manual working class in the top schools.

Parent 2: I did ask him if he needs to go to the cram school because everyone goes. But he said he can study by himself. I know one is because he does not like it, two is he does not want us to spend the money. We will let him go if he wants to go.

The pressure did not merely come from the parents, but from other family members too. An example was a sister of a student from group 8. She was 10 years older than her brother and was working as a nurse for 10 years before she took a year off from her career, to help her brother. She was very keen to help her brother’s study especially to improve his motivation. Her brother had changed from a science group to the social study group, while he had also started working in a pizza shop. He was then thinking of transferring to a vocational school. The sister was worried that her brother would eventually drop out of school and commit a crime.

Parent14: …the number of people who could win in the competition is very limited. This is not just a game for qualification but competition for your life. Therefore, people have to study extremely hard because study means high possibility of passing the examination and passing examination means success, eventually they can become scholars.

The sister took on her parents’ role and responsibility to help her parents and brother. She stopped working so that she could help her brother to fulfil their parents’ expectations.

7.1.2.4. Social norms and tradition

While students were explaining their reasons for choosing their study groups, they also referred a few cultural background elements that seem to provide fundamental drive and guidance for students’ goals. These include social norms, trend in society,
family responsibility, gender roles, and conformity.

1. Social norms:
It seemed a secure, well-paid job with high social status was brought up mostly frequent. The image of science students has a high value in society. For example, some social study students pointed out that “many” students choose science because they wanted to have a greater peer-group status, even social or personal attractiveness. They suggested that most people thought that science subjects were more difficult and require more intelligence and effort to study.

**Sty8:** you know there are many reasons, everyone thinks like it is clever and cool to study science.
**Interviewer:** So why you are not studying science?
**Sty8:** I wanted to but I know I am not that good. Some people just don’t want to admit the reality... I am out [not in the science study group] so I understand how they feel.

On the other hand, although the choice of social studies was less preferred, it can still lead to business or law in the future, which also has high social status. This is why entrance into these subjects is also highly competitive. Large numbers of students still compete for very limited places in the top universities, all having high entry requirements. Nevertheless, some top students chose social studies instead of science, based on their ability and interest in the subject, the material reward, and social status of a related potential job. Their route is different to that of other students who chose science but the ultimate goal is still similar to that pursued by the other members of society, i.e. respect from others, material reward and social status.

**Interviewer:** So why did you change to the social study group?
**Shw5:** I think I knew I was not going to get a very good department or good university if I study science because I am not that good really. Instead of getting a very bad university or department, maybe try something that I can handle better.
And

**Sck11:** However, if you are doing it as a career, then people think a social worker’s social status is lower than a normal salesman. The general public always feel the social workers are...sort of housewife jobs.... Sometimes you have to add reputation in. That means people might see you as a respectable person by your job. If you are a medical doctor, then everyone will think that you are respectable. So are teachers. They also have high social status. People still respect teachers...well, much less now. If you are a civil servant, politician, or something like that, you can also possess with this reputation.

2. The trend in society: Interview results showed that most students, parents and
teachers had similar ideal jobs in mind and believed that people who follow the “trend of the society” can always be in demand and are less likely to be left out of the job market.

Parent8: Yeah, everyone thinks science is the trend for the future and everyone chooses science. But I think if all the people go to science, who is going to do the other jobs? Personally I don’t think everyone should do what others are doing and I did not tell my daughter to choose science because she is not the material for that any way.

Here the “trend in society” expressed by the participants was, in actual fact, the direction of the future economic development according to the conversation. Because of the economic development is more geared up for high-tech industry, the trend in society is in the same direct, hence individuals follow the trend. That is also why jobs in the biotechnology and semi-conductor industry were highly favoured. Most students (including social studies students) considered choosing the science group because of this reason.

Shh3: Everyone is talking about biotechnology. You see that everything, including food, medicines and even makeup are all produced by biotechnology....
And

Sty1: I quite like something like biotechnology. And since it is the trend for the future, so why not go with the flow...

3. Family responsibility

Students felt that they had a responsibility to support their family in the future, or at least to be financially independent of their family. For these reasons, they feel it necessary to consider the future carefully.

Ssh1: You know you have to think about your parents. We have to support them when we grow up. You have to give them the most basic support.
And

Interviewer: Why do you need a good job?
Schk4: Well, you are expected to have a good job.
Interviewer: Why?
Sck4: Everyone more or less has some pressure from his parents and we boys have more responsibility for our parents.

4. Gender role

Apart from the students’ personal gender identity, their gender identity is also projected to roles in the family and society. It might be a two-way process, since gender role expectations from society influence individuals’ perceptions of their own gender. One aspect of this role is related to family responsibility, where boys
generally have more pressure than girls in terms of responsibility for supporting the family, when they grow up. Every male student, whether in the science or social study group, mentioned their responsibility to their family. Girls expressed their responsibility to be financially independent but seemed to feel less responsibility for looking after the family in the future.

Schk11: Of course! My mum always says that I am the only boy in our family, I should do this or that, or I should be this or that. Well, I just let her talk.

Shh3: I think they might live with my brother (when they get old). Our family is still quite traditional...

Parent 14: My brother felt that boys should study science and engineer. We hope he study in group 3, something medical. He can then have a qualification and license for jobs. I think it is a good and stable job, but my brother has no interest at all.

5. Conformity

Students pointed out that they knew friends or other students who were influenced or pressured to choose the study group preferred by their parents, which suggests the importance of parents’ opinion and conformity of children. In Chinese culture, parental opinion and involvement, is important for children of all ages. Parents make decisions for children from the moment they are born, through schooling, friend making, career and even marriage. Children normally obey and respect their parents’ opinions and decision (Hsu, 1949).

Many students choosing social studies stated that their parents had suggested or encouraged them to choose the science study group because they considered it a better choice. These views seemed to be deeply rooted in many people’s minds. For example, some students considered it to be a “better choice” or “better route” to choose science because “everyone” says so. Therefore, the preference for studying science has taken on the status of a social norm and most students chose to follow this norm. Other personal reasons may obstruct this line of action, for example if the student is not capable of achieving good exam results, they tend to follow what others regard is right or appropriate.

Sty12: My grandparents and everyone in my family want me to become a medical doctor....I don’t think my health is good enough to study science. It takes a lot of energy to work to study well in the science group and I know I can manage to have good results if I study in the SSP.

Interviewer: What are you thinking of doing?
Sty12: Lawyer or chartered accountant.
And
Shh7: I know people all say that it is better to choose science or at least try it first, but you know there are other factors involved when you are deciding things like this. Yeah...not every one can get the best [study science as expected].

Nevertheless, there were students who disregarded their parents’ wishes. They felt they had better reasons to choose the other subject but as a consequence, had to accept more pressure from their parents.

Sty10: She said my geography and history were not very good, why did I want to choose it. But my chemistry and physics are even worse.
Interviewer: So did you disobey your mum’s wish?
Sty10: Well, I was the one who had to fill in the form. She could not do anything about it, but I had to promise her that my scores will not be very bad.

7.1.2.5. Constraints in the education system

One reason for choosing to study science in the first place is that a later change to social science would be easier. It would be a different case to change from social studies to science as it was considered more difficult to “catch up” on missed science classes compared with social studies. This tactic was seen to be a way to optimise best results of the decision, whilst minimising the risk.

Shh7: I know people all say that it is better to choose science or at least try it first...

Even teachers suggested students should initially choose science if they have not made up their minds.

Interviewer: Do you give suggestions to students when they are choosing their study groups?
Teacher 6: Depends. Some students have already decided what they want to choose. For those who don’t know what to choose, I normally will suggest they choose science first and change to social study group if they cannot do it or do not like it.

In addition, most participants seemed to believe that there are more university places for natural science study compared to social study and there is a rapid growth of technology-based industry (see 7.1.2.1 and 7.1.2.2 ).

Shw7: They always say that technology is the best and safest way to have a job in the future.
And

Shh3: Everyone is talking about biotechnology. You see that everything, including food, medicines and even makeup are all produced by biotechnology....
However, some students in social studies did not think that everyone was interested and capable of studying science and there are other job options available.

*Sty 10:* You know, the results from exams will tell you which programme you should choose. Physics is always my headache. I know I will not have good life if I choose science...

And

*Sck9:* It is very competitive if you want to stand out in the science group... social studies is competitive as well if you want to be on the top but it is not as hard as science. And there are good jobs in the social studies, too.

### 7.2. Influence from Peers and Siblings

The opinions and choices of friends influence students at this stage and they would seem to focus more on their peers. Although none of the participants admitted that they have chosen their study groups based on their friend’s decision or opinion solely, many mentioned they had received information or suggestions from their friends, cousins or siblings before they made their decisions.

*Interviewer:* So who else gave you suggestions?

*Sty9:* Brothers and sisters in the family

*Sty11:* Some senior school mates suggested to study science then try all the subjects when taking the exams.

*Sty 9:* That is cheeky.

*Sty11:* Well, that was what they said when I asked them.

Every group of students also mentioned that they knew others who chose their study groups because their friends were going to that study group. Some social study students pointed out that this phenomenon seemed more common with the male students in the science group.

*Interviewer:* So did your classmates have any influence on your decision?

*Sck:* no...

*Interviewer:* Are there people who choose made the decision because his friends are going to one particular group?

*Sck:* yeah, I know one who chose the group which the girl he likes goes to.

### 7.3. Influence from the Media

When students were asked why they thought that there are more vacancies in the university or more opportunities in the job market for those studying science, they always referred to the TV news, newspapers, and the internet as their sources of
information. Media played an important role in the students’ daily lives. It provides all sorts of information not only for the students but also parents and teachers because they all mentioned some news about science related jobs. For example,

Shh7: The news is showing everyday about how well the technology engineers are getting paid.
Shh8: Yeah, they made it look like it is a very hot area and everyone should go in that direction.

And

Parent11: I do feel a bit worried about her entrance exam [for university] because on the news they were always saying about the science industrial park so and so...I don’t know what she can study[ in the future]. It might be difficult to find a job when in the social study group.

The news of high unemployment and stereotypical “good” jobs had an important influence on students’ choice.

Shw5: These days you heard so many news about how difficult it is to find a job and so many people unemployed.
Shw3: A lot of doctors [PhD] running on the street, haha.
Shw5: Yeah, if doctors cannot find jobs easily, it will be even more difficult for people who are only graduates.
And

Shh3: You know these days, jobs that are working for the government are much more a guaranteed job. (A: guaranteed?) Yeah, jobs from which you won’t get sacked easily. You know if you work in the private sector, you always have to worry about been fired when the company’s business is down. Working for the government does not have this problem. It will be a safe job.”

Moreover, their image of scientists has been greatly shaped by the media. All the science students did not want to become scientists, except one student. They thought that scientists are eccentric and work long hours in the lab.

A: why does no one wants to become a scientist?
Sck6: No...
Sck5: Not interested really. I don’t want to be weird.
Sck1: oh well, I know I am not that kind of person who can stay in the labs for a long time. It takes a lot of effort and time to be a successful scientist.

They all stated a preference to become engineers as an occupation, which is one particular option for science group students. Students thought that engineering was related to the concept of “practical experiments” and “hands-on work”, and this were also expressed in their perceptions of science. The reasons for becoming an engineer appears to be related to employment prospects, which may explain why students
choose to do science even if they do not have a high aspiration or very positive attitude towards science.

Interview: why engineers?
Sck5: Because I don’t want to be locked in the lab and there are many demand in the semi-conductor companies.

7.4. Choosing a Study Group, from Parents’ Points of View

Most of the parents stated that they “let” their children decide their study groups. However, they also stated that they had “provided” some opinions, suggestions, experience or analysis to their children.

Parent 7: Well, we let her make her own decision because there is not much point to force her to study the subjects that she does not like. We just provided our opinions and analysed the possibility for the future for her.
And
Parents 13: We told him what we think is the best choice, but that is our suggestion....

From the parents’ point of view, they were there to offer their help and provide their views, but the final decision was their children’s because it was the child’s life and they should be responsible for their own decisions.

Intriguingly, some students and teachers pointed out that a considerable amount of students had their study group decision, made by their parents.

Sck8: I think I am luckier because my parents did not force me to choose the science study group. I know they did want me to choose science group but because I am not very good in science subjects, so they let me choose to do social studies. Unlike other students, they have to listen to their parents to choose science or fight to choose social study group.
Interviewer: Really? Is it still happening nowadays?
Sck 9,11,12: Oh yeah.
Sck 10,13: Of course.

Although neither admitted by the parents, nor the children, it seems that many students were influenced greatly by their parents. The responses from students, parents and teacher, suggest that there was some cultural pressure from the parents to the students and the pressure was only obvious when they were talking about someone else. This might be because more children were given the freedom to make a final decision or they did not want to be seen as people who did not have full control of their lives.
7.4.1. Interest/attitude

According to the parents, their children’s interest in or attitude towards the subjects are important. The terms “interest” and “attitude” were both used by parents frequently referring to the students’ affective response to a subject. For example, parents used “he is more interested” in and “he likes”, to describe a positive inclination to subjects. These two terms had similar meanings and were not differentiated by parents.

Parent 1: ...but I think nowadays parents have changed their views. We do not tell them that if you choose their subject, you will stand a better chance to get a job...I think it is more important for him to do something he likes. He would feel satisfied with his pay if he is interested. So I respect his decision....His problem is he does not know what he is interested in....

From my data, the most important concerns of the parents were the children’s interests and their capability in the subject, as well as the opportunity in getting a place in the university and job market.

However, some parents used their children’s subject performance or exam results as an indication of their children’s interest and attitude because it signified the capability of their children. To the parents, their children’s performance on the exams means the children’s interest and attitudes.

Parent 2: ... His scores on the science subjects were always good. So we think it is natural for him to choose something he is good at and like....well, I think if he does not like it, his score would not be good.

And

Parent 8: Well, we did hope that he can choose science but his scores are not good enough. Sometimes you can’t force or push too much. If he is not good at that, then you have to let him choose another one.

7.4.2. Future prospect/employment

Future prospects were another important issue for all parents. However, because the interviews took place after the decision was made, some parents focused more on the possible development of their children, within the study group they had chosen. They stated that they hoped that their children would find easy, stable and well-paid jobs in the future. Most parents also admitted they gave “suggestions” to their children or just gave their point of view through daily conversation, when discussing future employment.

Interviewer: Why did your mother want you to choose group 3?
Sck 8: She said that the trend of the society is some fields like biotechnology. And
medical doctors are guaranteed a job in the future. They will not starve. In fact, the concern is more based on financial reasons.

Interviewer: You mean making money?
Sck8: yes
And

Parent 16: ...He was more interested in information technology, something related to computers, but then he transferred to social studies. You know it is easier to study social studies, urn, I am not saying it is bad to choose it but if choosing social studies has less competence[against others]...

The high expectation of future employment from the parents can be seen from students’ discussion.

Interviewer: Why did your parents suggested you to choose science?
Szy8: I think it was just because they think that is better for them.
Interviewer: What do you mean?
Szy8s: Because if we have a good job in the future than they will feel they have the face.
Szy9: Yeah, parents are like that.
Szy10: They don’t really care if we like it or not. They just want us to do what they feel is better. It is not fair. Adults are all gold diggers. They just like to compare all the time. Szy9: Yes. They like to compare with each other and even compare whose child is doing better. It is disgusting. Why is it so ugly in adults’ world?
And

Parent8: Of course, other people will always give their opinions. For example, I have a client whose child was told by the school to study for medical schools. The child was them studying in the military medical school. Everything for free and work for the government later. That’s why my wife always think it is better to be a medical doctor, making more money, too.

Parents’ shorter term concerns were related to employment and steady income. The longer term concerns were the wish for their children to be knowledgeable and respected in society. Student’s mention of ‘face’ is interesting as it indicates a concern with social prestige. However, the concerns for the future seemed to be vague and abstract compare to the more immediate entrance exam and job competition.

Most parents thought that it should be easier for science students to find employment. Similar views were held by both parents and students. It is not clear whether it is the parents’ point of view that influences the students or vice versa, but it is clear that parents feel very uneasy about their children not choosing to study science, unless they know that their children cannot achieve good marks in the subject or have a special talent for social studies.
7.4.3. Social norms/trends

Another aspect of parental concern was related to the social trend. Science and technology were thought to be the “trend of the future” and students “should try science if they are able to”. Science is preferred among parents because of the higher possibility of obtaining a better future and other people do it as well. Students were expected to choose science first, unless they had a good reason to take social studies.

Parent 9: Students who choose to do science will find a job easier and quicker and, possibly, paid higher. Therefore, if one wants to get a decent job, then it is better to be a science student to catch up with the future trend.

Another common parental hope or expectation was for their children to become medical doctors. This occupation would seem to be the ultimate goal when encouraging their children to take up science. Generally, the students were, both directly or indirectly, pressured and expected to study science.

Parent 2: His dad has mentioned that if he can manage to study in group 3, medical school is a good choice. However, he told us that he does not want to become a medical doctor even if he is able to.

And

Parent 8: I told my older son my opinion is that being a teacher is better because it is more stable, but his mum wants him to become a medical doctor....

Another benefit for choosing science was that students would have better alternative choices if they could not meet the requirements for medical school at university. Because most of the parents were aware of their children’s academic ability and performance, they understood the limited possibilities of entering medical school because it is extremely competitive. Parents and students would lower their target if the best option could not be achieved. Second choices were mostly electronics, mechanics, biology and biochemistry. They thought that taking up science would provide a higher chance in the job market of Taiwan’s developing technology industry.

Parent 5: My bother has two sons and they were both studying science. They are now working in the electronics industry, both of them. They said that science students are more likely to find a job rather than social study students. And also, you know that in Taiwan, we don’t have a lot natural resources, manufacturing is still the leading industry in Taiwan. And I believe that this won’t change in the next ten, twenty years. So studying in science might be a good choice if you can do it.

Although parents do accept that children might not be interested in or capable of studying well in science, they tend to encourage or pressure their children to initially
take up science. Likewise, students feel that they should attempt science first, if they think this can be accomplished.

Social norms were also reinforced by the tradition of comparison, among parents. Friends’ children or other family members of a similar age would be used for comparison or as role models.

Parent 8: My children’s mother emphasises the scores a lot. If they (the children) do not get good scores, their mum feels ashamed when she compares her children with other people’s children.
And
Sck11: ... They have higher expectation of me and hope I can go to a better school or subject. They sometimes say to me like, ‘Look, if your sister can get to the best school then you should be better because you are a boy’. I am used to it.

Also students who choose to study science are thought to be cleverer.

Parent3: Because in Taiwan...everyone likes the natural science group more. It seems like all the smart students should study science and it seems that the chance to get a job is higher as well.

7.4.4. Value of education

Apart from the concern over job security, there was a fundamental philosophy/perception held by parents towards the value of education. Parents seemed to believe that the more education their children receive, the more knowledgeable their children would become. Hence, they would become a better person and be held in high esteem by others.

Shh3: Parents always think the higher we study the better people we will be.
Interviewer: What do you think?
Shh3: Well, you know there is nothing wrong with studying a lot. You understand more about the way to be a good person.
And
Parent 15: Even if he cannot make a lot of money in the future, it is always good for him to study a lot.

The different choices made by students will lead to different levels of education for an individual. Not only are students expected to choose a good field, for getting a good job but also a good field that has better educational prospects. Therefore, the right study group choice is important because it will optimize the possibility of pursuing higher education.

Parent 8: If he is willing to get more education, we tell him to study harder and harder
otherwise he would be like us…. We hope that if he studies well, he would be able to find a better job in the future. If he does not get a lot education, he will be a labourer like other people.

And

Parent 11: It is hard to say these days. People who have higher education will definitely make more money, but it is always good to study more. At least you will know many things and people will respect you.

As mentioned in 7.1.2.3, students from different backgrounds all had similar pressure from their parents to go to university and get a good job. Parents who were manual workers were more anxious than others about their children’s future and seemed to push their children more. White collar parents assumed that their children should have a higher goal for the future, while blue collar parents urged their children to move upwards, by studying more and working harder. Thus, students from the office workers’ background seemed to have more liberal and understanding parents, compared with the blue collar background, where pressure seemed to be higher (See Table 7-1).

Table 7-1 Differences in support and anticipation among parents.

<table>
<thead>
<tr>
<th>Background</th>
<th>White collar</th>
<th>Blue collar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents Support provided</td>
<td>Work in offices or sales persons.</td>
<td>Manual/skilled workers.</td>
</tr>
<tr>
<td></td>
<td>1, 3, 6, 7, 9, 10, 14, 15</td>
<td>2, 4, 5, 8, 11, 12, 13, 16</td>
</tr>
<tr>
<td></td>
<td>Stated that they would provide as much support as possible. More social resources are provided, such as attending summer camps, meeting people from the white collar level.</td>
<td>Stated that they would provide as much support as possible but they could not help directly with the school work and struggle to provide private tuition.</td>
</tr>
</tbody>
</table>
7.4.5. Gender expectation

Roles depending on gender are an important issue in Chinese culture. From the parents’ point of view there were different gender roles and related family responsibilities. Boys are important to families because they continue the family name and have family responsibilities, while girls, after marriage, become members of their husband’s family.

*Parent 12: If it was not because my husband’s family wanted to have at least one boy, I would not have had more children when I had my daughters...I took a lot of blame when I was pregnant. People pointed at my tummy and laughed at me....My husband’s side all had sons, so the wives’ statuses were so promoted. I was like a little wife....For example, my father is in the nursing home.....there were a few times he ran away from the nursing home because he wanted to go home....My sister-in-law told me that in Taiwanese society parents depend on their sons, not daughters. I did not want to make them feel guilty.*

Because boys have greater family responsibility, they are expected to find secure employment with a steady income, thus, allowing them to support the family in the future; hence, the reason for expecting boys to study science, which presents greater job opportunities.

Gender views towards girls tend to be more relaxed, for example, girls have less pressure for supporting their family and are assumed to be suitable for studying arts and social studies. However, they are encouraged to be financially independent as much as possible. If a female student is capable of studying science and willing to choose the science group, she will be greatly encouraged and praised by her parents.

*Parent 7: You know she is a girl, as long as she has a stable job, finds a good husband. That will be a good life for her.*

And
Parent12: For girls we only hope that she can find a good job in the future, have her own income, find someone she likes, marry the right person, if she is lucky.

