The Hong Kong Polytechnic University

School of Design

Creativity and Its Roles in Design Education in Hong Kong

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CERTIFICATE OF ORIGINALITY

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

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WONG Yi Lin

Abstract

The development of creativity is parallel to the development and evolution of our culture and society, and researchers see creativity as the ultimate goal of education. Educators and researchers of design education believe that creativity can be developed in Design and Technology (D&T) classrooms at the secondary school level, as the design process in D&T relies on the development of novel, useful, and appropriate ideas. D&T is one of the best platforms to foster creativity, as it lends a kind of creative experience in realising objects which is distinctive from other subjects.

However, the value of D&T at the secondary school level in Hong Kong is underestimated by the Hong Kong government, school administrators, teachers, parents, and other stakeholders. If creativity is important in education, there is no reason to neglect a subject which can foster creativity. This study investigates creativity and its roles in design education at the secondary school level. Its objectives are (i) to review and investigate how teachers, students, and policymakers understand creativity, (ii) to understand the practical issues in the design education classroom or school, (iii) to suggest possible methods for teaching creativity in design education, (iv) to identify the roles of creativity in design education, and (v) to identify the issues related to the cultivation of creativity in design education.

Discussions of creativity are often related to four different areas: product, process, person, and environment. This study investigates these areas using a data triangulation approach. It begins by examining 46 exemplar design projects and their artefacts on the Hong Kong government website and public examination design projects on D&T syllabuses from 2005 to 2009. Thirteen interviews with Hong Kong teachers, students, and officers were conducted to understand issues of creativity in design education.

This study finds that creativity is not fostered to its fullness in D&T. Some perceptions of teachers and students, especially the narrow perceptions, affect the

cultivation of creativity. Shifts in perceptions, teaching methods, classroom management, and assessments are suggested so that teachers can cultivate creativity more easily. This study also finds that if creativity is promoted successfully, some roles of creativity should be found in classroom. These roles may serve as guidelines for teachers in assessing their creative classrooms. In addition, teachers must be aware of the issues related to the cultivation of creativity. They must prepare and work out plans which are suitable for their own classrooms and schools.

Publications Arising from the Thesis

Peer-reviewed Journal

Wong, Y. L., & Siu, K. W. M. (2012). Is there Creativity in Design? From a Perspective of School Design and Technology in Hong Kong. *Asia Pacific Education Review, 13*(3), 465-474.

Wong, Y. L., & Siu, K. W. M. (2011). A Model of Creative Design Process for Fostering Creativity of Students in Design Education. *International Journal of Technology and Design Education, 22*(4), 437-450.

Wong, Y. L., & Siu, K. W. M. (2010). Understanding and Nurturing Creativity in Design Education: A Case Study of Newspaper Perspective in Hong Kong. *The International Journal of Interdisciplinary Social Science, 5*(2), 317-330.

Siu, K. W. M., & Wong, Y. L. (2011). Changes in the Technological Aspects and Facilities of Design Education: A Case Study of Hong Kong. *International Journal of Information and Communication Technology Education, 7*(4), 47-59.

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Conference Proceedings

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Table of Contents

List of Figures

List of Tables

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Chapter 1

Introduction

Advances in technology have solved many problems of human survival and improved our quality of life considerably. Unfortunately, many solutions that technology has provided have generated a new set of complicated problems, for example energy shortages and climate change caused by the high percentage of carbon dioxide in the air. Some of these solutions have become inappropriate at the current stage of human development. The new set of complicated problems, in turn, require a new set of solutions, and those solutions must be of a higher standard than those developed in the past if they are to exert minimal effects on the world in which we live.

The problems in the world appear to have grown in number and complexity in the past few decades (Isaksen & Murdock, 1993; Runco, 2004). We thus need problem-solvers with the expertise to help us improve our living environment and solve the problems that we collectively face. The recent growth in the complexity and quantity of problems also calls for diverse solutions, as any single approach is unlikely to be adequate (Ng & Smith, 2004). Knowledge alone may no longer be sufficient to tackle the ever-changing problems. What maybe more important in tackling these problems is to determine the most effective way to combine and manipulate information and knowledge. The burning question is: What ability do human beings require to solve new and complex problems effectively? This ability is usually called

creativity, and it is associated with the ability to create and generate new ideas based on their precedents (Boden, 2004).