For those students who chose social studies, the parents of male students seemed to worry about their children’s future more than parents of female students. A parent of a social study student revealed her concerns about her son’s decision in taking up the social studies programme:

Parent 8: I am a little bit worried about him studying social study. I don’t know if he will find a job in the future when he finishes his school. What do you think, teacher? I told him to study in science but he did not want to. I let him do what he wants any way. He has to be responsible for his own future. We cannot do many things about it. All we can do is to provide as much help as they need for study, such as support them to go to cram schools for extra classes, but he only goes to the Maths and English classes.

7.4.6. Summary of parents’ views

Although parents claimed that they did not interfere with their children’s decisions, they seemed to be more influential than they believed. It seems that they left the final decision to their children and respected their choice, but most of the parents did provide their views and tried to influence their children’s decision if this was different from their own expectation. Some parents also stated that they did not want to be responsible for their children’s future, especially if their child disliked the subject or future related job, when they might be blamed later. However, it seemed that parents still used different techniques, to guide their children, thus, children might follow their wishes subconsciously.

The influence of traditional gender roles on students’ perceptions science and subject choice were similar to some previous studies elsewhere that identified gender as an important factor in attitudes, perceptions and subject choice. (Garratt, 1986; Hendley et al, 1995; Hendley et al, 1996; Lightbody, 1996a; Whitehead, 1996; Giles, 2002; Wallace and Louden, 2002; Osborne et al, 2003; Banya, 2004; Miller et al, 2006). The findings in this research also show the pressure from stereotype gender roles that students received from the outside world. On the other hand this pressure may be less for girls, since the more relaxed social expectations for girls seemed to enable them to choose their subject more freely than boys, although female students who did choose to study science are highly regarded.

All parents valued education highly, and had high expectations for their children.
They all seemed to provide as much support as they could, including personal support and financial support, which included private tutoring. A major finding in the research was that children from the manual workers’ background seemed to receive a higher pressure in obtaining a better university and job in the future compare with those from office workers’ background.

7.5. Choosing Study Groups from Teachers’ Points of View

Nine teachers, comprising one moral and citizenship education teacher and eight science teachers, participated in the in-depth interviews. Most teachers claimed they had limited influence on the students’ decisions because the students were old enough to make their own decisions. They felt that most influence came from parents, a view that contradicted those of students and parents.

Teacher 1: Actually it is because of the parents! I had a student; I kept telling him that his personality and the way he thought were more suitable for social studies and I told him not to waste his time on physics and chemistry. However, his parents did not agree with that.

However, most teachers said they still gave advice to students if they requested it. They had frequent interactions with students and understood the students’ academic performance. Hence, they felt they could tailor their advice to each specific student. Teachers thought the final decision should be the students’ personal responsibility because each student should take into account interest, ability, family expectation and future development. Nevertheless, teachers’ opinions still seem to have a great influence on students’ decisions, both consciously and subconsciously through daily interactions.

Teacher 2: Although most of the students already know what they want to study or their parents have something in mind, if they really come to ask me I still give my advice... If he does not show much different interest in both study groups or he does not have much interest in both sides, I suggest to him to study science. This is because in Taiwan if you study science, you still have to study history and geography.

And

Interviewer: Do you give suggestions to students when they are choosing their study groups?
Teacher 7: Yes, but it depends on the individual. Some students have already decided what they want to choose. For those who don’t know what to choose, I normally will suggest to them to choose science first and change to social study group if they cannot do it or do not like it.
It was interesting that all the teachers stated that they tried to encourage students to choose the study group which came closer to their own interests but left the final decision to them. They stressed, they did not want to take responsibility for making the decision for the students. Teachers generally thought that parents mainly influenced decisions or plans, and so they felt that their suggestions were not crucial to the students’ choice of study group. However, some teachers seemed to have a greater influence, if they were close to the student or family.

*Parent 7:* ...*Her homeroom teacher in the first year cared about her a lot. She also said that her personality is very suitable to study in the social studies group.*

*Sck1:* *My parents always discuss their views of education and the social trend with our neighbour because he is a teacher....He had taught many students and my parents quite respect him because he has more experience.*

There were certain concerns that teachers took into account when advising students on their choice of subject.

### 7.5.1. Interest and ability

All participating teachers claimed that they normally encouraged students first and foremost to think about their own interest when choosing their study group because it was “painful” if students had to study something they did not enjoy.

*Teacher 5:* *I told them that if you have a strong interest in science, choose science; if roughly equally interested in both sides, choose science; if your Chinese, English and maths is ok and you are not good in science subjects, then social studies because it would be painful if he studies science. For those who do not have a particular interest in both groups, choosing science will offer more opportunity to go to a university.*

Teacher 1 used her own experience to illustrate the discomfort and hardship, due to lack of interest, when choosing the wrong group. She stressed she was told to become a medical doctor when she was young, but realized she was not interested in biology in the first year at university. However, her father stopped her from changing her subject to social studies and she always felt unhappy with the choice and blamed her father.

*Teacher 1:* *...because my father is a Chinese teacher. I wanted to change to Chinese major but my father stopped me.*

*Interviewer:* *Why?*

*Teach 1:* *Because he said it is hard work having to read and mark compositions. You know the last generation of Chinese teachers had to work very hard because there were a lot of compositions to mark....He said that why work so hard if you are a*
teacher? ...now I always go back and tell my father it was because of him I have to teach so hard and get so tired.

Although her experience is from a generation earlier, the students’ comments illustrate that it remains much the same today. Parents’ views might significantly influence their children’s decisions, and the conformity of children to their parent’s wishes.

7.5.2. Future prospects

Seven out of nine teachers expressed openly that they normally encouraged their students to choose the natural science group, if they thought the student was capable, because science students have more employment opportunities.

Teacher2: hum...I think generally in Taiwan, it is easier for science students [to find a job]. It is natural people go for the choice that provides more opportunity.

Teacher 7: Of course it is easier to get a job if you study science. Well, take myself for example. Although I did not finish my PhD, I got a teaching job easily and that’s why I gave up. But I could have gone into the academia or industry. Not so many opportunities if you study social studies.

Teacher8: I think technology is still going to be the trend in the future. All our current economic policies are so pro-high tech. Our education and schools are the same. That’s why I took students to the Olympiad competition.

Intriguingly, not only did science teachers encourage students to choose science but also the moral and citizenship teacher. He expressed his point of view when advising students on their choice of subject.

Teacher 5: Choose the natural science group! That’s the only suggestion I normally give to students. It is much easier to find a job with a science degree. They will not starve if they have a science degree. Sorry that I have been utilitarianism and realistic, but that is the reality and the trend.....there are so many universities now in Taiwan, students can easily get in one no matter how badly they do in science.

7.5.3. Parental expectation

As mentioned at the beginning of this section 7.5, the teachers pointed out that they believed many parents made the decision for their children’s study group, not the students themselves.

They also mentioned that because of the change of many vocational schools to comprehensive schools, many students who might not have a chance to study academic science now have a choice to choose the NSP. Since many people perceive science as a better choice, parents would suggest their children to choose science first.
Teacher 3: .... To be honest, there are people who do not like to study science but because of their parents... Any way. On the other hand, the existence of comprehensive high schools is another choice for them because they could only go to the vocational school route before. So, it is an opportunity.
Teacher 4: And eventually parents still force their children to choose the science group.

Teachers thought most students chose their study group based on their parents’ expectations or that they were influenced by their parents’ opinions.
Teacher 2: Although most of the students already know what they want to study or their parents have something in mind..

Teacher 8: In fact some students do think about their interest but parents will try to influence their decision by telling what is better for their future, easier to find a job, etc. This is the reality. We teachers also have to analyse for them in that direction... and the problem is students normally do not understand their own interest, so they are more likely to listen to others or change later.

7.5.4. Tradition/Social norms

The traditional teaching and social norms also have a strong influence on the teacher. The teachers thought that the choice for study group is much defaulted into science and students are channelled or led to choose science as the first preference.
Teacher 1: People from the south always think that if your scores are high you should study to become a medical doctor... so I chose group 3 and I did feel that biology is interesting. Just I did not like the animal experiments...

A teacher also made an interesting comment about why many students and parents choose science in the first place. He commented that the Chinese tradition measures one’s success on the social status and material reward level one can achieve, therefore students’ and parents’ choices are aimed to have easier access to reaching the norms.
Teacher 6: In the Chinese tradition, one’s goal in life is to be successful. And that tradition is judged by exams. Even after Chiang Kai-Shek’s government moved to Taiwan, they used Chinese traditions to teacher the general public. It will take 20-30 years to change people’s perception.... Chinese people care about whether you have money or not, western people do not care about this. As long as it is a job that makes good money, it is a good job.

Culture, tradition and social trends seem to be the main factors influencing students’ choice. They appear to be linked together and students are embedded in this strong environment/background, which directs them along a certain path.

7.5.5. Gender role

No teacher particularly expressed any personal gender bias or distinction when they
gave advice to students. However, some teachers stated that “traditionally” girls are thought to be more suitable for social studies and boys are pressured to take up science.

Teacher 4: There are always more girls in the social studies group, but recently there is an increase of science students from both genders. Even girls’ schools are increasing their physics and chemistry teachers because they have more people taking up science now.

Teacher 1: I think the Taiwanese society still thinks that social studies are more suitable for girls. This is a kind of characteristics of the ethnicity and also the culture of the country will affect their judgments of values.

7.5.6. Peer pressure and personal relationships.

According to the teachers, peer pressure seems to be linked with gender role, and it occurs mainly for boys. Hence, boys tend to feel more pressure from their peers than girls to take up science.

Teacher 2: I think it is more obvious for boys. Even if he does not like science, because everyone chooses science, he will still follow others.

Teacher 9: When there are two choices, students will wonder why did my friends all choose science? I want to choose science as well...students do talk to each other and more or less they will influence or pull their friends together.

Some teachers also commented that students’ personal relationship with their friends or other sex might be one of the reasons why students choose their study group.

Teacher 7: Yeah there are always people who might choose their study group irrationally, for example, someone they like or their gang choose a study group, they will choose the same one deliberately. Not many but there are.

Teacher 4: Students at this age have a lot of things to do with boys and girls. And sometimes it is a reason why they choose the study group.

7.5.7. Media

Teachers claimed that the media seems to greatly influence students’ choice. However, teachers themselves also seemed to be influenced by the media which provide job information and university vacancy data, although the latter should really be provided from within the education system.

Teacher 7: Chinese culture is just after fame and money and our society and media are all educating our students that...everyday the newspaper talks about the rich people or who made a lot of money. You can’t find anything that tells about a good and decent story or person.

Teacher 2: Taiwanese students do not know why they have to choose a study group and
what can they do with different study groups, which also means they do not know what they can do if they study in different subjects. Generally they get the information about the science industrial parks. So they immediately relate science with jobs in the science parks when they think of the future. This has something to do with the media.

7.5.8. Constraints in the educational system and opportunity to university.

Constraints in the education and exam system was another important factor that teachers took into account.

Teacher 5: You can always study hard to catch up if you miss out classes in the SSP, but it is not possible to study science subjects by yourself if you miss the classes.

Teacher 4: There are a lot of people who really should not study science because they just cannot. But because the required scores for some science subject in the universities are so low, many of the rubbish students just choose NSP for getting a place in the university first.

Teacher 3: That has something to do with the examinations. ...business and economics schools only need results of Chinese, English and Maths. So girls in the social studies group protested because their maths is weaker compared to those in the science group...students can lose 30-40 points easily in maths...

This demonstrates the educational and exam system seem to create different disadvantages in different groups because of the limited subjects required. And because there are only two choices of study groups students have to assess their competence in each subject required by the study group. The degree of competition is extremely high between the students within each group. Students’ place at university depends on the total score of all subjects in the study group. They seemed to believe that they would have more choices and better competence than other students in the NSP, especially they could take advantage of their counterparts, the SSP students who studied easier Mathematics, by taking the SSP exam with those chose only chose SSP. This superiority effect of doing science seemed to attract a lot of students to choose science as a strategic technique to win in the competition of entering university. Such a phenomenon was also reported by Li, 2002a and Li, 2002b.

7.6. Summary of Students’ Concerns and Influences in Deciding Their Study Groups

7.6.1. Concerns in the process of decision making

In summary, the choice of study group is a critical point for many students. The
decision made at this point is likely to be a decision for life, and affects future employment and income. Concerns given were complicated, with influences on the students from various actors.

A mind map based on the participants’ views, illustrates the complexity of the decision making process (See Figure 7-1). Only a few students had a strong preference in the subjects and understood clearly their own interest and ability. Most of the students did not have a strong preference in either subjects, and took different concerns into account when making their decisions.
Figure 7-1 Concerns in students’ decision making
However, sometimes there were contradictions between answers; for example some students stated that money was not very important, but, their future goal might be a job that pays a good salary. Such contradictions occurred throughout many of the interviews. The study reveals the stated opinions of the interviewees, and thus, presents the complexity of real life and nature of people’s thinking, as suggested by Miles and Huberman (1994:10) as the most important feature of qualitative data:

*What is important about well-collected qualitative data? One major feature is that they focus on naturally occurring, ordinary events in natural settings, so that we have a strong handle on what "real life" is like*

There were similar concerns that each group of participants took into account when making the decision. These concerns included students’ interest/attitude, future prospects, social trends/norms, and gender roles. However, concerns varied with each individual. Parents tend to look at the broader picture, while students and teachers tend to include more short term goals and also identify constraints along the path of study.

Figure 7-2. The relationship of individuals and the wider society

From the individual student’s point of view, the concerns seemed broader and more complicated, compared to the influencing actors. All factors required consideration. These normally start from their attitudes/interest, which is closely related to their cognitive system, then gradually include and relate their concerns to the wider world
(see Figure 7-2). These concerns may be consciously or subconsciously weighed, so the priorities are set for the process of decision-making. The different emphasis and priorities of each individual may result in a different decision. For example, some students thought that future prospects were more important than their parents’ opinion but some weighted parents’ opinion more. Therefore, the strength of influence between individuals and the actors may not be the same.

7.6.2. Source of Influences

Figure 7-3. A 3-D structure of the influences surrounding individuals

Influences from other surrounding actors were crucial to students. Based on the relationship of an individual (section 7.6.1) and the disposition of an individual in making a choice (Careeship, Hodkinson and Sparkes, 1997), a concise figure of relationships between individuals and the surrounding actors (people) is shown in Figure 7-3. Although all the students and parents claimed that students were the ones that make their decision, some students stated that they have received advice from their peers/family members and also the media has provided information to affect their decisions. Furthermore, the concerns among students, parents’ and teachers were
similar. These suggest that students’ decisions were directly or indirectly influenced by different actors surrounding them or that the perceptions of all three groups were embedded in the same set of social, economic and cultural structures. In other words, they all influence each other, or that they are all influenced by the same structural forces. So although students made the final decision, this outcome may be regarded as the result of numerous consciously and subconsciously weighted decisions.

The sources of influence are categorised into four groups in this analysis: parents, other family members and peers, teachers and media. All seemed to have direct and indirect influences on students, and could also influence each other. For example, parents stated that they received information from the school and some also had experience from their other children. The distance between every actor and self illustrates the strength of the bonds between them. However, some of the bonds in this analysis may not be strongly related, for example the influence from the individual to the parents and teachers did not seem to be as strong as the influence from the surrounding actors to the individual. Nevertheless, every individual and actor, does not exist alone in society, each small unit can be extended and expanded to a larger scale in the real world. Thus, the macro structure can be stretched in different dimensions, and may contain many micro molecules to show the complex links, which constitutes the wider society. The extended 3-D structure of many micro tetrahedron structures, coincide with the structure of diamond in the science world, which can be used to illustrate the complex relationships of individuals and others in the decision making process in the real world (see
Figure 7-4). The atoms represent each individual in society and the bonds that link to different individuals form a complicated network in one’s everyday life. However, the structure/relationships of each molecule would be far more complicated and numerous in real life.
However, because the views presented in this chapter are cross-group analysis which based on different groups of participants, the influences between the individuals and different actors sometimes do not seem to be strongly linked between the individual. Examples are: 1) Both students and parent said that students were the independent body who made their own decision but the teachers pointed out that parents generally made the decision or students were strongly influenced by their parents’ opinions. 2) Students also said other students were influenced by their parents, but not to themselves. 3) Teachers claimed they had limited influence on the students’ decision, but they admitted giving suggestions and some parents said that teachers have influence on their children’s decision.

The following two chapters are two case studies that might give a full and clear picture of the scene set on an individual. They take a different perspective to present an insight of the students’ concerns in decision-making rather than conclusions from different groups of interviewees. The influences they have received from other actors and concerns they take into account are from a narrative point of view, of which can illustrate the environment they are in and the relationships between an individual and the wider society.
CHAPTER 8. INFLUENCES AND CONCERNS OF A MALE SOCIAL STUDY STUDENT ON HIS DECISION-MAKING

The purpose of this chapter is to illustrate the influences and the relationships between one male student and his surrounding people on his decision making. As this research explores influences on students’ decision making, the surrounding people might be as important as the individual’s personal opinion. A whole illustrative personal story can present a more bounded system from a student’s own view.

With this personal story, influences that connect and weave between different actors can be seen more clearly than just from each group of interviewees. It also illustrates the difficult and complex situation that individuals face in reality, thus, providing an insight into the deeper conscious and subconscious influences, that individuals receive from the outside world.

This chapter presents the results of in-depth interviews with Shaun, his mother and classmates and his science teachers in his first year of senior high school.

Initials appear in this chapter:
A is the interviewer
S is the interviewee Shaun [pseudonym]
SM is Shaun’s Mother
Young was Shaun’s former Biology teacher
Cheng was Shaun’s former Chemistry teacher

8.1. Contextualisation of Shaun’s Background

Shaun was a student of school 1 in Taipei. All school-leavers from this school go to university.

As required for entry into school 1, Shaun’s academic performance was very good. Shaun was top student in the social study group. He was very active in many
academic and afterschool clubs. Both of Shaun’s parents were senior officers of private companies, and both financially secure. Shaun’s mother was closer to the children and took charge of their education. Shaun’s sister is two years older than him. She chose to study science in a top ranked university at the time Shaun participated in this research.

8.2. Concerns that “Self” Takes into Account

8.2.1. Internal factors relate to attitudes and values

8.2.1.1. Personal interest
Shaun wanted to be a medical doctor when he was in junior high school because he likes to have contact with people.

S: Actually, I always wanted to be a medical doctor when I was in the junior high school, but when I went to high school I started to think about what I want to do. I wanted to be a medical doctor because I can interact with people; I like to be with people.

However, the competition to become a medical doctor is great and it was not easy to stand out from other people in the natural science group.

S:.. You know you have to study really hard to squeeze yourself in the tiny narrow gate of medical school, it is not that easy as you think.

He found that he was not interested in taking the required Chemistry and Physics subjects because these science subjects were “cold and rigid” and they would not provide good interaction with people...

8.2.1.2. Learning experience of both study fields
Shaun discovered that he enjoyed writing. He felt that writing inspired him to explore people’s feelings and their inner worlds. His work was published in school magazines. Because he believed he could not support himself in future through his writing, he wrote only as a hobby.

S: Well, I quite like writing and have written quite a lot of stuff for the school magazine. Hey, I don’t mean that I am going to become a professional writer. I just mean that I think I have found myself more in this side.
8.2.1.3. Reinforcement of the choice

Realizing that he was not interested in science subjects and because of his enjoyment in writing, Shaun started to consider changing his choice before the decision time. Similar experiences of other students reaffirmed his decision to choose social studies.

S: *Everyone thinks that it is more difficult to study in group 2 and 3 so and so but so many of them want to change to the group 1 so much...*
A: *Why?*
S: *Because they just can’t continue. [Too difficult for them to continue.]*

He felt that he was making the right decision, even though he did not receive much support from his family.

8.2.1.4. Gender role and family responsibility

Shaun was under great pressure from his parents, as he was the only boy in the family.

S: *Of course my mum always says that I am the only boy in our family, I should do this or that, or I should be this or that. Well, I just let her talk.*

Shaun’s sister was studying in another well-reputed top ranking girl’s high school. She has just been accepted by a very good university to start in the next academic year. Shaun is constantly being compared with his sister by his parents, and they keep reminding him that he should do better than his sister.

S: *They have a higher expectation of me and hope I can go to a better school or subject. They sometimes say to me like, ”Look, if your sister can go to such a good school then you should be better than that because you are a boy”. I am used to it.*

He felt he was required to bear more responsibility for his family, and felt it was unfair to be solely responsible. This shows the traditional gender role and responsibility of boys in the Taiwanese family.

S: *Yes I do! [Have the pressure of being responsible for parents], but I think everyone should have the responsibility, not only the boys have the responsibility. Girls should be responsible as well... This is OUR family, we should all be responsible.*

8.2.1.5. Value of education

Shaun values education highly. His view is that good qualifications do not automatically lead to a better lifestyle but improve the likelihood of having a better and easier life. Having a high degree (a master’s or PhD) does not mean a definite
success to Shaun, but having no education stands no chance of having life security. However, Shaun also accepted that life has unpredictability in the reality. The high value of education was geared up for the future prospective and also pushed Shaun to work harder and persistently.

S: Hum… I think the chance to have an easier life is bigger [if studying more], but nothing can be guaranteed. Yeah, some people just like to have a steady job. Some people still might have a crisis in their career at some point. Life is not that predictable.

8.2.2. External factors

8.2.2.1. Access to university

Although Shaun’s decision to study social studies was based on his interest in working with people, he mentioned other factors, such as access to university.

S: …it might look like that there are many places in some science departments in some universities but actually those schools are not so good. Many of the departments and schools are the least-favoured choice for people. If you look at the top choices in both of the groups, you will find out that there isn’t much difference in both, except there seems to be more choices for science students if their performance is in the bottom among other students. There are just a lot of schools and vacancies for science students. And of course, it depends on where you set your goal.

Shaun’s concern was not emphasising the possibility of going to “a” university. He wanted to go to a “good” university with the aim of entering law or business school, which were considered top choices. Shaun thought that many people chose to study science because they were not competitive, and this was the easiest route to finding a job.

Another reason for Shaun choosing social study group was that the exam system placed emphasis on Mathematics as one of the three main subjects. Shaun is likely to do well in the class, as he has previously had good scores in this subject.

Having good marks in Mathematics would also help him apply to the finance or economics departments, at university.

S: However, I was thinking that rather than coming back to SSP in the end, why not just choose group 1 [SSP] and do it well? I might get into finance and economics departments in the university because my maths is quite good. Some schools only look at our grades in Chinese, English, and Maths. They do not really care about history and geography. In fact, I am not very sure that if I am interested in doing some humanity subjects. I think my knowledge in this area is inadequate.”
He also pointed out that many people chose to study science because they thought that they could also try to take both the science and social studies entrance examinations, thus, giving providing more opportunities for a better outcome. However, Shaun thought that he stood the best chance with social studies.

Shaun’s mother also mentioned the way Shaun analysed his thoughts, during the decision making process. Shaun felt that he had a remote possibility of gaining entry to the best medical school, and would need to study hard during high school if he wanted to become a medical doctor. It is extremely competitive studying in group 3 because the goal of most students in this group is to become a medical doctor. Shaun realised that he would be competing with all the top students if he chose this study group 3. It would be completely different, if he were to study in a social study group. He might overtake other people, with his good Mathematics grades.

SM: He said that the chance to become a medical doctor is very slim. He knows himself well. ....He might not go to the best medical school that he wants and might end up going to a low rank medical school. He might feel bad about it. So he has evaluated the situation already. For group 2 (engineering), he has his reverse philosophy. He thinks that everyone in Taiwan is rushing into electronics and there will be a lot of needs for humanity types of jobs. No one cares about this now, so this is a good opportunity. He talked a lot about what he thinks about this and then came up with the conclusion of choosing social studies. I said, “Ok. Do what you want.” He did think about if carefully.

8.2.2.2. Access to jobs

Shaun’s concerns about choosing social studies are also based on the job market.

S: Some people know what they are going to do in the future, which is why they choose to study in SSP. It was not only for work, but also not purely for personal interest.

Although Shaun claimed that he did not have a clear idea about his future employment, he had already made up his mind but did not want to sound too ambitious in case he does not achieve what he wanted. His actual goal appeared to be clearer after a series of long indirect questions and answers.

S: Social workers or volunteers are only for those very rich people’s wives or people who want to become academic....Ok, I know what you mean. For example, if I study in business, of course I would not want to be a psychological counsellor. Do you understand me?
A: So you want to study business?
S: yeah.
Shaun was only in the second year of high school but he seemed to have drawn a map for his future. He wanted to become a businessman and had even done some calculations on the risk management of bankruptcy. His strategy in minimising the risk of financial problems was to increase personal ability and knowledge while he was still a student. So he was highly motivated in studying, and enthusiastic about extracurricular activities.

S: This is something to do with personal ability. Sometimes you have to rely on yourself. Improve your own ability. Yeah, there are always risks, but as long as you try to improve your own ability, the risk will be minimized. Yeah.

And

S: Of course if I want to start a business by myself, I would compare the risk and profit of having my own business and working for other people, then decide which way is the best way for me after combining all these evaluations together.

It appeared that Shaun’s ultimate goal was to find a job that paid lots of money. Care other people’s welfare comes when one is very rich. However he did not want to point out money directly.

8.2.2.3. Access to material goods
There was also a minimum monetary security Shaun initially wanted to achieve. He wanted to have “at least” a financial stability in the future. Although his ultimate goal was to become rich, he was also mindful with every step he took and thought thoroughly before he made any important decision.

S: I want my life to be at least a stable life. At least I don’t have to worry about my daily life because.....well, of course, I don’t have to worry about this if my parents spare me with a lot of money. I can do whatever I like at any time or I can even be a social worker! But I think that some things you have to strive and fight for by yourself, such as money. Do not depend completely on the inheritance from your parents.

Although Shaun’s family’s financial situation was good in the middle class level, he still considered that life stability is prior to aiming for difficult and high pay jobs. However, because Shaun had a good performance at school, he felt that he could achieve better than “just enough to get by”. He commented that the baseline for his goal was to have minimum security, but he also knew that his ability was far above the baseline.
Shaun thought that businessmen make more money than other jobs and money will also bring fame/social status. However, for Shaun, the concern of making money weighs more than high social status.

S: Yeah, one[reason] is the response to social classes, the other one[reason] is if you tell people how much money you can make every month, people will have a very different view about you.

8.2.2.4. Access to social status

Shaun however, revealed one main concern during the long conversation. He was in fact ambitious and wanted to do something in the future which had a higher social status. Business and law within the social studies group is believed to lead to a higher status.

S:... I think it has something to do with ambition. (laugh) yeah. (A: like what?) it’s... it’s…I mean…hum…. It’s different value. Hum...how can I say it?....it’s the problem of what you want for your life …if I choose to be a social worker then I can only……. Oh well, it depends….

Shaun had pictured the hierarchical structure of social status with some types of job and had positioned himself in the higher status level of the structure. Lower status jobs were not considered. For example, teachers and medical doctors are at the top of the social status structure; social workers and manual workers are at the bottom.

S: However, if you doing it as a career, then people think social worker’s social status is lower than a normal salesman. The general public always feel the social workers are….sort of housewife jobs.

A: So do you think the social status of social workers or people with similar jobs are lower than salesmen?”

S: Hum….it appears to be like that in this society….

And

S: I’d rather become a teacher than a police officer, although they both have very stable income. You get better respect of being a teacher, although you will not be paid a lot.

That is why the Police University and military universities, options of other students for secure jobs, were never on Shaun’s list of choice. When the levels of life and material security are similar, the higher social status would be taken into account seriously.

S: Sometimes you have to add reputation in. That means people might see you as a respect-worthy person by your job. If you are a medical doctor, then everyone will
think that you deserve respect. So are teachers. They also have high social status. People still respect teachers...well, much less now. If you are a civil servant, politician, or something like that, you can also possess with this reputation. He stated that the social status of businessmen varies according to the size of the business or reputation of the company. Normal business people do not have a high social status, only those working for large enterprises will have fame, as well as social status.

8.2.2.5. Structural constraints

Although Shaun’s school allowed students to change to another study group once they had started the programme, only a very limited number of science students could transfer to the social study group. No students changed their study group from social studies to science, once they had missed some classes. Therefore students had to think very carefully about their choice because of the difficulties of changing, after classes have started. In Shaun’s school, students who wanted to change to the social study group were required to take examinations in the summer to compete for the limited vacancies. When the social study group classes are full, the school is unwilling to create more classes. Therefore students unable to change must persevere with their original choice until the end of high school.

S: A lot of them transferred to the social study group all the time. The situation lasted for the whole year. Almost all the places in the social study group are filled up and the school has to close the entry now.

Shaun also pointed out that many science students chose to study science because they were “speculative”. They want to have more choices and have a higher possibility of going to university, regardless of their ability and competition in the science group.

S: They think that they would have more choice and a higher chance of going to university if they chose to do science; even if they cannot manage to continue to study science later, they could still transfer to the social study group later.

He disagreed with these students because he considered it better to focus on how to stand out in the group. He felt that those students trying all possibilities “diverted” and “wasted” their effort, through unnecessary exploration.
8.3. Influence from Parents

Shaun’s mother is a senior staff member of a stock trading company. She is more involved with the children’s life and education because Shaun’s father works long hours. She changed her job 10 years ago from a shop manager of a supermarket chain to that of a stock trader, as she wanted to spend more time with the children, help with homework and prepare their food. Shaun’s father is an engineer of an equipment company for which he worked in China for 5 years, before changing to a Taiwanese company, one year ago. He is now living with the family. Although he did not spend so much time with the children, Shaun described his father as “a great man who respects our decisions”.

Shaun’s mother was interviewed because she is closer to the children. She described Shaun as a very independent child who always has his own opinion. She did not want Shaun to choose business or social studies but Shaun wanted to choose the social studies group because he liked reading newspapers and magazines, and discussing his opinions with friends and family members.

8.3.1. Perception/value/role of education

8.3.1.1. High value of education

Shaun’s parents regard education as important for their children. They encouraged their children to focus on their education, and sent them to Canada every year to experience a different education system. His mother turned down his request to start a hobby.

*SM:*...He said, “Mum, give me some money. I want to learn singing.” I told him, “Finish your University entrance examination first.” You know kids are like this. They always want to do something so much in the beginning but cool down very soon.

Shaun also described how he thinks his parents’ view on education, of which coincide with Shaun’s high value of education and usefulness in the job market.

*S:* In general, they say that the more books we read, the more knowledge we will have. Then we will feel easier when we start working.

8.3.1.2. Impact of political and economic change in Taiwan
Shaun’s parents had great concerns regarding the political uncertainty, and economic change in Taiwan because Shaun’s father was working in China. They feel that the competition from China is growing rapidly. In Taiwan, the future job market for the next generation has been shrinking and the only way they can make their children more competitive has been to encourage them to study hard.

SM: Tell you what, the politics has led us to nowhere. There are fewer and fewer vacancies in the job market. Taiwan is no longer competitive now. It is true, I am not kidding you. Every time my friends come back from China they say that Taiwan is finished.

Sending the children to Canada in summer was expected to help them develop a global and international point of view, rather than focus on events in Taiwan. She also thought that maybe Shaun should study abroad, after finishing at university in Taiwan.

SM: It does not mean that we worship foreign things, but to have some international views. Taiwan is really small. You don’t know what the world really is if you don’t go out to have a look.

8.3.2. Stability and social status

Two primary concerns, though not a problem for Shaun, were the stability of life and employment in particular. This perceptions of life stability might be influenced by his parents.

Shaun’s parents were hoping Shaun would choose natural science because they hoped he would become a medical doctor. There are several reasons Shaun’s mother thinks this. Firstly, she understands that Shaun likes to work with people. He likes to talk with people all the time.

SM: When he decided to take group 1, I was a little bit disappointed. So I asked him why. He said that he found himself like to be with people, he likes to talk and like to be the leader. He does not like machines. So he is not suitable to become a doctor.

Secondly, Shaun’s academic performance was outstanding at school and she thought that most of the Taiwanese children who do well in school choose to do natural science.

SM: Yes, because in Taiwan...everyone likes the natural science group more. It seems like all the smart students should study science and it seems that the chance to get a job is higher as well. Thirdly, being a medical doctor means having a guaranteed income and security.
Shaun pointed out that “many parents”, in fact, want their children to choose the natural science group because they want their children to become medical doctors. Shaun noted that all parents want their children to become a medical doctor because it is a stable job. Doctors normally have their particular occupation decided when they finish their study. They normally keep their jobs for a long time or even for their whole career.

A: Why do you think many parents want their children to study in group3?
S: Hum...I think they are thinking more practically about future. Mainly about better pay and higher social status. And.....not so easy to be unemployed.
A: What do you think then?
S: I think it makes sense....

However, choosing a different study group from his parents’ expectation has not been a great difficulty in Shaun’s case because his parents were not worried about Shaun’s capabilities to find a stable job; instead, they want Shaun to find something better than just ‘stable’. This is one reason why Shaun felt much pressure from his parents’ expectations.

8.3.3. Gender role
Shaun’s view on gender roles and responsibilities was similar to his parents. Although respecting their children’s decision, his parents still seemed to hold conservative and traditional views towards Shauns role as a boy and a son. Shaun’s mother thought that Shaun should be as good as his sister, if not better. She thought that boys should choose science because science jobs are for males and social study work is for girls.

SM: This is like people say “Boys do not want to choose the wrong career, girls do not want marry the wrong guys”...I know he is still a kid and has a lot of time to explore life but it is more important for boys...

And

S: She always says things like, “you are a boy why did you choose to study in social study group?
And

Shaun was also expected to be more independent and have a part time job at
university. However, Shaun’s older sister was not expected to work while studying at university.

SM: I think when Shaun goes to the university; I will start to let him have some part-time jobs. Let him earn his allowance and become independent. I told him that he had better not to fail his exam or he will have to make his own way.”

8.3.4. Image of science students

According to Shaun’s mother, the general public view people working in science fields as clever. Therefore, her high expectations for Shaun, determined that Shaun should study science.

SM: Because in Taiwan...everyone likes natural science group more. It seems like all the smart students should study science and it seems that the chance to get a job is higher as well.

8.3.5. Access to university

Shaun’s mother still thought that choosing to study science was probably a more secure route to a good university.

S: What she is saying is that if you study in group 2 or 3, as long as your grade in maths is good, I will still have the privilege [of going to a good university].”

Because of the study group system and Shaun’s good results in Mathematics, his mother thought that he should first choose natural science because by taking both university entrance examinations, he would have a choice.

S: You can still take the exams for group 1 students later and have a good result if your other grades in the natural science group are not good. She [my mum] heard that many of her friends’ children who studied in group 2, 3 always had very bad scores like 60 for maths but still had very high scores or beyond the upper average level when they took the exams for group 1. Some things like that.

Additionally, taking social studies is an irreversible, one directional route. Science students may try science first and then transfer to social studies.

S: They thought that hum...because according to our system, you are able to take exams for group 2 and group 1 even if you are studying in group 3 but it is not possible to do it the other way around.

Shaun’s parents’ views, were to take the difficult science option first, and believed in Shaun’s capabilities. They thought that even if Shaun was not the top student in the
natural science group, other choices would be open to him, in engineering or social study subjects without enrolling in the programme.

S: Parents certainly think that if you study in group 3, you will always have some backup choices if you do not do well in group 3. The choice in group 1 is quite limited.

8.3.6. Parental experience

8.3.6.1. Parent’s occupation background
Shaun’s father was a graduate engineer and his mother studied in business. Their experience in education is also the ground of their suggestion to Shaun.

SM: My husband is an engineer as well. We all hope that he will study science. And I do not what him to study business because I studied business when I was a student.

8.3.6.2. Other child
Because of Shaun’s older sister, the subject choice decision making process had been experienced previously. After experiencing the education system with their eldest child, Shaun’s parents feel less apprehension for him and his younger sister. Shaun’s mother described this experience as “Raise the first child according to what the books say, raise the second one like raising a piggy, and raise the third one as you please”.

Although Shaun felt threatened, having constant comparisons made between his sister and himself, he felt fortunate because his parents would have probably interfered with his decision, if he had been first child.

8.3.6.3. Relatives
Shaun’s mother also thought that Shaun should study science because her family members who studied science all attained good, respectable jobs. She is expecting Shaun to be like them or even better.

SM: All my brother’s children studied engineering. One of them studied in Chung-Hsing University. My brother got a master’s degree in nuclear engineering in Ching-Hwa University. He is over fifty now.

8.3.7. Freedom to make decisions

8.3.7.1. Respect of children’s choice
Shaun’s mother stated that they have respected Shaun’s right to make his own decision.

SM: Yeah, he decides his own affairs but we tried to listen to his reasons. I think decision-making is very important in people’s life. People have the right to decide.

However, she thought that people should have some leeway or opportunity to make a change if they were unhappy with their original decision. Therefore, if Shaun had made a wrong decision, he should still have a chance to make a change at university level. Most important of all would be his learning experiences, e.g. how to make a good decision and how one can remedy a wrong choice.

SM: You can still change your subject when you feel that you do not really like it in the university. We told him that he can choose group 1 (social studies) now and if he really feels not like it in the future, he can always work harder to transfer to another subject he likes. You know you have to put more effort to make it up if you made a wrong decision. It is the same as when you first leave the school, you might choose a wrong career. It doesn’t matter. You know people need time to find their way out.

8.3.7.2. Ascribing responsibility

Furthermore Shaun’s parents did not force him to follow their expectations because they wanted him to be responsible for himself and not blame them for making the decision for him. They wanted him to follow his own commitment without any excuse.

SM: We just let him decide it in the end because he will have to justify his decision in the future. It does not work if we force him to follow out choice because he might blame us for telling him to study it if he does not enjoy it in the future.

8.4. Influence from Teachers

Shaun claimed that he did not receive suggestions and did not ask for help from his school teachers because students in his school were more mature and independent. Most of them made their own choice or made the decision with their parents.

S: I do not think so because teachers in our school mind their own business. Besides, decisions like this should be made by the students and the parents. Teachers normally do not suggest any thing unless the student’s aptitude is quite obvious but he would not need any advice if his aptitude is obvious. So, teachers do not make much suggestion.

This statement was also verified by Young (science teacher) and Cheng (Biology
teacher). They both thought that a lot of the students listen to their parent’s opinion rather than following their own interest, or rather than approaching their teachers for advice.

Young: I think in Taiwan, the industry is more delicate-industry [high technology industry] orientated. So even if they like social studies, their parents will tell them to choose natural science. Parents will tell their children it is ok to choose whatever exams they want to take in the last year (exams for NSP and SSP students at the university entrance examinations) but they are told to have to study natural science while they are in high school.

Cheng: Only a few of the students in my supervising class will ask for my suggestion. I normally will tell them to choose what they like, not just do what others do.

On the other hand, Shaun’s mother insisted that Shaun was inspired and encouraged by his former class supervisor who also taught Chinese in the first year of high school. It seems that the Chinese teacher have exerted more positive influence on him.

8.5. Influence from Peers

Shaun stated that he had approached his friends, who were studying at various universities, for advice. His friends told him of their experiences and provided suggestions. Shaun felt that his friends’ analysis was similar to what he was thinking, so his decision to take social studies was reinforced.

S: I have some friends who are a bit older than me. You know some big brothers. They are studying in the university now. I have asked them for advice when I was thinking about this decision-making.

8.6. Influence from Media

8.6.1. Higher employment rate for science students

All interviewees mentioned that there are more opportunities in the job market for science students and media were always included.

S: Maybe because of the news from the media.....for example, ..... a new HIGH TECH NOBEL [young rich engineers] who make more than ten million dollars every year, something like that. The news and reports tell us all the time that if you choose to do this, then you will become rich.

Cheng: Media seems constantly passing the message. Then people believe it and then it becomes a truth.
Information of such goes around between people through different types of interactions and communication. The information might have consciously and unconsciously internalized by the participants and travel to the media or reprocessed among different actors.

8.6.2. **Implementation of the hierarchy of social classes**

Shaun stressed the hugely different social status between a businessman and a social worker. A businessman was better than a social worker because “Social workers are the same level with manual workers”. And manual workers were portrayed as being at a lower level by television programmes (see 8.2.2.4). Shaun claimed that this kind of value is rooted in everyone’s mind because society as a whole, accepted it as the norm. All people have the same criteria for a good job.

*S: In fact, this is a general impression about manual work. And everyone is talking about getting a job that is easy, high paid and close to their house. But you know normal contract staff can probably make about NT20000 a month sitting in an air conditioned office making phone calls to customers all day. A construction supervisor might make more than NT100000 in a construction site.*

The science teacher, Young, also had the same reflection on the content and way the media presents news. She thought the media often created ‘imaginary facts’, rather than the ‘real facts’. Most people do not have time to verify the report, so they believe the media or the media influences them.

*Young: In fact I think the trend of the society is controlled by the media. They decide what they want to report and most of the people just receive the information.*

8.7. **Summary**

There were several issues that Shaun considered when making his decision. Material rewards and social status were the ultimate goals for him, above all the other concerns including financial stability, gender role and trend of the industrial development. The decision making process involved a series of complex deliberations, and balancing of the pros and cons. The process involved a combination of ideology and reality. Although Shaun did not get much approval from his parents, the idea of becoming a businessman was, in fact, a projection of his parents’ wish to become a medical doctor, in that what Shaun expects to get from being a businessman, is similar to that
to be gained from being a medical doctor: money and social status. However, his parents remained supportive after he chose social studies because of his outstanding performance in academic work and his extra-curricular activities. His parents trusted him to be successful with his future plans. Shaun’s concerns in choosing the study groups are shown in
Table 8-1.
Table 8-1. Shaun's concerns in both of the study groups

<table>
<thead>
<tr>
<th>Positive Factors</th>
<th>Natural science Programme (NSP)</th>
<th>Social study Programme (SSP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Greater possibility of university entry</td>
<td>1. Interest</td>
<td></td>
</tr>
<tr>
<td>2. Stable employment</td>
<td>2. Easy to study</td>
<td></td>
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<tr>
<td>3. Steady material reward</td>
<td>3. Higher competitiveness against other SSP students (Mathematics)</td>
<td></td>
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<tr>
<td>5. Parental expectation</td>
<td>5. Higher potential revenue in the future job market</td>
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<td>6. Experience from family members</td>
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<tr>
<td>7. Advantage of from the system</td>
<td>6. Encouragement from the teacher</td>
<td></td>
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<tr>
<td>8. Being thought of as smart</td>
<td>7. Encouragement from friends</td>
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The effect of each factor may vary according to Shaun’s own view. Some concerns are psychological, for example, being thought of as smart, level of interest, learning experience and perceptions of science. Some concerns are economic, for example, material rewards. Some concerns are sociological, for example, access to social status and parental approval. Other concerns are traditional and historical, for example life security and gender expectations.

The process of deciding a study group, in Shaun’s case was similar to making a rational choice by calculating and assessing his own ability and possible outcomes of different decisions. However, these calculations and weightings are based on Shaun’s own reasoning and justification. The pragmatic process of decision making also serves his future need in ideology, tradition and modern society. Such tactics are similar to the first part of Hodkinson and Sparkes’ sociological theory of career decision making (1998). Young people tend to make pragmatic calculations when making a choice, in order to get the maximum results.

In addition, Shaun’s concerns were shared by surrounding parties. Their concerns
influenced each other and also guided Shaun in various directions. This is similar to the study of Bourdieu, 1984; Bourdieu, 1990; Hodkinson and Sparkes, 1997; Hodkinson, 1998, of which concluding that when youngsters are making decisions, their positions in the game are important in terms of resources and possibilities.

Shaun’s Chinese teacher and friends who were at university, seemed to be the main parties that had the most important influence on Shaun’s final decision. Figure 8-1, shows the entity “self” which represents Shaun and his central concerns. The entities “teacher” and “peers” are closer in the diagram, as Shaun feels a greater affinity with them, regarding these concerns. This is important because it shows that the influences of ‘significant others’ are mediated by pre-existing inclinations and dispositions in the individual. The tetrahedron unit which resembles Shaun and different influencing parties has a different shape, from a standard tetrahedron. The new tetrahedron shows the relationships and strength of influences between different parties, in the context in which Shaun is living. For example, Shaun and his parents both presented their opinions and respect each other; whilst Shaun took much of his friend’s and Chinese teacher’s opinion on board when making his major decision of life.
Figure 8-1. Relationships between Shaun and different influencing parties.
CHAPTER 9.  INFLUENCES AND CONCERNS OF A FEMALE SCIENCE STUDENT ON HER DECISION-MAKING

This chapter illustrates the concerns and influences that students have when they choose the Natural Science Programme (NSP). A detailed personal story of Jade, a female science student, is presented in this chapter to show her concerns and the factors influencing her decision.

The initials used in this chapter:
A is the interviewer
J is the interviewee Jade [pseudonym]
JF is Jade’s father
Cheng is Jade’s Physics teacher
Zhang is Jade’s Chemistry teacher
Lin is a civics teacher who joined the teachers’ discussion
Shh1-6 are students in a group discussion that included Jade

9.1.  Contextualisation of Jade’s Background

Jade is a quiet and hard working science student from school 2., School 2 is ranked in the middle level among all the senior high schools in Taiwan. Jade’s academic performance in her school is high among other students.

Jade’s parents are manual worker and own a small family factory near their home. The factory polishes metal parts, for example bicycle parts. The parents are hard working and sometimes the whole family helps during busy periods, although the children help less due to school work. In addition, business has become quiet since a significant amount of the Taiwanese manufacturing industry has moved to China.

Jade’s sister who is one year older than Jade studies in the NSP in another high school, of which was ranked as the best girls’ high school in her home county. Jade’s brother is a 3rd-year student in the local junior high school.
9.2. Concerns that “Self” takes into Account

9.2.1. Factors relate to interest and learning experience

9.2.1.1. Personal interest

When Jade was asked to talk about her choice of study group, her answer was prompt and firm. She stated that she was more interested in the science subjects.

J: I was very sure that I wanted to study in the science study group.
A: Were you sure about it from the beginning?
J: mm. [Positive tone]
J: I was more interested in this .... Hum.. it’s that hum [pause for 1 sec] something like maths, physics, and chemistry. I was more interested in those subjects.

Another reason Jade chose science was because she did not like to study the subjects in social studies, and she felt that working with numbers was more fun. Social study subjects require a lot of memorizing. The time and energy spent memorizing annoys her and also she forgets the subject material easily.

J: I just felt that those things like history and geography needed a lot of memorisation. They were annoying. I did not like to study them.
A: Annoying?
J: Yeah. There were lots of things in the subjects that needed to be memorised, so I felt that numbers were more fun.

A: So how were your scores in history and geography?
J: Quite good because they only needed to be memorised and recited.

A: Oh, so what do you think is the difference between social study and science study?
J: You can get high score in social study group if you memorise things but you need to understand them if you are to study science.

9.2.1.2. Learning experience

Jade had some unpleasant learning experiences in social studies: the rote learning process of history and geography produced a negative attitude towards her study. She described how uninteresting the teaching was to her, the teachers only read textbooks in class and asked the students to memorize the content.

J: Because I always felt that they were boring since I was in the junior high school. The teachers just kept reading the textbooks, so I just studied the textbooks and memorised things in the books.

The poor teaching method in social studies, including memorising, and long hours of
concentration created an emotional barrier between Jade and the Social Science Programme. She chose to avoid social studies because she preferred to learn by understanding rather than memorising facts. Hence, although Jade did not feel science was easy, it was much more preferable for her way of comprehending and digesting subject material.

She also found science livelier. Her aptitude for figures made memorising Mathematics and Chemistry formula acceptable, compared to memorising history or geography.

Jade’s understanding of both study programmes and their applications was not altogether clear. Moreover, she had limited understanding of the choices available at university. Neither her school nor her parents provided adequate information about the high school curriculum’s link with the universities. Hence, she did not understand the relationship between what she was currently learning and the choices available to her later.

Although she was confident about choosing science. She was not keen to become a scientist because of her negative image of scientists.

J: I don’t know. I just feel messy.
A: Why?
J: [laugh] I don’t know. I felt that they are messy whenever I watched them from the telly.
A: Really?
J: Yeah. The scientists have to lock themselves in the rooms all day long.
A: Really? Do they?
J: Yeah, you know people who are doing research always lock themselves in the rooms all day long.

However, Jade had no immediate concerns for her future. She wanted to focus on her current study; her aim was to pass the entrance examination for university.

9.2.2. Factors relating to individual and family

9.2.2.1. Pressure from academic competition
Jade felt that she had to be better than students in the same year so that she could be competitive.
J: Yeah, I was thinking of going to a Police College but I saw my sister took the exam before and I did not think that I am able to pass it.
A: Why?
J: There were many people (raises the tone) and she did not pass the exam either.

Apart from exam pressure, Jade had pressure from the comparison with her cousin who studied in the Police University and worked as a police officer. This made Jade anxious.

J: Oh....my cousin who studied in the Police University. They would say that she studied very well. [laugh] Their whole family all studied very well any way. My parents feel that it’s better to be like them, having jobs like that. Maybe it’s because they all like to compare with each other.

9.2.2.2. Pressure of competition from wider society

Jade felt that society is very competitive so she had to be fully equipped to deal with the competitive world. She thought that the only way to raise her competitiveness was to raise her school marks.

Her anxiety towards study seemed to drive her motivation to study, although she did not specify who applied external pressure. Her concern for future employment also appears in the interview.

A: Do you think that finding a job is competitive?
J: Yeah.
A: How do you know?
J: Everyone says that.

And

A: Do you worry about work competition a lot?
J: Yeah, that is right. All I can do is to try as much as I can or what else can I do?

Her school also contributes some pressure to the feeling of competition that Jade has. To improve its reputation, through good university entrance results, the school would encourage the top performing students to attend additional weekend and holiday classes. This drive to improve performance increases the pressure on the students.

9.2.2.3. Value of education

Another strong force that has driven Jade to study hard was the value that she placed on education. Jade believed that increasing her knowledge will improve her problem solving abilities leading to more opportunities in future employment and a high social status.
J: I think it’s very important to study a lot. It’s important for other people to think you are respectful. People will think you are respectful when you study a lot any way.
A: Why? Why is it important to study a lot?
J: Because then you can have more knowledge.
A: But what can you do with more knowledge?
J: It might mean that you have more ability to solve the problem that you may have.
A: Solve what problem?
J: Any problem.
J: Yeah, maybe we will have more choices.
A: Choices, to choose what?
J: It is….depends on what you want to do. Everyone feels that if you study a lot then people will respect you more.

According to Jade, the high value of education is a social-wide phenomenon, of which was also why she was so highly motivated and studied hard. Although attaining a high degree does not guarantee a higher salary, it provides more choices and future possibilities.

A: So do you think the more education you receive, the more you will be qualified for the job market?
J: Yes.
A: Can you make more money?
J: It depends. For example, there are many people with PhD degrees but they only got low paid work. I think it’s not for sure you will make a lot of money if you have a higher degree, but the possibility is higher and you might have more choices.

Jade pointed out that her parents had passed on this view, since she was young. She seemed to have expropriated her parents’ views as her own. Her valuing of education has also been shaped by other influences, such teachers, peers and the media. These influences will be discussed in later sections.

9.2.2.4. Family responsibility and expectations

Jade felt an obligation to her family to study hard. She felt that because her parents worked so hard to support the children, she should not disappoint them. Jade thought that she should find a stable job so that her parents will not have to worry about her. Moreover she would try to support her parents financially.

A: Do you feel that you are responsible for your family when you start making money?
J: Yes, because they are supporting our life now.
A: So you do feel that you will have to support them later?
J: Yes.

Although Jade thought her parents would not accept her money, she felt a duty to try to support them. She said that this view was taught at the school, and did not come
from her parents. It shows that filial piety is taught in the school and may not be so
gender specific as it is in the family.

9.2.3. Factors Relating to the future and wider society

Further interviews indicated that apart from Jade’s interest in science, there were
more complex reasons for deciding upon the science study group.

A: Why did you want to become medical school at the beginning?
J: It should be the job seems to be very stable. Yeah, I was thinking of going to a Police
College but I saw my sister taking the exam before and found out that I won’t be able to
pass it.
A: Why?
J: There were many people (raises the tone) and she did not pass the exam either.
A: So what is your reason for taking the exam [Police College]?
J: Steadiness. Yeah, it’s a stable job and good pay for girls.
A: Really?
J: Yeah, especially for girls, the pay is really good.
A: But isn’t policing hard work as well?
J: It’s ok for girls. Normally girls stay in the office only. They rarely work outside the
office.
A: So you think steadiness is important for a job?
J: Yes.

Her concerns seemed to involve future jobs, opportunities, security, stereotype and
expectation of gender roles and possibly social status in the short passages.

9.2.3.1. Access to university

Jade stated that she did not consider choosing science an “easy way” to get to
university because she had to study hard to go to a good university.

A: Do you feel that there is a higher chance to go to university for NSP students?
J: Em…why does everyone says that? I don’t feel so!
A: Why?
J: Because I feel that you can do either very good or very bad if you study in science but
if you study badly, which university will want you?

However, she was aiming to study medical related subjects in a good university and
she felt hard to stay ahead among other people. Her comment about what other people
thought reflects that it is a common opinion that NSP students have a high chance to
go to a university. This probably also influenced Jade subconsciously, though she was
having a hardship with her study.
9.2.3.2. Access to jobs

The most important concern that Jade had was having a job in the future. She admitted that science students can find a job easier.

A: So did you mean the possibility for science students to find a job in the future is higher than the other?
J: I don’t know. Maybe.
A: Why?
J: Hm because I haven’t got to that stage yet but it looks like it will be easier.
A: why?
J: Because it sounds like you are more skilled.
A: Which kind of skill are we talking about?
J: Science students know more about physics and chemistry than others.

She seemed to view knowledge in science as skills that may be useful for future employment. However, because the future was still far away and there were other realistic factors, such as her competitiveness and not being able to take the exam because of the height requirement, she only had a vague goal (a stable job like policewoman or pharmacist) and hoped that she will reach her goal through her hard work.

9.2.3.3. Access to stability

Jade is concerned about future stability. From her ideas of studying to become a medical doctor, to becoming a police officer, she always had in mind a “stable” job.

A: Why were you thinking of studying in medical school before?
J: The job seems to be very stable.
A: Why?
J: Because no work means no salary, no salary you can’t do anything, right?
A: Which do you think is more important to you? Having a job which you like or a stable job?
J: Having a stable job is more important to me.

She wanted a secure life, in which she and her parents would have no worries. For this reason she was aiming for a highly skilled, secure and well-paid job. Being a policewoman was considered a secure job. Jade’s family experiences showed that job cuts are a serious threat.

A: What are the reasons for you wanting to take the Police College Entrance Examination?
J: Steadiness. Yeah, it’s a stable job and good pay for girls.

Jade gave many examples of advantages to becoming a policewoman. The idea of
being a policewoman was also inspired by her parents and teacher, as will be discussed later. Jade indicated gender differences when she was talking about the job role and income of a policewoman:

J: Yeah, the pay is really better from a female’s point of view.
A: But isn’t policing hard work as well?
J: It’s ok for girls. Normally policewomen stay in the office only. They rarely work outside the office.

Jade also stressed her opinion of gender equality.

A: Do you mean boys and girls are not equal?
J: No, isn’t everyone talking about they should be equal? There are always reports about super women on the TV.

9.2.3.4. Access to status

In Jade’s opinion, education does not only provide her with knowledge and opportunity to find a stable job but allows her to gain more respect from others. This was important to Jade and her family.

J: I think it’s very important to study a lot. It’s important for other people to think you are great. Any way, parents will think you are great and be proud of you when you study a lot.

Education is a path for providing both material rewards and social approval. To Jade, employment is important because of the link with social status. For example female police officers and office workers are respected by other people.

J: Working in the office is better! Everyone wants to get a job that looks nice.

9.2.3.5. Access to material goods

When first asked, Jade did not immediately reveal her feelings about the importance of money.

J: You don’t have to be very rich, just enough will be fine.

However, she continued to mention salary for certain jobs, suggesting that monetary reward was in fact more important to her than she admitted. The amount of salary was an important issue to her.

J: Yeah. I heard it [The amount of police salary] from our English teacher. Yes, I was surprised by the high salary as well.
A: Do you feel such salary is very tempting for people to take the exam for police schools?
J: Should be. Plus, they start to get money while they are a student.

And

A: What do you think about money in this society? Is it important?
J: Yes. It is important.
A: Why?
J: You can do many things if you have money.
A: Do many things if you have money? For example?
J: To live! It always cost money to live. Plus the money you have to give to your parents. Yeah, you will feel pathetic when you don’t have money.

For Jade, it was not all-important to be very rich but having ‘enough’ money was recognised as a basic necessity of life, which for her included meeting family obligations.

J: They gave us money to study since we were little. So of course I feel that we have to pay it back when we grow up.

9.3. Influence from Parents

Jade’s father seemed to be more dominant in the family. He disapproved of the current education system and thought that schools push students too much. He suggested schools want students to gain good results in the university entrance examinations, only to benefit their own reputation. Teachers were pushing students to study hard because they wanted to “save face” in competition with their colleagues. He added that parents pressured their children to study hard because they were worried about their children’s future. He felt that parents should take greater responsibility in their family education.

Jade’s father stated that he has put a lot of “effort in educating and communicating” with his children. His concerns and suggestions discussed with his daughter are presented in the following sections.

9.3.1. Jade’s performance in the school

Jade was a self motivated child who did very well in the school. Her father acknowledged that if Jade was capable of studying the subjects, the choice of science would not be a problem.

JF: It is her own choice, really, and I don’t think there is anything bad for her to
choose science. If she is capable of doing that, then that is good. We do feel that our first daughter was struggling in studying science but Jade’s situation should be better. I think she is doing ok now in the school.

He stated that when deciding on their subject choice, the children should first think about their ability to study the subject. However, there were also different gender issues within the family which will be discuss in 9.3.5.2.

9.3.2. Perceptions of the disciplines/fields of study

9.3.2.1. Perceptions of science and its application

Although Jade’s father had a limited education himself, he understood some differences between the natural science and social study groups because of the experiences of his elder daughter when she chose her study group, two years ago.

JF: Yeah, we know that when our first daughter went through the second year of senior high school a couple of years ago. I think students who study in the science group will study some medicine or engineering subjects in the university; for social study students, they will be doing something like business or finance. Sort of like that, right?’

However, his understanding of the discipline was more related to its future application. He held stereotypical views about future job roles for each of the two study groups: the science students could become engineers or medical workers, while the social study students could pursue a business career.

9.3.3. Freedom of choice

9.3.3.1. Respect of children’s choice

Jade’s father had emphasised how Jade was given complete freedom to choose her study group.

A: So did you make any suggestions when Jade was choosing the study group?

JF: Oh, I didn’t interfere with her choice. I let her choose what she wanted to do. I just told her that she had better think carefully before she makes any decision. She should be responsible for her own choice.

In Jade’s interview, she also claimed that her parents let her decide the study group and respected her choice. However, she also mentioned that that her father had “more or less” influenced her to choose to study science.
9.3.3.2. Ascribing responsibility
Another reason why Jade’s father respected his children’s decisions was that he
wanted his children to be independent and responsible for their own life. He argued
that parents should neither make the decision for their children nor should they worry
about their children’s life.
JF: … it is she who made the choice, she has to be responsible. We do not want to tell
her what to choose. You know parents should not tell their children what to choose
these days.”

However, teachers take a different view. Jade’s teachers stressed that in their school,
most parents chose the study group for their children or they pressured their children
to choose science.
Cheng: Yeah, It is because of the new era we have now. To be honest, there are people
who do not like to study here but because of their parents…Any way. On the other hand,
the existence of comprehensive high schools is another choice for them because they
could only go to the vocational school route before. So, it is an opportunity.
Zhang: And eventually parents still force their children to choose the science group.

9.3.4. Perception/value/role of education
Jade’s father thought education was very important, and he wanted his children to
receive as much education as possible.
JA: What can you do if you don’t study? It is very competitive in society now. Having a
degree seems to be a basic requirement for the future…

Although Jade’s brother was not doing well at school, Jade’s father still hoped that he
would continue after compulsory education.
JF: Yeah, of course. We will encourage him to study as much as he can. These days
you cannot find anything if you are only a junior high graduate. You can’t find a
good job even if you are an undergraduate. So many people can’t find a job. You
know it is competitive out there.

He worried about competition in the future job market, when talking about his own
experiences; he implied that the situation nowadays required people to have a higher
degree.
JF: We would not want him to continue this job if he can find a better one. I had to do a
lot of low skilled work because I did not do a lot of study. I did not have much choice. I
am not saying that this is a bad job, learning a skill is not a bad thing. But you know
parents, of course they would want their children to have an easier and stable job.
He regretted not having the chance to get a better job because of his lack of education and therefore wanted his children to benefit from opportunities he never had. He did not want his children to do manual work as him. His high expectations were thus projected onto his children with a strong emphasis to get out of the working class. However, he also acknowledged that not everyone shines at school. He thought that “learning a skill is not a bad thing” because skills are practical and can still provide stable employment. Therefore, he did not exclude the possibility of his son continuing the family business if the son cannot make his way through.

9.3.4.1. Access to Jobs

His view of the future job market was that science related manufacturing industry would still be dominant in the next two decades. Thus, choosing to study science would still offer the best job prospects for the future.

_JF: You know that in Taiwan, we don’t have a lot natural resources, manufacturing is still the leading industry in Taiwan. And I believe that this won’t change in the next ten, twenty years. So studying in science might be a good choice if you can do it._

Therefore, he was happy with Jade’s decision to study science.

9.3.4.2. Access to status

Jade’s father felt a job with high social status is also important. Although Jade’s father did not mention which jobs he regards as having a higher social status, he disapproves of his children having manual work. Jade shared a similar opinion with her father.

_A: So do your parents care about social status?_
_J: Yes. I think so._
_A: Why?_
_J: Because they didn’t get much education, so they feel like their work is hard work._
_A: Do they give you any examples?_
_J: Yeah. They would say that it’s not very good to be like them because they didn’t study a lot, so they have to do coolie jobs._

Jade’s parents felt that their lack of higher education limited their career options and development. Their personal experience has strengthened their desire to provide better opportunities for their children, and to give them the necessary encouragement.
Although Jade claimed that she did not feel study pressure from her parents, she thought that having good academic results were a sign of high social status among the family.

9.3.5. Perceptions of tradition

9.3.5.1. Moral education and conformity through family

Though not linked directly with her decision, Jade’s family education has illustrated the strength of her father’s influence on the children. He stressed that he tried to teach his children good morals and ethics because he believed these values should come primarily from the family and not necessarily from the schools. He wanted his children to understand their responsibility in both the family and society.

_JF_: I always ask my children to come downstairs to chat when they have locked themselves up in the rooms for a long time. Children need to have breaks when they are studying. Also, I always tell them what the right and wrong attitude is. They need to learn how to get along with other people in the society. Study is not the only thing in our life.

Jade also mentioned about school teachers encouraging filial values, which reinforced her view of financial independence and “repayment” to parents. Hence, both family and school views reinforce each other.

9.3.5.2. Gender role

Although Jade’s father declared he had no bias towards boys or girls, he did have different gender role expectations for his children.

“it might be better for girls to choose social studies”
“Yeah, of course, for girls, medicine and pharmacy is better than working in factories.”

Jade also pointed out that her parents had stereotypical gender views.

_J_:.. It’s because they still have that kind of traditional “first grandson” ritual.
_A_: So is your father the first son?
_J_: Yeah, that’s why they would have that kind of opinion.
_A_: What does the first son and first grandson mean to you?
_J_: Hum..maybe it means that he can have all the family possessions.
Jade referred to gender differences in terms of family roles and responsibilities. The first son holds an important position in the family. They continue the family clan and traditionally are the only family members recorded on the family tree. They inherit the family’s assets, and the responsibility for supporting the family. Jade’s parents continued to have children until they finally had a boy. Because of these responsibilities to support the family, her parents were not happy with their son’s interest in doing gardening and cooking because they thought it too feminine. Boys are expected to be strong and do heavy jobs.

9.3.5.3. Stability
Jade’s father considered security and stability important, although he stressed that he did not push the children to study, to reach this goal.

\textit{JF: I do not put any pressure on them, to be honest, as long as they will have a stable job in the future, I think that will be fine.}

This might be related to his own experience at work as he lost many orders several years ago after many factories moved to China. He felt that having a stable job will mean less worry.

\textit{JF: Jobs like yours. A teacher’s job is very stable and easy.}

\textit{JF: You know these days, jobs that are working for the government are much more a guaranteed job. (A: guaranteed?) Yeah, jobs from which you won’t get sacked easily. You know if you work in the private sector, you always have to worry about been fired when the company’s business is down. Working for the government does not have this problem. It will be a safe job.}

Getting a teaching job or a government job provides a steady monthly income and there is no risk of job loss, when business is bad. He did not wish his children to be ambitious, own a large business, or even become rich. His main concern regarding his children’s future is “stability”.

Jade’s shared the same views as her father. She thought that unemployed people are a burden to the family. These same views may have been regularly discussed by the family and evolved over time, either deliberately or unwittingly. By the age of 17, Jade had formed a strong understanding of the requirements of her life.

9.3.6. Other child
Jade’s parents had already experienced the education system, with Jade’s older sister, who was one year older than her.

JF: *I think we know quite a lot about this now because our oldest daughter is going to the university in half a year. She is actually going to have her first examination in February. We know quite a lot of stuff from the first daughter.*

Jade’s father suggested that schools should be more responsible for providing information to students, because parents sometimes were not fully aware of the education system and curriculum. They often received the information directly from their children instead of talking to teachers or getting information from schools.

9.3.6.1. Relatives
Jade’s cousins’ experiences of education provided another source of information for her father to understand the process and possibilities for different choices. The cousins both chose to study science some years before, and managed to find good jobs working in industry.

JF: *My brother has two sons and they were both studying in the science stream. They are now working in the electronics industry, both of them. They said that science students are more likely to find a job rather than a social studies student.*

Jade’s family maintained a close relationship with other branches of the family and information about current and future trends and their experiences were shared between the family members within this extended family.

J: *Oh….my cousin who studied in the Police University. They would say that she studied very well. [laugh]Their whole family all studied very well anyway. My parents feel that it’s better to be like them, having jobs like that. Maybe it’s because they all like to compare with each other.*

9.4. **Influences from the Teachers**

Jade seemed to receive more influence on obtaining a secure job than her decision on the study subject. For example, she mentioned about her information about universities, jobs and competition was provided by “everyone” including teachers. The information, however, provided her different aspects and perceptions of future direction that were beyond her own experience and daily life.

Cheng: *I always tell them (students) that if they want to study in a public university,*
then they should choose Physics. If they can only go to a private university, then go for engineering. The engineering subjects in public universities are very difficult to get into. If you want to study in a public university then study physics but basically engineering is better.

A: Why?
Zhang: Employment.
Cheng: Because you will definitely change to engineering when you want to continue in postgraduate school. Say if you study for a PhD in Physics, what are you going to do after you finish your PhD? What you learn in a physics PhD is too different from the industry. ......
Zhang: ...So it’s better to study engineering straight away.

9.4.1. Access to universities

Access to universities is a concern expressed by the teachers.

Cheng: Hum...generally it takes less effort to get “a” place in the university for science students than social study students because the range band of entrance scores for social study subjects is smaller. They need to study very hard to get in that band; whilst the band of the scores for science subjects is much much wider. Have you heard the news? You only need less than 100 points (5 subjects) to study applied math in a university. That will not happen in the social study group.

However, they also felt frustrated about the students’ ability in studying science when the students did select the study group strategically.

Zhang: I asked them about their [students’] goals, they told they want something that does not need a lot of memorization, more chances to get to a university and less demanding. So they rarely study.
Cheng: So there are more and more students choosing to do science. For example, we only had 5 science classes in each grade.
Zhang : Well, it was only four in the beginning.
Cheng : Yep, then now we have six classes in each grade. In fact, the level of the students’ ability declined a lot. It is because the number in the classes has increased and they should have gone to the social study group in the first place.

9.4.2. Access to jobs

While both of the teachers pointed out that it was parents who want their children to choose science due to the many science related employment opportunities, their opinions appeared to be similar to the parents and students. Jade’s physics teacher had a detailed analysis of why students should choose to study science and commented on their strategies for making their decision.

Both of them thought that students should choose subjects with a practical use for their future, thus, preparing them to gain employment.
Zhang: Interest and the job market. As long as his interest is not too specific, and is something slightly related to technology, I will normally suggest to him to go in that direction.

She also expressed that she strongly advised her students to study science subjects that were related to information technology, electronics, material science, engineering and biotechnology because she believed that there was still a great demand in the current and future market. The science teachers paradoxically encouraged students to choose science despite their complaints of students’ lack of capability and motivation in learning science.

Nevertheless, a civic education teacher thought that students should choose the subjects that can help with their future jobs, and encouraged his students to plan their future, based on the industrial and economic needs.

Lin: You were talking about most students choosing their schools [universities] according to their concerns over future jobs. In fact, not only schools tell students that, I tell students that as well. There was one student came to see me during the lunch break. He came to ask me which school he should apply for. I told him, “Think about the future employment!!” I just told him openly and straight away. Then I told him what we have to think about our future all the time and that it is linked with higher degrees.

And

Lin: You have to understand that even if the student chooses to do science, it does not mean he wants to explore scientific phenomena. He is purely making a preparation for his future. It is utilitarian, nothing about scientific attitude or attitude towards science. So when he is thinking about his problem [the future], he wants to get a result in the future and this result ought to be able to transfer to the practical production level. Industry is a good application.

He pointed out bluntly that students see science knowledge as a means to find employment. Their reasons to study science, tends not to be out of personal interest to acquire scientific knowledge. Hence, their priority is for living in the future, and not the process of learning. It is industry which appears to dictate educational requirements, to the educational authorities and society as whole, in Taiwan. The civics teacher has an explanation for the situation.

Lin: Because the economic development in Taiwan has shifted from intensive labour to a high technology industry. It is not possible we can transcend to this stage without the technology. So degrees link to employment when you look at the whole economy or industry of Taiwan.

The high level of competition in the job market was mentioned several times. It was
possible that teachers also emphasised this fact to their students and possibly to their parents. Their recognition of the trend in the job market reflected the same concerns as those of students and parents. The availability of science jobs directs their teaching towards a more score-gaining strategy.

In addition, both of the science teachers did not appear to understand different subject choices in the university apart from their own subjects, however, they still suggested students to choose subjects that everyone thinks are popular. This might also explain the lack of understanding outside science textbook by students in chapter 6.

Zhang: But, to be honest, I do not know either because some of the subjects, I do not even know what they are. I only heard people say that finance is good. So is economics, this means middle level, not hot or cold. I can only tell my students that electronics and material engineering are hot subjects, psychology is not very popular. This is all I can tell them. About what they can do after the university, I think electronics and mechanical engineering are very similar. Sometimes it’s really difficult to tell them the differences. And electronics and IT is also very much the same. So when students get to the last year, what they care is that they do not want to be jobless in the future. They choose a subject or a university that has the least risk of unemployment.

9.5. Influence from Peers

Jade did not mention the influence from her school friends but they shared similar perceptions of science, image of scientists, aspiration for higher education, views of future jobs and gender roles. Everyone in Jade’s group believed that there are more vacancies and choices related to the science group. Receiving a higher education meant there were more opportunities to obtain a good job and income for the future.

This might be the characteristics of interactions between individuals and people around them in their daily life.

Shh1: You know if you study (have a high degree) then it will lead to good jobs. And good jobs lead to a lot of money.
Shh4: Some people buy degrees [study abroad].
Shh3: Yeah, but that’s because they are rich. Unfortunately we are not rich people. So we have to study hard to get a job. That’s the only way poor people can make money.

The experience of Jade’s sister and cousin seem to be more influential than her friends from the school (see 9.3.6).
9.6. Influence from Media

Television appears to greatly influence her perceptions about her choice of science group and her future plans. Jade mentioned that television was her main source of general information and current affairs, despite the fact that her father doesn’t let her watch much.

A: Do people get good pay of that kind of work (semi-conductors)?
J: Yeah, yeah.
A: How do you know?
J: Of course! I do watch TV! [laugh]
A: Does the TV have a huge influence on people?
J: Yeah. It does influence us a lot.
A: How much?
J: They instil some concepts in our daily life.

The media often report on work and income, in Taiwan. There tends to be particular emphasis on engineers and others working in the science industrial parks. Also, science or high-tech products are constantly advertised. This seems to raise a high awareness of such jobs.

Jade’s father also mentioned that television has provided him with information on economic development and job market demands. Science related jobs and income are promoted by the media.

JF: Yeah, right. TV does talk about this some times.... About trends in the society, you do get a little bit of information from the news occasionally. They talk about some jobs that everybody envies or the development in the society, but I think this should be only references. If you are not capable of studying in that area, it does not help any way.

9.6.1. Image of scientists

Jade’s negative image of scientists was influenced partly from her teachers and partly from television.

Jade: Old messy men with crazy hair stay in the lab and remain poor throughout their life...You know the television is always talking about this all the time”

9.6.2. Unemployment rate and crime

Jade is fearful of future unemployment, which is reported by the media to be continuously worsening. She feels frustrated and not confident about future
employment.

A: Where do you get this fear from?
J: TV. Don’t they have reports about unemployment all the time?
A: Do you know how much the unemployment rate is now?
J: I don’t know. I just know that it’s rising all the time.

Jade also associated the high crime rate, reported on television, with those having a lower education. She thought that the unemployed and poor are more likely to commit crimes. These suggestions together with family and moral values seemed to be passed on from her father (see 9.2).

9.6.3. Successful examples

She was inspired by two successful female entrepreneurs presented on television. She called them “super women” and wanted to be the same as them. However, the term “super” implies that it is more difficult for women to become successful. Jade seemed envious when discussing these women.

A: Do you think boys and girls are not equal?
J: No, isn’t everyone talking about equality? There are always reports about super women on the TV?
A: Would you like to be a super woman?
J: Yep.
A: What do you think a super woman should have?
J: Like Yin-Qi and Chen Pin-Xun [Successful businesswomen who runs the high speed train company and the finance company in Taiwan]. They are really great.

9.7. Summary

When Jade described her decision to choose a study group, she first expressed that she was more interested in science comparing to the SSP group because of the learning experience from SSP subjects. However, there were more concerns she took into account, such as access to university, future job prospects, family responsibility, gender role and role models. These concerns were also shared by the surrounding actors included the media.

Jade’s father and television, seemed to have the greatest impact on Jade’s daily life and decision making. Everyone around Jade appeared to be affected by media information also. It presents the current social situation, economic development, and the future trends, in Taiwan. The influences and interactions between actors around
Jade can be illustrated as Figure 9-1. The media, parents and peers (siblings) have more influences on her decision rather than the teachers and the actors also have some linking between each other. The various influences seemed to direct her towards the NSP group rather than the SSP group and the options include medical doctor, police officer, chemist or entrepreneurial ‘superwoman’.

Figure 9-1. Influences from the surrounding parties

![Diagram](image)

Despite the influences, Jade made the final decision herself. The pros and cons in her mind were based on her personal feelings, perceptions of science, experience, competence, opportunities, vision of the future, access to university, employment possibilities, future social status, etc (see
Table 9-1). Each of these factors may produce an individual response. However, factor weight allows priorities to be made for the final decision. For Jade, the NSP had more favourable factors, while the SSP appeared more unsuitable and undesirable.
<table>
<thead>
<tr>
<th>Pros</th>
<th>Natural science Programme (NSP)</th>
<th>Social study Programme (SSP)</th>
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<td></td>
<td>Interest</td>
<td>1. Easy to achieve high score by rote learning.</td>
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<td>Little rote memorisation</td>
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<td>Higher competitiveness against the counterpart of SSP in exams for SSP students</td>
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<td>Perceived difficulties</td>
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<td>Negative image of scientists</td>
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### 9.8. Summary of Students’ Concerns and Personal Illustrative Stories

Generally, when students made their choice of study programme, they recalled or gathered information from various people and groups (actors) around them. The
tetrahedron model presents the individual and surrounding influences. Different situations, will reflect the scale of influence, i.e. the shape of Jade and Shaun’s tetrahedrons are dissimilar because of their own unique situations.

The numerous concerns for the decision making process may include personal perceptions, attitude towards the subjects, learning experience, family expectations, gender roles, social norms, future prospects, values of education. In addition, students’ own performance/capability in studying the subject was a factor that shaped their attitudes, as well as the limited choices, which appeared to exacerbate the frustration and negativity.

The concerns in the decision making process had different levels of importance, according to the individual and their circumstances. When students were making the decision, they tended to analyse their concerns, by weighing the favourable and unfavourable factors, in each study group. As a result, they chose the group that weighed more positively or avoided the one they disliked more.

Intriguingly, although science subjects were thought to be more difficult to study, most students considered the science study group, as a first choice. The exception to the rule was when they had a strong negative attitude towards natural science. Parents, teachers and students themselves, all considered science students to have a greater opportunity to gain entry to university, find a good job and achieve higher social status. Science students were also thought to be cleverer. However, the educational system itself was instrumental in this inclination, due to the limitations of alternative choices and vacancies in the universities.

With regard to the many concerns during the decision making process, the final choice might not be the most interesting to the student, preferred or most suitable subject for a student. Instead, this choice tended to be a compromise based on internal and external factors. Moreover, all the teachers reported the lack of internal motivation among students because a considerable number of students did not choose their study group based on subject interest. Consequently, students did not enjoy learning science, which led to many failures and frustrations. These frustrations resulted in negative attitudes towards the subjects, which in extreme cases caused a
downward spiral enthusiasm. Understanding the students’ concerns helps to identify the possible reasons for lack of prominent achievement and originality in the sector of academic science research.
CHAPTER 10. EXPLORATIVE MODEL OF DECISION-MAKING IN STUDY GROUP

10.1. Introduction

The model constructed in chapter 6 illustrates the mechanism involved in the formation of negative and positive attitudes towards school science, and the tendency towards choosing school science based on the model of pro-environmental behaviour. The model could not predict the students’ choices, either explain why a considerable percentage of students chose to study science when they hold negative attitudes towards science, or keep staying in the science group when they developed a negative attitude. The findings in chapters 7, 8 and 9 revealed that their attitudes and interest are not necessarily the most important factors that students take into account during their decision making. Therefore, another model is needed to provide a more comprehensive and clearer picture of the influences and concerns.

In this chapter, a decision-making model for subject choice will be constructed based on the findings from the chapters 5 to 9. The sociological model of “Careership” (Hodkinson, 1996; Hodkinson and Sparkes, 1997) is used as the basic framework to examine the complex components and procedure of decision-making of the Taiwanese students.

The dimensions proposed in the Careership were 1) the pragmatic rational choice, 2) the disposition of the player in the training fields and 3) the unexpected turning point. To construct the model, different concerns were grouped to show influences that the individual receives are organised as his position in society (see 10.2 and 10.3) and resources available during the process of pragmatic choice (see 10.4 ) and personal/learning experience. The model was then expanded to four parts because of the complexity of decision-making: the macro-position of individuals in society (diamond structure), the actors that have close or direct influences on the individuals (micro structure of a tetrahedron), the factors involved in the decision making at the personal level, and the goals individuals pursue. These parts are closely related and
embedded together. Figure 10-1 is given to explain the complex process of choosing a study group in relation to the people and the cultural context involved. It demonstrates the concerns, influences, goals and positions of an individual during the decision-making processs.
In Hodkinson and Sparkes’s data, individuals have different trajectories based on their life experience and their position in the “game” and each player has his own goal during the game. However, the goals were not clearly described by Hodkinson and Sparkes because their interest is in the individuals’ trajectories rather than their end point. My research has important findings, from the implicit concerns that participants have revealed, to the implicit and explicit goals that young people and their family seek in life. These goals determine their behaviours and decisions. These goals will be discussed in this chapter, from the imminent decision they have to make in the school to the ultimate ideological goals that guide the decision making as well as the development of one’s pathway.

10.2. Influences from the Surrounding Actors: Social capital and Decision of Collective Opinions

Students and teacher expressed the pressure and suggestions that parents have influenced the students but most of the students said that they were allowed to make the final decision. This reveals something more complex than the superficial statements the participants have made. It may reflect that the individual feels – or likes to feel – that we are free actors making our own decisions, and not to recognise that these decisions may be highly influenced, mediated or even determined by structural factors, by things outside ourselves.

Hodkinson & Sparkes (1997) in their sociological framework of younger people’s decision making strongly argued that individuals are not completely free in making their own decisions. They pointed out the unequal resources that the individual has in the “training credits field” which might also affect their choice. By looking at this aspect, they use Bourdieu’s concept of “social capital” to explain the role and position that players have in “a game” or “a market”: players have different positions and each player has his own ideal goal. All these players have different resources and powers that form the “relations of forces” in the game. The resources and power of each player are deemed as his capital. Players play their game on the field with different social capitals and different horizons for action arise during the game. As a result there is a mixture of “alliance, negotiations, agreements and conflicts” that
individuals might experience during the game.

Hodkinson and Sparkes’ (1997) theory arose from their study of job and training opportunities. But, a similar situation and individual position are found in this research. There are various forces, arising from different external actors, pushing or leading individuals in different directions. In this research, the influencing actors are cast in four categories: parents, peers and siblings, teachers and the media, according to the sources of information around the individuals. The relationship between individuals and the influencing actors can be considered to form a shape of a tetrahedron with the individual’s “self” in the middle of the micro structure (Figure 10-2). Individuals receive different information and suggestions from the surrounding actors and process the information through alliance, negotiations, agreements and conflicts. As a result, the strength of the influence from various actors might form different tetrahedron shapes, depending on the strength of influence, thus, reflecting the individuals’ situation. The individual’s final decision is a decision that is revised by the self and surrounding actors. This choice is also influenced by the social norms. Accepting the collective opinion of significant actors may reduce the pressure and sense of personal responsibility, while increasing a sense of security from for the individual.

![Figure 10-2. A 3-D structure of the surrounding influences on individuals](image)
The key factors that influence the individual by the four groups of actors are discussed below.

10.2.1. Parental influence

“Youzi [a philosopher] said: They are few who, being filial and fraternal, are fond of offending against their superiors. There have been none, who, not liking to offend against their superiors, have been fond of stirring up confusion. A noble man starts from himself. That being established, all practical courses naturally grow up. Filial piety and fraternal submission, are they not the root of all benevolence?” (Analects of Confucius: Learning 1:2)

Parental influence appeared to be the most important factor involved with students’ decision making according to the teachers and students (those who mentioned having friends whose parents made the decision). Traditionally, children are taught to respect their parents, which is a doctrine found in numerous modern as well as ancient textbooks (Analects of Confucius, Dao De Jing, Hsu, 1949; Hwang, 1995). One important element of filial piety is obedience to parents, and this conformity sometimes extends to society, for example, as social norms. Young people left important decisions to their parents, thus showing respect, and acknowledging their parent’s authority and wisdom. The parents will try to make the best decision for their children. However, a change is occurring where the younger generation appears to have more freedom to make their own decisions, although they still consult with their parents on important decisions. Findings in this research show that students had the freedom to make their final decision, but parents still tried to impose their opinion. Parents today hold back their traditional authority and express their opinions with a more suggestive or reserved tone. They tend to avoid telling their children directly what to choose and want them to take responsibility for their own decisions, but most of the students seemed to adopt their parents’ opinions or suggestions.

Studies have shown that when children spend most of their time with their parents, whose opinions are an explicit and implicit influence by their parents as parents express their preferences in their daily life (Piaget, 1969; Zastrow and Kirst-Ashman, 2007). This effect, where, seems to be very noticeable in a society with close family ties, as found in this research.

Although parents who participated in this research said that they respected their
children’s choice of subject and did not force their children to make the choice that they preferred, the parents, in fact, did voice their opinions. Most students either “considered” or “chose” the study group that their parents suggested, unless they had a better reason to do otherwise. This was particularly obvious with students from the science study group because parents stated openly or implied that they preferred and encouraged their children to choose to study science. All the science students expressed that their parents were happy with their choice. Many social studies students received parental dissatisfaction with their choices. It is clear from the students’ comments that parental opinions are taken very much into account. These opinions are influential but not necessarily determining, due to the influence of other factors.

There are similarities between what is observed in this research and Bourdieu’s analysis (1990) of the reproduction in education. For example, in this research the manual worker parents stated that they could not provide the same cultural capital in terms of direct academic support as can the more educated “office workers”.

However, there is one fundamental difference from Bourdieu’s (1990) work. This is that parents of all backgrounds in Taiwan value education just as strongly. For manual working parents, education is seen as a route to upward social mobility for their children. They do what they can, therefore, to promote their children’s education, including working hard to pay for private education. In many ways, the pressure on their children to succeed educationally is greater from these parents than it is from office working parents. There is more to gain for their children from educational success, hence greater pressure to succeed.

10.2.2. Teacher’s influence

“Respect the teacher, respect the dao”. (Chinese Proverb)
“God, earth, lord, parents, teachers” (Tai Pin Jing)
Tzu Hsia asked about filial piety. Confucius said, "What is important is the expression you show in your face. You should not understand 'filial' to mean merely the young doing physical tasks for their parents, or giving them food and wine when it is available." (Analects of Confucius: The virtue 2:8)

Teachers in traditional Chinese culture have a high social status and this tradition is followed in Taiwan. Teachers’ words and opinions are highly respected and are
influential on students and parents. Although the structure of schooling and social culture has changed greatly in modern society, and the teacher’s word might not carry as much weight as it did in the old Chinese teaching, the teachers’ opinions are still well respected. This is reflected in this research which students still consulted their teachers for suggestions on subject choice. Knowing the traditional teacher-student ethics helps to understand and explain why/how teachers’ opinions may influence students’ decisions both consciously and subconsciously. The respect and influence were clear in statements form several students interviewed in this research.

10.2.3. Peers

Confucius said: "Isn't it a pleasure to study and practice what you have learned? Isn't it also delightful when friends visit from distant places? Is he not a man of complete virtue, who feels no discomposure though men may take no note of him?" (Analects of Confucius: Learning 1:1)

The philosopher Tseng said, "I examine myself on three aspects daily: whether, in transacting business with others, have I been not faithful; whether, in intercourse with friends, have I been not sincere; whether I have not learned the instructions of my teacher." (Analects of Confucius: Learning 1:4)

Friendships and siblingships are very important in the Chinese context because keeping good and respective relationships with friends and siblingships are particularly emphasised in the traditional Chinese teaching. In this research, friends, siblings and relatives who are of a similar age are categorized as “peers”. Being of the same generation, they often communicate with each other, within the same subculture and form of language.

Although no students admitted being influenced directly in their decisions by friends, many of them gave examples of others who had been so influenced. This suggests that such influence is common but may not be recognised by the individual. Peer role models, experience and pressure were the most frequent patterns of student influence because of their similar age and position in society. So students were pressured to follow the other students’ opinion so they do not feel different from their peers, while some saw successful examples as good models to learn. Similar influences/pressure on young people’s career decision making from peers were also found in other studies (Ball et al, 2000; Hodkinson and Sparkes, 1997).

Moreover, there seems to be a culture of parents comparing their children with other
children in the same generation. The purpose of this comparison was to set up a role model, to push their children to work harder or to raise their aspirations. Although children tend to be unhappy with this comparison, and feel pressure with this competition, this method seems to have a positive effect. Students will generally take their studying and future planning more seriously, when they experience this type of competition.

Nevertheless, the young people in this research appear to have some level of identity crisis and confusion that has been repeated elsewhere (Malim and Birch, 1998; Ball et al., 2000; Hogg, 2005; Zastrow and Kirst-Ashman, 2007). They are expected to be good students, son or daughter, role models, as well as have a successful future. The association together with pressure from various actors often influence them to choose most common or possibly same choice as their peers, which may make their decision easier and reduce perceived risks.

10.2.4. Media

When faced with making an important decision, individuals collect information from people with whom they are in daily contact. However, the individual’s world at this stage is limited. In addition, influences received from different actors sometimes appear disordered and bewildering.

The media appear to be important to students and towards other actors around the individual. Everyone, including parents and teachers, in this research, repeatedly mentioned the media as a source of information, especially television. Trends of the future job market and vacancies for university placement were two key media topics of interest. The recognition of the media as sources of information was: 1). Information about the world beyond one’s immediate experience; 2). Perceived authorities and credibility that the media may carry. The modern society that young people live in is complicated. They receive daily information from many different types of media sources. Thus, the influence of the media is vast and deep.

In the first part of this study, some students explained that negative images of scientists came from cartoons and television programmes. Such findings may easily be overlooked but they highlight the impact of the media on people’s opinions and
decisions, both consciously and subconsciously. This evolving relationship between the media and the public is a feature of the modern world.

10.2.5. Conclusion

Most students’ opinions may be shaped by influences from different actors. This means the actors involved exert varying influences, which the recipient will compile and assess, and thus may either assimilate or react against. How these outside influences modify the recipient, depends on the individual’s views, capability and strength of character. These changes to an individual’s opinion may be subtle, occurring from early childhood.

In addition, some actors appear to have diverse paths of influences. For example, the media had a strong effect on all the other actors around the individual. However, not everyone followed the direction of the collective opinion, and some students disagreed with various actors’ views and suggestions. These students express greater confidence of their goals in life, and dealt with their decisions using a strategic approach towards achieving their goals. The reflection and choice is often determined by the various opinions and influences.

10.3. The Decision-making Process at Personal Cognitive Level: Pragmatic rational choice

The choice of study group entails consideration of a wide range of factors, from the internal cognitive and attitudinal factors, to the external social factors. The concerns may be divided into two levels: the four core central concerns, and the other surrounding factors that shape these central concerns. The process of decision making involves a series of sophisticated comparisons and the weighing of the importance of each concern. Hodkinson and Sparkes (1997) called such complex calculations “pragmatic rational calculations”. However, findings in this research show that there is more than just calculation involved in the decision making. Specific strategies/calculations aimed at achieving the best or particular results were also employed by students. Factors involved in the rational calculations are discussed here, and the implicit strategies that are employed to achieve different goals in life are discussed in section 10.4.5.
The sociological theoretical model of young people’s career decision making, 
Careership, developed by Hodkinson and Sparkes (1997) is used here as a framework 
in discussing students’ concerns and influences. The model includes three complete 
integrated dimensions: 1) pragmatically rational choice decision-making which is 
located in the habitus (Bourdieu, 1997) of the decision-maker, 2) interactions with 
others in the youth training field that relates to the unequal resources that individuals 
possess, and 3) unpredictable patterns of incidents or turning-points that make up the 
course of life. The model was based on Hodkinson’s previous theory, “horizons for 
action” and Bourdieu’s work on cultural reproduction and social inequality. 
Hodkinson and Sparkes (1997) claimed that the model can avoid the two pitfalls of 
arguments in other studies i.e. the implicit social determinism, and seeing young 
people as completely free actors to make decisions.

Due to individuals’ varying objectives and circumstances, for example chapter 8 and 
9) no set orders of consideration of factors were found in this research. The most 
important core concerns included personal factors, social norms, parental 
expectations, and opportunities (see Figure 10-3).

Figure 10-3 Concerns involved in the decision making

Under the main core concerns, there are various factors that influence the final 
decision, which additionally shape the four main concerns (See chapter 5-9). These 
factors are sometimes crucial and may determine the outcome of the decision making, 
for example bad exam results may cause students to choose another subject, 
regardless of a positive attitude/value towards the original subject. Individuals weigh 
the pros and cons of each factor, and then make a choice based on the desired 
outcome (jobs or income found in this research). The importance and weight of each
concern or factor, varies according to the individual, depending on how much the concern/factor can support or restrict the future development. Factors that shape an individual’s attitude and perceptions of different subjects are discussed in chapter 5 and 6. Only the four core concerns (personal factors, social norm and tradition, opportunity and competence, and parental expectations, shown centrally in Figure 10-3), are discussed in this section.

10.3.1. Personal factors

When an individual makes a choice, psychologically they start from factors that closely relate to themselves (Marlin and Brich, 1998; Hogg and Vaughan, 2005) (also see 7.1). They take into account personal factors, such as interest, attitude and their ability in the subject. Thus, students with a more positive attitude towards science, tended to choose science. Although some students value highly and have considerable interest in school science and real science, they chose the social studies group because of their poor exam result. However, as discussed in Chapters 5 and 6, interest, attitude and belief are complicated, and attitudes often represent the sum of all the factors. An individual’s cognitive system also does not recognise the different influence of the various factors, when the learning process is gradual. By the time students need to choose a study group, many of them have already formed specific attitudes and will tend to choose the subject they like or to avoid the subject that is associated with a bad learning experience. However, as discovered in this research, there were also a high percentage of students whose final decisions were not necessary based on their attitudes. This again shows the complexity of human behaviour.

10.3.2. Social norms and traditions

Social norms are powerful influences on behaviours of individuals and society as a whole. People do things to seek acceptance from friends, family or society because they want to be part of the main stream, and individuals are afraid of being left out by their group or even society as a whole (Hogg and Vaughan, 2005). Actions and behaviour may also serve the purpose of avoiding exclusion from others. In this study, most people tended to follow the social norms consciously or/and subconsciously.

Social norms are strengthened by the bonding between the individual and those surrounding members of the individual. They are deeply embedded in the social
context and reaches individuals through different channels. Therefore, young people make their decision under the influence of social norms. Within social norms, students take into account the following:

10.3.2.1. Future trends
The findings of this research show that the view of “future trends” was shared by students’, parents’ and teachers’, which is based on the technology industry in Taiwan. These similar views tend to be the social norms on people’s view of future opportunities, which has been formed over a long history of traditional teaching, economic development and globalisation.

10.3.2.2. Value of education
The value of education was commonly mentioned by students and parents. Education has been important in traditional Chinese society and still remains a symbol of high social status in modern society. It is a way to move upwards in a hierarchical society, as well as gaining respect from others. A common opinion held by research participants was that “It is always good to study as much as you can”. One student (Jade) expressed the opinion that education allows one to acquire more knowledge, a greater capability in problem solving, which would lead to greater potential for future possibilities. The view might be instrumental but is where the socially recognised value lies. That is why students spend a huge amount of time in the school and private tuition.

10.3.2.3. Gender roles
Socially accepted perceptions of roles and responsibilities of different genders appeared to be important for the decision of study group. Boys are considered tough while girls are thought to be soft. Science subjects are seen as rigorous and tougher, and are thought to be more suitable for boys.

The traditional structure of Chinese society is more paternal and it still remains much like it in Taiwan. Boys are responsible for supporting the family when they grow up and girls are expected to marry into another family. In addition, boys represent the
family line and they are responsible for honouring their ancestors. Therefore, boys have pressure placed upon them, to plan for their future. Girls, on the other hand, receive less pressure but should they find a job to help the family, it is viewed as a bonus. With the industrial and technological development of Taiwan over the last two decades, boys are under more pressure to take a path leading to a science based career. Now there is a greater sense of equality between the sexes and girls are also encouraged to study science if they are interested or capable of studying science although they tend to have a free hand for their decision. However, despite the differences in expectations for males and females, all students sought for secure and well paid employment.

10.3.3. Opportunity and competence

Hodkinson and Sparkes (1997) noticed that while the players are “playing the game”, there are other things happening in the field, such as unexpected sporadic opportunities. Sometimes an opportunity may appear several times before the player seizes the occasion. When this occurs, it becomes the transition point where young people change their trajectories. Similar to Hodkinson and Sparkes’ theory, some unexpected events may change the original plans but the findings in this research are more intriguing. Students were, in fact, trying to predict and pre-calculate different scenarios for the future before they have reached the point of more unexpected changes, such as the exam results.

The two most important and immediate goals for students are entry to university and obtaining employment. Vacancies at universities and academic competence are the two dimensions they take into account. Potential achievement and possibilities were carefully calculated and estimated. This is similar to Hodkinson’ and Sparkes theory, that a new route to the goal starts when the individual grabs an opportunity. However, in contrast to Hodkinson and Sparkes’ theory, this research found that the road map or blueprint to personal future development were already formed and examined before students made their decisions. Calculations and strategies were employed to optimize the possibility for achieving their goals or to minimise the possibility of failure. However, these calculations were mostly not made systematically because none of the students were formally trained in strategic decision making, although they were able to state the reasons why for choosing the route and goal they were aiming
to achieve.

An important characteristic of these calculations and estimations of opportunity and competence is that the weight of concerns cannot be quantified due to each individual’s situation. The weight of each factor is measured on every individual’s own scale. The decision is mostly rational in one’s own standard and interpretation. For example, some people weigh their future prospects more than their attitudes or some people feel memorising is more bearable than others.

10.3.4. Parental expectation

As mentioned in the source of influences in 10.2.1, parental expectation is important although it might be subtle and implicit in today’s society. Most of the students take their parents’ suggestions into account. However parents’ expectations are also related to students’ interests, social norms and job opportunities.

10.4. The Implicit Goals in life and Strategies Employed

One important feature emerged from this research was the pulling force from the perceived future goals. Various strategies were used by students students to achieve their goals. Similar to the characteristic of rational choice (Hatcher, 1998; Goldthrope, 1998; Scott, 1999) and pragmatic decision (Hodkison, 1995; Hodkinson, 1996; Hodkinson and Sparkes, 1997)--calculations and comparisons will be meaningless without a goal.

The goals of the students are divided into four stages: short-term goals, mid-term goals, long-term goals and the ultimate ideological goal. The imminent short-term goal is to decide their study group as required by their schools; the mid-term goal to continue their education at university; the long-term goal to have a secure life; the ideological goal which is to be a respected person. However, both students and parents have a less precise vision for the goals further into the future. Each stage may be viewed as the development of the student’s life. Hence, there are different foci for each level.

Parents also have similar future prospects to their children’s. However, unlike
students facing the challenge of choosing their study group in a short term, parents are more focused on future prospects, for example, university entry, employment and the ideological goals. The visions from the various actors and the goals in life are shown in Figure 10-4.

Figure 10-4. Goals in life from students' and parents' point of views

Although the goals stated were not presented as a coherent scheme, the short-term, mid-term, long-term and the ideological goals logically will emerge in different stages of life. This is why goals and visions have now tended to become part of the philosophy of life. Based on the teaching that the student has received, the ideological goal is the ultimate goal that a person should try to achieve, although it is not strictly required by society. However, as part of social norms, most of the people follow the teaching. This shows that the goals present society’s ideals. The goals are closely linked and causally related from the previous stage to the latter stage. Within each stage of goal, there are also different sub-goals.

In this section we will explore students’ conscious and subconscious goals. This finding is important because it explains the utilitarianism aspect of the complicated calculations and rational choice in choosing a study group.
10.4.1. The short-term goal
With their education in mind, the students’ immediate short term goal is to choose a study group that best serves their interest, attitudes and ability. However, the short-term goal is closely related with the mid-term goal and serves as a preparation for the next stage. Shortly after choosing their study group, the main mid-term goal of entering to university becomes significant.

10.4.2. Mid-term goal
The general mid-term goal is to continue to a higher education level, namely, to pass the entrance exams. As education is highly valued, both traditionally and in the job market, the most important goal at the high school stage is to gain entrance to a university. However, some students with more confidence and ability, aimed higher for entry into distinguished universities. It follows that the mid-term goals relate closely to the long-term goals with employment being paramount.

10.4.3. Long-term goals
The long-terms goals include the seeking of security, status and access to material goods through employment. Decisions made in the previous stages should serve the purpose of achieving these goals at the time of planning. However, each individual will have different standards and views for an ideal life style. Therefore, the route individuals choose, will undoubtedly vary from student to student.

10.4.4. Ideological goals
The ultimate goal for students is to be a person who embraces the philosophical integrity, who will be respected by others and thus can honour their own family. In the traditional Chinese teaching, such a person is expected to be knowledgeable and benevolent. To achieve the goal, persistent education and hard-work are normally required.

Nevertheless, no one has mentioned the level or intelligence or unequal opportunity for different sexes in the data. It seems that to ensure the ideological goals are achievable, the following two basic and ideal principles are generally accepted:
1. Everyone is born equal, approximately, in term of intelligence. No-one is less intelligent but some people do not work hard. Everyone can achieve the same level at study if he works hard. This was because no participants had taken this concern into
account or discussed the relationship between gender difference and ideological goals, although they have received different expectations for genders.

2. Girls are equally as clever as boys if they are provided with the same education and opportunity. So if they are encouraged to choose science they can be as good as boys. Therefore, girls choosing science should not feel discouraged.

However, students and parents are aware that there is a gap between ideology and reality. They understand that they cannot always achieve their ideals because there are other factors at play apart from equality. For example, although everyone should be able to achieve the best results in life through hard work, parents and students were aware of the possible obstacles to students’ actual academic ability. Realization that goals may be unobtainable naturally requires parents and students to lower their expectations or choose alternative options.

In practice, the achievement of equality can be shaped by gender roles and stereotyping. In contrast to other studies (Garratt, 1986; Sturman and Sharples, 1992; Whitehead, 1996; Giles, 2002; Osborne, 2003; Williams et al, 2003; Banya, 2004; Miller et al, 2006), girls are found to have less pressure compared to boys when they choose to take up science and they receive more praise if they excel.

The two situations are illustrations of how Taiwanese students and parents cope with the gap between ideal education philosophy and reality. Such examples show an important characteristic of the culture, of which members are embedded. Because of the traditional teaching that individuals hold in their life philosophy, the employment of strategies are reinforced to minimize the gap of ideology and reality.

10.4.5. The implicit strategies employed

The process of decision making at personal level includes influences from the surrounding people, and different factors operate at the internal cognitive and affective level. Individuals’ goals serve their basic human needs for security and self-esteem (Maslow, 1943) and they also have characteristics in different dimensions: psychologically, sociologically, historically and economically. Students are always seeking means to achieve their goals and to meet other people’s expectations in order to meet their own basic needs. However, the strategic decision making is done subconsciously and descriptively. It was discovered in this research, that students
employ several different techniques to achieve their goals based on rational calculations. Calculations of likelihood of outcome and possibilities are analyzed within each option. Decisions are made by different strategies in order to reach their goals.

The first strategy is close to the “optimization” or “maximization” used in the mathematics, economics, psychology and management fields (Coleman, 1909; Aliningham, 2002; Anderson, 2002). Based on the student’s competence and social resources available, the option that achieves the best outcome or seems to provide the highest possibility for success will be chosen.

The second strategy is similar to that called “minimax” in the business and management field (Wit and Meyer, 1998; Camerer, 2003). Possibility of losses and failures in each option are calculated and the option that has the least risk or losses is selected. The calculation is also based on ones’ estimation of personal competence in relation to one’s chances of failure.

The third strategy aims to achieve at least some level of success. Similar to “minimax”, this technique sometimes has the same effect. However, the approaches are not exactly the same. As used in the game theory and social decision-making, “maximin” (Rawl, 1999; Camerer, 2003) is to maximise the minimum gain. This tactic is favoured amongst those students who prefer to have a lower risk of failure but also want to achieve their goals. For this technique, one creates a predisposition for the future position by avoiding and absorbing the unexpected outcome. For example, students might choose the science group because they believe that they will “at least” get a place in the university in case they do not do well in the exam. This tactic is more related to the insecurity that human beings have at the psychological level, as well as the sociological goal. Its aim is to ensure success at least at a level in one’s favour.

The strategies can be used singly or combined. Some students combine all approaches in order to achieve the optimal gain and minimum loss when making their final decision. Nevertheless, the weighing and comparison is subject to the individual’s own scale. Therefore, each individual has differing methods of calculation, even
though they might share similar concerns and goals. Thus, taking various factors into account, decisions might vary from person to person.

Although the students’ goals were ordered from the short-term to the long-term and supported by their ideological goals, they tended to plan their goals and decisions in different orders. A common practice was to outline or formalize the aims for the long-term goal and then work through the mid-term and short-term goals. They tended to anticipate their future plans and then designed a road map to reach this point. Thus, the decision was made based on the route planned. Although unexpected events might occur and the young people might “revise, resee and rejudge” (Hodkinson and Sparkes, 1997), the decision will always be made again using similar techniques and new routes will be generated at the point when new decisions are made. Thus, goals might also change as life progresses but they remain important and serve as guidelines for calculations, strategies and decisions.
CHAPTER 11. CONCLUSIONS AND RECOMMENDATIONS

11.1. Research Conclusions

The aim of this research is to provide answers to the questions raised in chapter 4. The research questions were as follows:
1. What are the factors that shape Taiwanese students’ attitudes towards school science and real science?
2. How are real science and school science perceived in by students in Taiwan?
3. What are the concerns students take into account during the decision-making process and what are the influences from the surrounding environment?

Objectives generated by these research questions were summarized:
• To produce a questionnaire to identify Taiwanese students’ attitudes toward school science in junior high and senior high schools.
• To gather data to enable understanding of Taiwanese students’ attitudes toward school and real science in junior high and senior high schools.
• To identify reasons for or explanations of why students like or do not like real science and school science.
• To generate discussions among students in order to explore Taiwanese students’ perceptions of school and real science.
• To interview students in order to explore and analyse the concerns they take into account when making their decision of choosing study groups.
• To interview parents in order to understand their points of view thus shedding light on their children’s decision making process.
• To interview teachers on how they think students’ decisions are influenced or made from teachers’ point of view.

Although initially students’ attitudes and perceptions of science and influences from parents and teachers were thought might be the reasons for students’ to choose natural
science, more factors and influences emerged through the process of research. A diagram (Figure 11-1) shows the relationships between the various concerns and influences.

Figure 11-1. Factors emerged in this research

Conclusions
The findings of this research provide a clearer understanding of factors that shape the students’ decision-making when choosing their subjects, especially the influences involved in the decision to take up science. A large number of factors and participants were investigated in order to clarify and identify the influences and concerns that shape students’ decision making for their choice of study group.

The work accomplished in this research is outlined as follows:
1). Identifying Taiwanese students’ attitudes toward school science and real science and the factors that shape their attitudes.
2). Understanding the Taiwanese students’ perceptions of science and social studies.
3). Exploring the concerns and influences on students’ subject choices during the decision-making process.
4. Constructing a model of decision-making process of study group among young people in Taiwan.

A profound finding was that, different from the situation to which most of the western (largely UK) literature refers, the decision that Taiwanese students have to make for their study groups was perceived as a crucial splitting point in their lives with profound implications for career options by the students, parents, and teachers. This was partly because of the point they have to make this decision is close to the age at which they become legally independent and partly because of the cultural background, the organisation and constraints within the educational system. It might be same important for the UK students to choose their subjects at A-level but prior to that point, many students are able to choose their subjects in the school. The early splitting point might mean that the choices are more related to the attitudes rather than the career concern.

Also, there are only two pathways for the high school students in Taiwan- the NSP and SSP options. After the splitting point the pathways remain largely distinct and separate. The chances for students to change from NSP to SSP are few but almost none from SSP to NSP. However, under the influences of cultural, educational and economic concerns, most of the students are set to take up science unless they have major reasons for not doing so. A lack of enthusiasm or a negative attitude towards science is simply not an adequate reason on which to base a decision which has such significant consequences for future life chances. The decision over which study group to enter is treated seriously and carefully than would appear to be the case reported in the Western literature. In that literature, the age at which subject choices must be made tends to be lower but the students have more flexible curriculum and a greater range of choices compared to the Taiwanese students. The multiple pathways and the possibility of changing pathways also reduce the pressure of absolute career concerns. Other conclusive findings to the questions raised in this research are:

11.1.1. Perceptions of science and social studies by Taiwanese students

The purpose of understanding students’ perceptions of science is to clarify how perceptions of science can fundamentally influence students’ subject choice. Although students claimed to receive science information outside the curriculum from
the media, parents and daily life, the information outside textbooks still appeared to be limited and shallow. The results showed that for both science and social studies students, their perceptions of school science and real science was rigid and instrumental. For example, science is generally associated with stimuli and responses, measuring equipment, numbers and calculations, experiments, logical thinking, observations, questioning, hypothesis and theory building. However, since students from both study groups had a similar definition of science, their perceptions of science still did not explain fully how students choose their study groups.

Students’ perceptions of the value of science or the usefulness of science was found to have a stronger connection with their choice of study groups; for instance, science students tended to give more praise to science while the social study students showed less appreciation.

In addition, the media were found to have a wide influence on aspects of their views of science, from images of scientists, to applications of technology and science. The science students expressed a preference to become engineers and medical workers.

11.1.2. The attitudes the shaping factors toward school and real science and
A survey of 729 secondary school students was conducted in order to understand student’s attitudes toward school science and real science. It is evident in
Figure 6-1. (Chapter 6), presenting attitudes towards school science, that there is a notable decline in positive attitudes coinciding with a trend of negativity and ambivalence, with the advancement of students’ schooling. Thus, school science becomes increasingly unpopular, in particular for the high school students.

A number of factors were found to be related to the students’ attitudes toward school science, such level of interest, teaching methods, perceived difficulty, teachers and teaching, curriculum and assessment, subject differences and gender differences. Some of the findings are similar to those found in the previous studies (Schibeci, 1984; Kelly, 1987; Murphy, 1991; Clark, 1998; Hendley, 1996; Lightbody and Durndell, 1996a; Whitehead, 1996; Bennet, 2001; Wallace and Louden, 2002; Osborne, 2003; Miller et al, 2006). However, a number of new findings were also discovered, which have not appeared in previous studies i.e. pressure from excessive, repeated exams and low confidence due to the poor exam results, and other general distractions from learning.

A higher percentage of positive attitudes toward real science were found amongst the same participating students, which remained stable throughout the schooling years, as shown in Figure 6-5. This is a reflection that, firstly, real science and school science are not perceived to be the same, and secondly, school science has failed to raise students’ interest and motivation, despite their being a potentially enthusiastic audience.

In addition, in the survey of science students in year 11 and year 12, 28% and 36%, respectively, stated they disliked school science. Such findings reveal that a large proportion of students who chose to study science do not actually enjoy the subjects of the study group. This phenomenon of choosing a subject which one finds disagreeable has been difficult to explain and is inconsistent with the high achievement in the international science competitions and high competitiveness of Taiwan’s technology industry. The reason for students to choose to study science is not a reflection of their attitude towards the subject.

Reasons why students did not like real science were more related to their interest, bad learning experiences in the school and negative images of scientists; whilst the
positive attitudes were more related to the interest and the relevance of real science to the real world. A cognitional system of behaviour model was constructed to illustrate factors that shape students’ attitudes and inclination when choosing to study science (see Figure 6-7). This behaviour model illustrates detailed factors that shape an individual’s attitudes at the cognitive level and the tendency of choice.

11.1.3. Concerns and influences on students’ subject choices during the decision-making process

Influences on the decision making process are complex. At a personal level psychological, economic and traditional concerns prevail, whilst other sources of information present additional complications to the reasoning that they place.

The internal factors consist of interest, attitudes, perceived difficulty, life experience, usefulness of the subject, academic achievement, learning environment and the perceived gender role. The external factors comprise access to university, access to employment, parental expectation, social norms and traditions, social gender role pressure, constraints in the education system and suggestions from others (Chapter 7). These factors are related to the students’ resources, which are similar to Bourdieu’s “capital” (1973) used in Hodkinson and Sparkes’ sociological theory for young people’s decision-- “careership” (1997) and the process of decision-making was also pragmatic. However, an unusual characteristic of students from manual working backgrounds contrasts with Bourdieu’s cultural reproduction because these students, in this research, endure higher parental expectations and pressure to move upwards in the hierarchical social structures. In consequence, the effect of cultural reproduction in Taiwanese society maybe not as obviously as that in the western countries, of which also implies the restriction of its application in a different cultural context.

11.1.4. A Model of decision making for study group choice

The model constructed in Chapter 10 (Figure 10-1), illustrates the complex decision making process amongst students in Taiwan, using the sociological framework of careership as described by Hodkinson and Sparkes (1997). The model shows the position of individuals in the decision making process, as well as relationships between the individuals and wider society. These include the positions of individuals in society, the closer world they are related to, the resources they possess, the factors
that influence their decisions and the goals they pursue in life.

Each individual, naturally, has different concerns and decides in a different way, although there are similarities and patterns in the different trajectories. The core concerns include interest/attitude, parental expectations, social norm/trend, opportunities and competence. However, the weighting is subjected to individuals’ cognitive and affective circumstances. The implicit goals that students have for different stages of their life, provide guidance for their decisions. These goals tend to be socially constructed or influenced by the surrounding actors but may also be restricted to the social resources available to the individual. Students employ various strategies to achieve their goals, both consciously and subconsciously, although this may be derived from parents and teachers, as no formal training is provided at school. Parents and teachers also have very similar ways of calculation and planning. It seems that to think strategically is important in the Taiwanese culture context especially when it is related to future jobs.

The model in Figure 10-1 provides an insight and explains what factors and forces are involved when making the decision of choosing a study group. A further complication comes from the individuals’ strength of character and resources, and how they adapt and conform to their culture, society and social norms by using different tactics to achieve the best results at the first splitting point of their career path. As a result, the behaviour and interactions individuals carry out in the wider society are the ways they make sense of their own world.

11.2. Recommendations for Helping Students’ Decision-making

The results from this research show that students experience considerable levels of pressure and difficulties when selecting their subject choice. By identifying factors and mechanisms that are involved in the decision-making process, students, parents, teachers and policy makers may have a clearer understanding of how attitudes and decisions were shaped. To reduce the pressure and difficulties that students experience during the decision making process, suggestions are made based on the opinions and needs expressed by the students together with the issues raised in this research.
11.2.1. Improving students’ self understanding

Most students described how they experienced confusion and difficulties, during their decision making. The lack of self-understanding seemed to be a major issue, especially in terms of their own interest, attitude towards subjects, future plans and accessible resources. Educators and parents should provide more activities or facilities to help students explore their own identity and life goals, which are crucial to students’ personal development. This research deduced that when students had a better understanding of themselves, they experienced less pressure and confusion during their decision making, as shown in Shaun’s case in chapter 8.

However, prior to improving students’ self-understanding, it is important to improve student’s ability for independent thinking and self expression. Adeptness of independent and critical thinking is essential for self-understanding. Generally, the students’ lacked the ability to express themselves although it was found that students from the urban areas were most articulate, together with social study students.

11.2.2. Improving students’ attitudes toward school science

As discussed in chapter 7, students generally stated that attitudes and interest were key factors for the decision making process. Thus, the motivation to choose science can be enriched through raising both interest and attitudes. From the responses shown in chapter 5, several aspects emerged which were seen to cause negativity. The following sections highlight these problem areas, and offer ways to enhance students’ attitudes towards school science:

11.2.2.1. Raising the value and job prospects of school science

The usefulness of school science and its job prospects were found to be important in this research and some previous studies elsewhere (Ebenezer and Zoller, 1993; Woolnough, 1995; Elsworth et al, 1999; Bennett, 2001; Campell, 2001; Osborne, 2000; Osborne, 2003). Students with positive attitudes towards school science were found to give more value to the subject. In this study, students’ views and valuing for school science and real science were different but related. For example, students who did not value real science highly also expressed similar opinions for school science, as shown by the results in chapter 5 and 6.
Beliefs in the good prospects for science related jobs, such as medicine, engineers, etc, were found popular amongst most of the students. However, the image of scientists was found to be rather negative and is influenced by the media.

An efficient way to promote the image of scientists would be through television programmes, although such productions would rely on funding from various science education organisations. Alternatively, the image of scientists and related job prospects could be promoted by science teachers. If teachers could provide more positive images of scientists and their work, there might be more willingness and motivation for students to engage in the science research if they think high-tech is the direction for the future.

11.2.2.2. Teachers’ training
The learning environment plays a vital role in influencing students’ choice and teachers are in a key position to influence students’ attitudes towards school science and their subject choice. However, a perceived bad learning experience has a greater influence on students than many good ones, and could lead to the student seeking an alternative. For example, students from group 8 planned to choose science in their first year of senior high school but all changed their decisions. This occurrence was due to poor performance and negative attitudes, as a result of the teacher’s poor teaching ability/style. This demonstrates the need to provide ample teacher training in their academic field, along with efficient teaching skills. Furthermore, having a friendly and caring personality is fundamental, in creating a warm and inspiring learning environment as this was a key characteristic for those students who had close relationships with their teachers.

11.2.2.3. Curriculum design and assessments
Two main reasons for students to dislike school science were the perceived difficulty of science, and the frustration developed through bad examination results. Curriculum and assessments were found to be important in shaping students’ attitudes towards school science. In the survey, students suggested that making the science curriculum
relevant to daily life would raise their perceptions of the usefulness of school science. In addition, frequent assessments cause a great level of stress and frustration for the students. Reducing the amount and frequency of assessments or changing assessment methods might alleviate the stress and feelings of negativity attitudes towards school science or social studies.

11.2.2.4. Extra-curriculum materials and activities
An important issue raised in this research was the lack of knowledge and understanding of real science (see chapter 6). Although science was valued highly, it was also found that there was a general lack of knowledge outside science textbooks amongst students from different academic groups and areas. The ability to relate unknown items outside the science textbooks was also found to be poor amongst the students. Furthermore, it was also found that students who read science magazines, attended science camps, and watched scientific documentary programmes had more positive attitudes towards school science, suggesting that greater exposure to science can raise students’ awareness, interest and motivation towards science.

From the empirical data collected in this research, having a good learning environment is essential to maintain positive attitudes for students. Poor teaching easily increases the chances of the students switching to another subject, rather than good teaching. If educators and parents are made aware, and act on these important factors, more students will develop positive attitudes towards school science and find science more enjoyable.

11.2.3. Providing a flexible curriculum and more information
When students and parents are choosing the study group, the main constraint appears to lie with the educational system and curriculum. There tends to be a lack of continuity between the high school curriculum and university subjects. Subjects available at high school do not seem to be relevant to those available at university, for example studying history and geography at high school, is a prerequisite for studying accountancy at university. For many students, there is little relevance in what they learn at high school compared to studying for future employment. Students view compulsory study of irrelevant subjects as tedious and uninspiring. Moreover, the
subject choices at high school level are very limited, so students are generally unfamiliar with the subjects available at university.

Perhaps there should be more open, flexible and diverse subject/modules available at high school level, that link to the university courses. In this way, students may have an opportunity to sample some university subjects, and thereby make a more positive choice in determining their career.

Many students, who are unable to make a distinct choice of study group, select science. It is easier to change at a later stage, from the NSP to the SSP but not vice versa because of difficulties in catching up with the science curriculum. The problem may lie with the very nature of the two different types of curriculum. However, if schools could provide more support for those wishing to change their minds, for example, extra summer or winter courses to allow catching up. Hence, students may not feel so pressured, and it may assist them to choose their most suitable subject group.

Changing the whole design of curriculum and educational system is neither simple nor easy. It would involve both the redesign of a new high school curriculum and the university entrance system. Thus, more research and trial modules would be required. However, if the system does not change, some fundamental problems and difficulties might still remain during students’ study and decision making process. The schools and educational authority should consider future research, modifications, improvements and investments for an overhaul of the system.

11.2.4. Parental involvement
Students seemed to have a stronger desire to learn when their parents were involved in their school learning. This effect was particularly noticeable for their attitude towards school science when parents taught, gave demonstrations, or encouraged attendance at science camps. Parental involvement in any science related activities was seen to develop positive attitudes and motivation. This suggests that parents should also be encouraged to get involved with students’ learning both physically and psychologically.
11.2.5. Improving equality of female students

Gender has always been a complex issue, psychologically and culturally (Garratt, 1986; Murphy, 1991; Lightbody and Durndell, 1996a; Whitehead, 1996; Clark, 1998; Giles et al, 2002; Wallace, 2002; Osborne, 2003; Miller et al, 2006; Wong et al, 2006). This research found that although there were still stereotypes for boys and girls in terms of subject choice, girls were not discouraged in choosing science. Instead, when some girls chose science, they were given more praise than boys. However, a more equal expectation of gender roles might improve the enrolment in science amongst girls or possibly reduce the pressure boys have. This might be achieved by teachers and the media.
11.3. Implementation and the Importance of Findings in this Research

The findings of this research regarding the decision making process suggest that choosing a study group in Taiwan is strongly linked to and shaped by an individual’s subjective pragmatic and strategic calculations, which are grounded in the individual’s personal attitudes and learning experiences as well as external factors, most notably:

The simple binary subject choice available in the education system. Some students did not show much interest in either study group but chose the one that was relatively less disliked and thought to be more ‘useful’ in their future job prospective. Some students chose NSP because they thought they could catch up with SSP if they decide to switch to SSP later.

 Vacancies in the universities. Some students chose NSP because it seemed to provide more opportunities at university or the requirements for university admission were lower for science and engineering subjects.

Gender responsibilities. Most boys have more pressure to choose science compared to girls because of the perception that it will lead to a job that will better enable them to meet their anticipated responsibility towards their family. Boys tend to go for NSP as the ‘default option’, unless there is a good reason to choose SSP.

Employment prospects. Science/engineering related jobs are perceived as being more available in the job market compared to jobs which demand ‘social studies’ as an entry route.

Traditional beliefs. There is a strong cultural belief that one should try to pursue as much knowledge/qualifications as possible to gain respect in society. Furthermore there is an expectation that one will respect or take into consideration elders’
Teacher guidance. Some teachers thought that choosing NSP leads to better opportunities at university and in the job market.

Parental expectations. Some parents thought that security is the priority of life; some thought that gaining a higher degree means earning respect and honouring the family, and some thought that boys are to be more responsible for the family. In the Confucian Heritage Cultural context of Taiwan, these expectations may carry considerable weight with the students.

These aspects go some way to explain the high percentage of students continuing their education at the higher education level and the tendency to take up science regardless of their attitudes and enjoyment of school science.

There are many positive aspects to school science education in Taiwan: high take-up of science, students value the usefulness of real science, and students have positive perceptions of science related careers. However, without highly positive attitudes toward school science or enthusiasm about learning science, there is a danger of science becoming a ‘dead’ subject or just a tool to get a place in the university or a job in the future. Findings identified in this research do not only provide an insight into how Taiwanese students make their decisions but also reveal some issues that hinder the development of science education, which has implications for economic development in the Taiwanese national context. These findings also contribute to suggestions for improving Taiwanese science education as well as providing an illustration of the contextual influences on school science take-up which may be compared to other national contexts.

Key areas where the findings may assist improvement and change would include:
1. Provide a better understanding to policy makers, who have greatest influence and capability to make the necessary changes to the educational system, in Taiwan, e.g. the national curriculum guidance, university entrance examination system and initial teacher training.

2. Comprehension of the key factors that shape students’ attitudes towards
science and their decision making for subject study groups may assist educators, e.g. realisation and understanding of how attitudes towards science deteriorate with the progression of education, may act as a springboard for working towards improving attitude and motivational problems when learning science.

3. Providing a clear picture of factors and influences to help students and parents understand their aims and goals on students’ decision-making. Educational and career paths would be more explicit and informed if students can foresee a wider range of opportunities, concerns, goal, and expectations within the wider society.

4. Raising the issue of lack of prominent achievement in the pure science arena despite the high achievement of students in international science competitions and high level of development in technological industries. With the possible reasons discovered in this research, implementations could be made by policy makers and educators to improve the attitudes and motivation of science learning. Thus, might allow self-sufficiency and sustainability in Taiwanese economy and scientific development.

5. Addressing the importance of creating an enjoyable learning environment will not only increase the number of science students, but also develop their capabilities, their self-motivation and willingness to devote themselves towards scientific research and development. Above all, it will improve the well-being of students during the difficult process of learning and will reshape students’ values toward school science and give them a different outlook.

6. Another potentially valuable outcome of this research is the implication for results in the neighbouring countries around Taiwan, such as China, Hong Kong, Korea, Japan, and Singapore (Confucius heritage countries, CHC). They also have very similar educational teaching, educational system, economic development and science achievement in the international assessments. The problems identified and the models constructed for this research may provide a basic framework for explaining similar phenomena and problems in these countries or for further research.

7. On the other hand, the recent development of science education in western
countries has shown a decline. Science enrolment has been at a low level, opposite to that in Asia. Although the problems of science education in western countries might have a different focus, the experience of Taiwan may be a good example of raising science enrolment among young people. However, the encouragement for young people to take up science will still rely on the educators, parents and the media as they make the most part of the culture.

Apart from seeking the reasons for such an underlying problem, this research also aims to enlighten those countries that are trying to develop high-tech industries or to encourage their students to up take science subjects.

11.4. Limitations

Although this research was designed to understand the factors involved as much as possible, it was small-scale research and might not be representative. However, due to individual differences, no one will have the same trajectory. Larger scale research can be carried out to test the further accuracy of the model of pro-school science behaviour (Figure 6-6) and model of decision-making (Figure 10-1). Although the models do not tend to provide answers in terms of which subject is the best choice, they show the tendency of choices and forces that come in the process of decision-making.

11.5. Further Research

The methodology adopted and the models constructed in this research can be used as a framework to examine their validity in similar cultural context or examples of other countries in the world. Thus problems with students’ attitudes towards school science and subject choice can be identified for further suggestions or improvements.

Also, in this research, the strength of influences and concerns are qualitative rather than quantitative. Further research might be conducted to measure the strength of different influences and concerns to develop a more quantitative model, adding a more predictive element to understanding the decision making process.
Furthermore, a longitudinal method could also be adopted to investigate the development and changes of students’ decision making. The results from a longitudinal method might portray clearer trajectories of individuals as well as provide a comparison in the research methodology.
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APPENDICES

Appendix 1. TIMSS Results

1. TIMSS Results of Grade Fourth

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Note: 26 participant countries in 1995, 38 countries in 1999 and 48 countries participated in 2003
Source from: Department of Statistics, Ministry of Education, Taiwan, R. O. C.

2. TIMSS Results of Grade Eighth

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Note: 26 participants countries in 1995, 38 countries in 1999 and 48 countries participated in 2003

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G=Gold medal, S=Silver medal, B=Bronze medal, H=Honourable prize

-Source from:

Department of statistics, Ministry of Education, Taiwan, R.O.C


Accessed on 2008-04-09
Appendix 3. Education Index

1. The Continuity Rate to next Education Stage in Taiwan (%) 

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2. International Gross Higher Education Enrolment Rate by Educational Level and Sex (%)

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Source from Ministry of Education, R. O. C., Taiwan.

[http://publications.teachernet.gov.uk/eOrderingDownload/PKHSN5-PDF.pdf](http://publications.teachernet.gov.uk/eOrderingDownload/PKHSN5-PDF.pdf)

2007-12-16.
3. Higher Education Initial Participation Rate (HEIPR) for English domiciled first time participants in Higher Education Courses at UK Higher Education Institutions and English, Welsh and Scottish Further Education Colleges: 1999/00 – 2006/07

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<td>HEIPR (female)% Initial entrants (thousands)</td>
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<td>HEIPR (full-time) % Initial entrants (thousands)</td>
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*Provisional

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- Source from Department of Statistics, Ministry of Education, Taiwan, R. O. C, 2006,
5. Governmental Education expenditure in proportion to GDP (%)  

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**Note:** 1. Data from 1999. 2. Data from 2001. 3. Data from 2002.

**Data source from** Education at a Glance OECD Indicators- 2006, Tab. B2.1a, b

http://www.edu.tw/files/site_content/B0013/overview57_1.xls

Accessed on 2008-04-20
6. Annual Technology Development Program (TDP) Expenditure and Expenditure Allocation

Statistics of R&D of Science

The investment into research and development, which advances the high-tech industry development, has shown the up trend in the last decade. The percentage of research and development budget, in terms of GDP, has growth up from 2.16% in 2001 to 2.30% in 2002. In 2003, the TDP budget was NT$17.19 billion, increased by NT$1.33 billion comparing with NT$15.86 billion in 2002, the growth rate was 8.3%. The research budget of TDP is steadily increased by the year. In the future, the goal for the total budget will be reaching 3% of GDP in accordance with the “Challenge 2008 National Development Priority Plan”. Through the investment into the research and development, our nation’s industrial research infrastructure and capability will be enhanced, and the newly emerged industry domain and the competitive key core technology will be created.

Department of Industrial Technology, Ministry of Economic Affairs, R. O. C., 2008.

http://doit.moea.gov.tw/newenglish/03_Achievements/exp.asp

Access on 2008-04-20
Appendix 4. Economic Index

1. Make in Taiwan products

Table 5-1: Products made in Taiwan ranked No.1 in the world

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<tr>
<th>ITEM</th>
<th>Production Value</th>
<th>Production Volume</th>
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<td></td>
<td>US $ million</td>
<td>World share %</td>
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<tr>
<td>IC Foundry</td>
<td>11,599</td>
<td>69</td>
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<tr>
<td>IC Packaging</td>
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<tr>
<td>Mask ROM</td>
<td>280</td>
<td>91</td>
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<td>PDAs</td>
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<td>60</td>
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<td>ABS Copolymer</td>
<td>800</td>
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<tr>
<td>Glass fiber</td>
<td>580</td>
<td>42</td>
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<td>Golf heads</td>
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Table 5-2: Products made by Taiwan ranked No.1 in the world

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<th>Production Value</th>
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<td>Product Type</td>
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<td>Unit</td>
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Source: Industry & Technology Intelligence Service (ITIS) and IDB.

Industrial Development Bureau, Ministry of Economic Affairs, 2008.


Accessed on 2008-04-20
## 2. Structure of Domestic Production in Taiwan (Proportion to GDP%)

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<th>Total (%)</th>
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<td>2007</td>
<td>p</td>
<td>100.00</td>
<td>1.45</td>
<td>27.50</td>
<td>23.75</td>
<td>71.06</td>
</tr>
<tr>
<td>Q1</td>
<td>100.00</td>
<td>1.28</td>
<td>26.10</td>
<td>22.32</td>
<td>72.62</td>
<td>20.30</td>
</tr>
<tr>
<td>Q2</td>
<td>100.00</td>
<td>1.68</td>
<td>25.23</td>
<td>21.42</td>
<td>73.09</td>
<td>20.67</td>
</tr>
<tr>
<td>Q3</td>
<td>r</td>
<td>100.00</td>
<td>1.29</td>
<td>29.62</td>
<td>25.67</td>
<td>69.09</td>
</tr>
<tr>
<td>Q4</td>
<td>p</td>
<td>100.00</td>
<td>1.55</td>
<td>28.70</td>
<td>25.24</td>
<td>69.75</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>--------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
</tbody>
</table>

Source: DGBAS     Executive Yuan.

http://2k3dmz2.moea.gov.tw/GNWEB/english/indicators/reports/A03.xls

Accessed date 2008-04-20
3. Economic Growth Rate - By Industry (At 2001 Constant Prices)

<table>
<thead>
<tr>
<th></th>
<th>Economic Growth Rate (%)</th>
<th>Contribution to Economic Growth (Percentage Points)</th>
<th>Annual Rate of Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Agriculture + Industry + Services</td>
<td>Agriculture</td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td></td>
<td>5.75</td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td>5.77</td>
</tr>
<tr>
<td>2001</td>
<td></td>
<td></td>
<td>-2.17</td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td></td>
<td>4.64</td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td>3.50</td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td>6.15</td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td>4.16</td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td>4.89</td>
</tr>
<tr>
<td>Q1</td>
<td></td>
<td></td>
<td>5.12</td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td></td>
<td>5.07</td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td></td>
<td>5.34</td>
</tr>
<tr>
<td>Q4</td>
<td></td>
<td></td>
<td>4.07</td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td>5.70</td>
</tr>
<tr>
<td>Q1</td>
<td></td>
<td></td>
<td>4.19</td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td></td>
<td>5.24</td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td></td>
<td>6.86</td>
</tr>
<tr>
<td>Q4</td>
<td></td>
<td></td>
<td>6.39</td>
</tr>
</tbody>
</table>

Source: DGBAS Executive Yuan.

on 2008-04-20
4. Approved Outward Investment by Area (China is not officially approved for investment by the Taiwanese government)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total (US$ 1,000)</th>
<th>Annual Rate of Change (%)</th>
<th>Asia</th>
<th>Singapore</th>
<th>Hong Kong</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>1,356,878</td>
<td>-16.07</td>
<td>467,721</td>
<td>31,649</td>
<td>99,555</td>
<td>8,811</td>
</tr>
<tr>
<td>1996</td>
<td>2,165,404</td>
<td>59.59</td>
<td>661,717</td>
<td>164,978</td>
<td>59,927</td>
<td>6,798</td>
</tr>
<tr>
<td>1997</td>
<td>2,893,826</td>
<td>33.64</td>
<td>818,743</td>
<td>230,310</td>
<td>141,593</td>
<td>32,342</td>
</tr>
<tr>
<td>1998</td>
<td>3,296,302</td>
<td>13.91</td>
<td>580,819</td>
<td>158,176</td>
<td>68,643</td>
<td>29,596</td>
</tr>
<tr>
<td>1999</td>
<td>3,269,013</td>
<td>-0.83</td>
<td>836,378</td>
<td>324,524</td>
<td>100,318</td>
<td>121,867</td>
</tr>
<tr>
<td>2000</td>
<td>5,077,062</td>
<td>55.31</td>
<td>851,065</td>
<td>219,531</td>
<td>47,512</td>
<td>312,222</td>
</tr>
<tr>
<td>2001</td>
<td>4,391,654</td>
<td>-13.50</td>
<td>814,981</td>
<td>378,300</td>
<td>94,901</td>
<td>169,033</td>
</tr>
<tr>
<td>2002</td>
<td>3,370,046</td>
<td>-23.26</td>
<td>530,055</td>
<td>25,760</td>
<td>167,063</td>
<td>23,554</td>
</tr>
<tr>
<td>2003</td>
<td>3,968,588</td>
<td>17.76</td>
<td>1,063,915</td>
<td>26,403</td>
<td>641,287</td>
<td>100,370</td>
</tr>
<tr>
<td>2004</td>
<td>3,382,022</td>
<td>-14.78</td>
<td>1,275,089</td>
<td>822,229</td>
<td>139,702</td>
<td>149,330</td>
</tr>
<tr>
<td>2005</td>
<td>2,447,449</td>
<td>-27.63</td>
<td>430,673</td>
<td>97,701</td>
<td>107,559</td>
<td>42,552</td>
</tr>
<tr>
<td>2006</td>
<td>4,315,426</td>
<td>76.32</td>
<td>1,390,621</td>
<td>806,303</td>
<td>272,021</td>
<td>10,926</td>
</tr>
<tr>
<td>2007</td>
<td>6,469,978</td>
<td>49.93</td>
<td>2,366,606</td>
<td>1,194,110</td>
<td>189,568</td>
<td>18,815</td>
</tr>
<tr>
<td>2008</td>
<td>J</td>
<td>163.38</td>
<td>340,472</td>
<td>18,283</td>
<td>25,459</td>
<td>12,897</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>237.74</td>
<td>29,274</td>
<td>-</td>
<td>1,479</td>
<td>846</td>
</tr>
<tr>
<td>Current Cumulating</td>
<td>760,286</td>
<td>--</td>
<td>369,747</td>
<td>18,283</td>
<td>26,938</td>
<td>13,743</td>
</tr>
<tr>
<td>Cumulative</td>
<td>183.92</td>
<td>--</td>
<td>309.99</td>
<td>3677.48</td>
<td>-61.35</td>
<td>3918.31</td>
</tr>
<tr>
<td>Change from the Same Period of Last Year (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Investment Commission, Ministry of Economics Affairs, R. O. C.  
http://2k3dmz2.moea.gov.tw/GNWEB/english/indicators/reports/D04.xls
Accessed on 2008-04-20
5. Annual TDP R&D Manpower and Allocation in Taiwan

In the period from 1999 to 2003, the research and development manpower devoted to the corporation TDP was increased from 5,561.2 person/year to 6,644.9 person/year, the compound growth rate reaches 4.55%. In terms of the educational background for the R&D professionals, the manpower percentage with master degrees is rapidly increased, however, the doctor degrees and the bachelor degrees maintain the same level. The manpower quality has improved.

In terms of the devoted manpower percentages, comparing with 2002, both industrial and academic TDPs have the increase of 4.85% and 4.55% of the total devoted manpower respectively. In observing the devoted manpower to TDP, whether in the corporation TDP, the industrial TDP or the academic TDP, comparing with 2002, it all shows the growth.

![Annual TDP R&D Manpower and Allocation](image-url)
Annual Corporation TDP R&D Manpower and Allocation by Education Degree

Source from Department of Industrial Technology, Ministry of Economic Affairs, R. O. C., 2008.

http://doit.moca.gov.tw/newenglish/03_Achievements/Manpower.asp

Access on 2008-04-20
6. Unemployment rate, by country

<table>
<thead>
<tr>
<th>Country</th>
<th>R.O.C.</th>
<th>U.S.A.</th>
<th>Japan</th>
<th>Germany</th>
<th>France</th>
<th>U.K.</th>
<th>Italy</th>
<th>South</th>
<th>Singapo</th>
<th>H.K.</th>
<th>P.R.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>2.7</td>
<td>4.9</td>
<td>3.4</td>
<td>11.5</td>
<td>12.3</td>
<td>7.2</td>
<td>11.7</td>
<td>2.6</td>
<td>1.4</td>
<td>2.2</td>
<td>3.1</td>
</tr>
<tr>
<td>1998</td>
<td>2.7</td>
<td>4.5</td>
<td>4.1</td>
<td>11.1</td>
<td>11.5</td>
<td>6.3</td>
<td>11.8</td>
<td>7.0</td>
<td>2.5</td>
<td>4.7</td>
<td>3.1</td>
</tr>
<tr>
<td>1999</td>
<td>2.9</td>
<td>4.2</td>
<td>4.7</td>
<td>10.5</td>
<td>10.8</td>
<td>6.1</td>
<td>11.4</td>
<td>6.4</td>
<td>2.8</td>
<td>6.2</td>
<td>3.1</td>
</tr>
<tr>
<td>2000</td>
<td>3.0</td>
<td>4.0</td>
<td>4.7</td>
<td>9.6</td>
<td>9.5</td>
<td>5.6</td>
<td>10.6</td>
<td>4.2</td>
<td>2.6</td>
<td>4.9</td>
<td>3.1</td>
</tr>
<tr>
<td>2001</td>
<td>4.6</td>
<td>4.7</td>
<td>5.0</td>
<td>9.4</td>
<td>8.7</td>
<td>4.9</td>
<td>9.1</td>
<td>4.0</td>
<td>2.6</td>
<td>5.1</td>
<td>3.6</td>
</tr>
<tr>
<td>2002</td>
<td>5.2</td>
<td>5.8</td>
<td>5.4</td>
<td>9.8</td>
<td>9.1</td>
<td>5.2</td>
<td>8.6</td>
<td>3.3</td>
<td>3.6</td>
<td>7.3</td>
<td>4.0</td>
</tr>
<tr>
<td>2003</td>
<td>5.0</td>
<td>6.0</td>
<td>5.3</td>
<td>10.5</td>
<td>9.8</td>
<td>5.0</td>
<td>8.5</td>
<td>3.6</td>
<td>4.0</td>
<td>7.9</td>
<td>4.3</td>
</tr>
<tr>
<td>2004</td>
<td>4.4</td>
<td>5.5</td>
<td>4.7</td>
<td>10.6</td>
<td>10.0</td>
<td>4.8</td>
<td>8.1</td>
<td>3.7</td>
<td>3.4</td>
<td>6.8</td>
<td>4.2</td>
</tr>
<tr>
<td>2005</td>
<td>4.1</td>
<td>5.1</td>
<td>4.4</td>
<td>11.6</td>
<td>9.9</td>
<td>4.7</td>
<td>7.7</td>
<td>3.7</td>
<td>3.1</td>
<td>5.6</td>
<td>...</td>
</tr>
<tr>
<td>2006</td>
<td>3.9</td>
<td>5.0</td>
<td>4.4</td>
<td>12.1</td>
<td>...</td>
<td>5.2</td>
<td>...</td>
<td>3.9</td>
<td>2.6</td>
<td>5.2</td>
<td>...</td>
</tr>
</tbody>
</table>

**Notes:**

1. Data of France, U.K., Singapore and H.K. are seasonally adjusted.
2. The figures of U.K. are official unemployed rates on survey-based.
3. The figures of Singapore are average data.

Source: Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C.


Accessed on 2007-6-2
1. Attitudes to Science Questionnaire (Pilot)

Dear Students,

The purpose of this questionnaire is to understand your attitude towards science in a small-scale study. I hope you can take some time to read it over and answer the questions, as it is an important pilot study to my research and an indicator of your own attitudes.

All your responses to the questions are confidential and will not be revealed to your teachers. So please feel comfortable and be honest to answer all the questions. If you do not wish to take part of this research, please do not hand in this questionnaire or you can contact me any time after this session.

You will be kept fully informed of questionnaire outcomes after I finish this study, if you are interested in discussing the analyses of the results. My contact details are on the card that comes with this questionnaire.

Thank you for taking time to finish this questionnaire.

Chiu-Yen Hsu

1. Personal details

<table>
<thead>
<tr>
<th>1.1</th>
<th>Your Name (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>Your School</td>
</tr>
<tr>
<td>1.3</td>
<td>Grade</td>
</tr>
<tr>
<td>1.4</td>
<td>Sex</td>
</tr>
</tbody>
</table>

Please answer the following questions if you are less than 16, go to 1.5.2 and 1.6.2 if you are more than 16.

<table>
<thead>
<tr>
<th>1.5.1</th>
<th>Hours of science class per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6.1</td>
<td>How many hours of extra tutor class after school</td>
</tr>
</tbody>
</table>

Please answer the following 2 questions if you are more than age 16

<table>
<thead>
<tr>
<th>1.5.2</th>
<th>Hours of science class per week in the school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>Chemistry</td>
</tr>
</tbody>
</table>
1.6.2 | How many hours of extra tutor class after school
| Physics | Chemistry | Biology

1.7 | Total hours of studying in science (per week)

Attitudes toward science.

Please answer the following questions according to the four point scale describe below.

1..... strong disagree
2..... disagree
3..... agree
4..... strong disagree

This "scale" needs an answer to every statement.
Please indicate your view by circling the code number.

<table>
<thead>
<tr>
<th></th>
<th>Scientists are always interested in better explanations of things.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scientific ideas can be changed.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Scientists believe that nothing is known to be true for sure.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>When scientists have a good explanation, they do not try to make it better.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Scientists discover laws that tell us exactly what is going on in nature.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Scientific laws have been proven beyond all possible doubt.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Scientists cannot always find their answers to their questions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Some questions cannot be answered by science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>The senses are one of the most important tools a scientist has.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Anything we need to know can be found out through science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>We can always get answers to our questions by asking a scientist.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12.</td>
<td>If a scientist cannot answer a question, another scientist can.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13.</td>
<td>Scientific questions are answered by observing things.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14.</td>
<td>Good scientists are willing to change their ideas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15.</td>
<td>Scientists must report exactly what they observe.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16.</td>
<td>It is useless to listen to a new idea unless everybody agrees with it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17.</td>
<td>If one scientist says an idea is true, all other scientists will believe it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18.</td>
<td>Scientists should not criticize each other’s work.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19.</td>
<td>A scientist must have a good imagination to create new ideas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20.</td>
<td>Ideas are important results of science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>21.</td>
<td>Science tries to explain how things happen.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22.</td>
<td>Electronics are examples or the real valuable products of science</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23.</td>
<td>A major purpose of science is to produce new drugs and save lives.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>24.</td>
<td>A major purpose of science is to help people live better.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>25.</td>
<td>Most people can understand science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>26.</td>
<td>People must understand science because it affects their lives.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>27.</td>
<td>Every citizen should understand science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>28.</td>
<td>Only highly trained scientists can understand science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>29.</td>
<td>Most people are not able to understand science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>30.</td>
<td>Scientific work is useful to scientists.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>31.</td>
<td>I enjoy studying science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>32.</td>
<td>I like to work with other scientists to solve scientific problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>33.</td>
<td>I may not make great discoveries, but working in science would be fun.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>34.</td>
<td>I like to be a scientist.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>35.</td>
<td>Working in a science laboratory is fun.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>36.</td>
<td>The search for scientific knowledge is boring.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>37.</td>
<td>Scientific work will be too hard for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>38.</td>
<td>I do not want to be a scientist.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>39.</td>
<td>Scientists do not have enough time for their families or for fun.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>40.</td>
<td>Scientists have to study too much.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Some open ended questions

Did you like science when you were in primary school? Why?

Do you like the school science? Why? (list different subjects if varies)

When did you change your attitude to if you don’t like the school science now? Why?

Do you like science in general? Why?
How or what can help to keep your motivation to study science?

What is the ranking of your science performance in your class? (Upper 25%, 25%-75%, lower 25%)
2. Attitudes to Science Questionnaire

Dear Student,

The purpose of this questionnaire is to understand your attitude towards science in a small-scale study. I hope you can take some time to read it over and answer the questions, as it is an important pilot study to my research and an indicator of your own attitudes.

All your responses to the questions are confidential and will not be revealed to your teachers. So please feel comfortable and be honest to answer all the questions. If you do not wish to take part of this research, please do not hand in this questionnaire or you can contact me any time after this session.

You will be kept fully informed of questionnaire outcomes after I finish this study, if you are interested in discussing the analyses of the results. My contact details are on the card that comes with this questionnaire.

Thank you for taking time to finish this questionnaire.

Chiu-Yen Hsu

1

1. Did you like science when you were in primary school? Why?

Do you like the school science? Why? (list different subjects if varies)

When did you change your attitude to if you don’t like the school science now? Why?

Do you like science in general? Why?
How or what can help to keep your motivation to study science?

What is the ranking of your science performance in your class? (Upper 25%, 25%-75%, lower 25%)
3. Group discussion

This is a warm up exercise before the interview session. Please spend a few minute to look at the items below and decide whether it is a science to you. Please note that this is not a test or competition so there is no right or wrong answer. You are encouraged to discuss with the members in this group about your choice and the reasons for it. Please note that you do not need to change your answers because you will not be assessed with your answers. Thank you very much for taking part in this group discussion.

Is it a science?

<table>
<thead>
<tr>
<th></th>
<th>Agree</th>
<th>Not sure</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creationism</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Water divining</td>
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<td></td>
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<tr>
<td>Acupuncture</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Spiritualism</td>
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<td></td>
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<tr>
<td>Theory of relativity</td>
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<td></td>
<td></td>
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<tr>
<td>Psychotherapy</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Nuclear Physics</td>
<td></td>
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<td></td>
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<tr>
<td>Computing</td>
<td></td>
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<td></td>
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<tr>
<td>Theory of evolution</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Astrology</td>
<td></td>
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<td></td>
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<tr>
<td>Plumbing</td>
<td></td>
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<td>Space exploration</td>
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<tr>
<td>Biochemistry</td>
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<td>Automobile design</td>
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<tr>
<td>Physiotherapy</td>
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<tr>
<td>Meteorology</td>
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<tr>
<td>Herbal medicine</td>
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<tr>
<td>Economics</td>
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<tr>
<td>Electronic communication</td>
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<tr>
<td>Lie detection</td>
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</tbody>
</table>

(Provide by Paul Denley PGCE course, Bath University.)
4. List of topics of the students’ in-depth interview

Do you remember why you chose to do science (or not to do science) last year?
Why would you think your parents want you to study in science?
What made you think that they wanted you to study science?
Do you think your job in the future is important to you? Why?
Why do you think there are more opportunities to study in the universities if you are doing science?
Why do you think it’s easier to get a job if you are a science student?
What do you think a good job can benefit you or your family?
Why do you think money is important? What do you need money for?
Did your parents force you to choose science?
Why did you chose science if your parents didn’t force you to?
Where did you get the information from? (If the student answers that it’s easier to find a job for science students)
What will be your parents’ reaction if you choose to do the social studies?
Do you like science? Do you like school science class? Why?

Topics to cover

<table>
<thead>
<tr>
<th>Future concerns</th>
<th>Family expectation</th>
<th>Influence of the media</th>
<th>Personal interest</th>
<th>Other factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>University vacancies</td>
<td>Gender difference</td>
<td>Perceptions of science</td>
<td>Interest</td>
<td>Optimum advantage concern</td>
</tr>
<tr>
<td>Job vacancies</td>
<td>Image of science students</td>
<td>Perceptions of scientists</td>
<td>Image of science students</td>
<td>Low risk of the family responsibility</td>
</tr>
<tr>
<td>Job security</td>
<td>Social status</td>
<td>Job vacancies</td>
<td>Image of scientists</td>
<td>Teachers</td>
</tr>
<tr>
<td>Status of job</td>
<td></td>
<td></td>
<td>Experience of learning science</td>
<td>Friends/siblings</td>
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<td>Incentives</td>
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<tr>
<td>Work load</td>
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</table>
Appendix 6. Reflection of the Research Methodology

1. Reflection of research approaches

Accessibility to the schools and participants varied due to available resources and the school culture. Although both time and expenditure were limiting factors, the data collection technique was found to be appropriate. Networking, or so called Guanxi in the Chinese language was employed strategically in order to approach specific groups of participants for the surveys. Selecting the appropriate groups for this research proved successful for the data collection. Figure 1. highlights the possible similar research methods, especially one with a similar cultural context. The diagram shows the basic positions and relationships between the researcher, intermediary and participants the within the institution.

Figure 1. Approaches to different participants: teachers, students and parents

2. Operation under the Chinese cultural context network: Guanxi

Detailed planning was required, in order that the data collection was successful and ran smoothly. Data collection requires careful consideration. Thus, researchers should always be mindful and work towards avoidance of data manipulation although all research tends to have some element of bias. Hence, the balance between
manipulation and naturalism must be carefully handled throughout the data collection process.

Finding a representative selection of participants was difficult, together with establishing contact and getting agreement for their participation. In most cases, I was introduced to one or two schoolteachers for each of the target schools, by friends, colleagues or family members. The guanxi for each school was then developed with the help of the first contact teacher. For some schools, contact at headmaster level, was not required. Therefore, the procedure of approaching the students and science teachers varied for different schools, according to the situation and school culture. The reasons for approaching schoolteachers first rather than the headmasters are:

1. Access was easier to contact schoolteachers rather than headmasters, based on my previous working experience.
2. Some headmasters may have been reluctant to help, and most important of all, could change the target school selection chosen for the research. Neither was there any funding for this research by the Taiwanese government nor was there any connection between myself and the head teachers. Thus, an indirect approach was advised by other senior colleagues.
3. Teachers understand their own schools’ culture, and may still organise the necessary contacts in an appropriate and acceptable manner.
4. Introduction by a school teacher to his/her colleagues, tend to result in these colleagues being more willing to help.

The data collection process demonstrated two dimensions of sociological operation in a Chinese context society, which were the official authority and personal guanxi/connections. These two elements determine if things succeed or not in a Chinese context society. For organizations and institutions these two elements work best in unison.

The following provides brief descriptions of the data collection process for each school. These diagrams illustrate how these two elements act and their importance for organising and accessing interviewees, in a Chinese/Taiwanese cultural context.

A. Routes accessing participants in Cheng-Kao Senior High School (school11)
The first contact teacher in School 1 was a biology teacher who volunteered to be involved in the research and also introduced another science teacher. This school was an old, well-reputed school with conservative views, and a tradition of respecting the head teacher. Consent was obtained from the head teacher, who asked the director of studies to help arrange interviews. However, the director of studies became resentful of this additional work, which was reflected with the one month time interval between the first and second interviews. She did not feel a need or any obligation to help me as there was no guanxi, which created a difficult situation. Such bad feeling illustrates how research may impact on people and can disturb their daily life. Research activity, either experimental or observant, can never be value-free.

The guanxi (connection) in school 1 had its limit due to the authority from the hierarchical structure and legitimacy of this research in the school. The guanxi could expand horizontally from teachers to teachers but not directly upward to the
headmaster or downward to the students. In this case, the headmasters’ authority helped overcome the difficulties of having no guanxi between myself and the director of studies.

For school 2, the first contact teacher was a former colleague. This teacher not only held a senior position but was also an administrative member of staff. He did not feel any necessity for consent from the headmaster, and approached the director of studies. He also made contact with the necessary teachers (whom I also knew), and arranged the interviews with the students. The venue for the students’ interview was also arranged to take place in the most comfortable room on campus, an air-conditioned floral conservatory, where students could feel very relaxed and privileged. The whole process of data collection in this school was well organised and successful.

The guanxi network seemed to work perfectly in this school because many of the teachers in this school had previously known me. Everyone was willing to help, and the connections were well linked between the teachers and other participants. I was not seen as “an outsider” but made to feel that I was a close colleague.

It seems that teachers who have a better relationship with the higher administrative level do not need permission to proceed with activities, such as helping with this research. In addition, the first contact teacher, having an administrative role, had more resources and authority to arrange students’ schedules and the location for interviews.
The smoothness and completion of data collection, in school 2, illustrates perfectly how guanxi works in a miniature society, with a Chinese context. People who have good social skills have better guanxi with others, and often they can obtain the power and resources.

For school 3, the first contact teacher was introduced through family contacts. The first contact teacher (who I did not know) had been teaching in this school, for more than twenty years. Due to his seniority, it was unnecessary to contact the headmaster or the director of studies, providing that the interviews were out of academic hours. This teacher arranged interviews with students, along with interviews with teachers and the locations.
C. Routes accessing participants in Hu-Wen Senior High School (school 3)

The contact teacher was well respected, with a good relationship with everyone in the school. Hence, agreement and arrangement for the interviews were made easily. This situation gave some insight of how an unofficial authority can form in an institution through traditional and sociological interactions.

The first contact, a history teacher, was new to school 4, although very helpful in arranging consent and the interviews. Although the director of studies also helped by introducing a Physics and Chemistry teacher for the interviews, difficulty was experienced to find a selection of participating teachers. Generally, older teachers were found to be unwilling to help with the survey.
D. Routes in accession participants in Taoying senior high school (school 4)

Both authority and guanxi in this school were important. The History teacher had good guanxi with the administrators, which helped greatly. However, she did not have guanxi with the science teachers, who were uncooperative and unamiable when asked to take part in the surveys. Recommendation by someone in authority, would have reinforced the link, and stimulated good feelings and helpfulness.

For the whole of this research, most of the interviewed teachers were below the age of 40. Unless an older teacher was introduced personally by a well-acquainted colleague or had received orders from their boss, he/she tended to be more reluctant to help a stranger. This highlights how the sampling of this research may be affected by generational differences. Such occurrences are unfortunate because some important ideas may be missed, due to those unwilling to participate in the research. However, since schoolteachers may retire with a good pension at the age 55, only a few older
science teachers were working in this school.

In summary, guanxi (personal network) is important in carrying out fieldwork or similar projects for research, in a Chinese culture context. One of the best strategies for successful data collection in this culture context might be from a teachers’ level of the school hierarchy. With an influential or relevant horizontal contact on the level of those who have direct control of the participants or situation, progress with the fieldwork should be favourable.

As shown in this research, having authorization from a much higher position in the hierarchy may cause some difficulties between individuals, with a possible risk to the data. An informal and relaxing atmosphere should be more desirable in order to get authentic and valid data when approaching the participants. Therefore, having a suitable contact to access the participants is crucial to the success of the operation, although consent from a higher authority may still be necessary in some schools. Hence, greater sampling for cross-checking and triangulation could considerably reduce the bias, caused by bureaucracy. However, the route for approaching participants will always vary depending on the school culture, and the complex relationships between contacts and schools.