1.1.   RESEARCH ON CREATIVITY

Creativity is essential for our survival, and it is thus unsurprising to find increasing numbers of researchers attracted to the topic. Creativity has been of research interest in a variety of fields since Joy P. Guilford, a leading psychologist, addressed the issue in the realm of psychology in *American Psychologist* in 1950, and creativity-related research has been expanding ever since (Gardner, 1993; Isaksen & Murdock, 1993; Mayer, 1999; Sternberg & Lubart, 1999).

Over the years, however, creativity research had encountered a number of roadblocks, primarily due to the misunderstandings of the creativity concept and its multifaceted nature. Creativity was a neglected topic in psychology research. Sternberg and Lubart (1999) noted that it was considered a relatively marginal topic in the past, with only 0.5% of the articles in *Psychological Abstracts* from 1975 to 1994 found to concern creativity. They also found that the topic was seldom covered in textbooks, and no university course was devoted to it. Furthermore, universities lacked creativity studies departments, and no top-cited journals on creativity studies existed. According to Sternberg and Lubart (1999) and Isaksen and Murdock (1993), creativity research encountered the following roadblocks in the course of its development.

- Creativity was originally seen as mysterious and spiritual, and anything mysterious and spiritual was most likely unsuitable for scientific study and analysis.
- Most research focused on a pragmatic approach to identifying ways to develop and facilitate creativity. The topic's verification and grounding in psychological theory were neglected.

- The methodology used in creativity studies differed from that in empirical studies in psychology, which resulted in creativity being seen as a marginal topic.
- Creativity was vaguely defined, which generated difficulties in carrying out scientific research.
- Creativity was considered as a process or structure that was abnormal or extraordinary. Thus, there was no need to study it.
- A unidisciplinary approach was generally adopted, resulting in the perception that creativity was a narrow rather than multifaceted and cross-disciplinary subject. Even when a multidisciplinary approach was adopted, the coverage of creativity tended to be too broad, meaning it was always on the fringes of established disciplines.

Despite roadblocks, creativity research had not ceased to develop. Researchers have come to general consensus on a definition of creativity (Atkinson, 2000; Howard, Culley & Dekoninck, 2008; Howard-Jones, 2002; Mayer, 1999; Sternberg & Lubart, 1999). Creativity has also been more firmly grounded in theory, and a variety of instruments and approaches to its study have been developed. According to Rhodes (1987), creativity is often approached in terms of the 4P's: person, process, product, and press. Different point of view and theories have been developed to understand creativity. Creativity has also been linked with other disciplines in different cultural contexts. The concept of implicit theories is also another hot topic that has been discussed among researchers, and a considerable effort has been devoted to unravelling the 'mysteries' of creativity.

Given its ability to facilitate greater productivity in a wide range of business fields and academic disciplines, the government and educators in Hong Kong and worldwide become increasingly aware of creativity's importance in the secondary school curriculum.

1.2. CREATIVITY POLICIES IN GOVERNMENT AND EDUCATION

In the past decade, governments around the world have begun to realise the importance of creativity and to develop policies to promote the creative industries (UNESCO, 2006). For example, the UK government's efforts to support the development of these industries have achieved success (Reid, Albert, & Hopkins, 2010). The Hong Kong government has also noted the significance of creativity in industry, education, business, and other areas. In his 2009-2010 policy address, the Chief Executive of Hong Kong announced that six industries, i.e. education services, medical services, testing and certification services, the environmental industries, innovation and technology, and the cultural and creative industries, are crucial to Hong Kong's economy (Government of the Hong Kong Special Administrative Region [HKSAR], 2009).

It appears that fostering creativity in the next generation has become an important goal in the world. It may also be beneficial in developing the creative industries. Education is undoubtedly fundamental to cultivating creativity in the next generation. Teaching young adults to solve problems creatively has thus become an important educational task. In recent decades, the governments of regions and countries such as Hong Kong, Singapore, and the UK have implanted elements of creativity into their school curricula to prepare the next generation to confront the challenges of the future (Curriculum Development Council & Hong Kong Examinations and Assessment Authority [CDC & HKEAA], 2007; Eggleston, 2001; Ministry of Education, 2006; Rutland & Barlex, 2008). In Hong Kong, Design and Applied Technology (DAT) was added to the senior secondary curriculum in 2009 as an extension of Design and Technology (D&T) at the junior secondary level. DAT considers innovation as one of the core abilities that students should develop, and its aim is to produce autonomous and creative problem-solvers (CDC & HKEAA, 2007). Creativity has clearly become a core theme of educational policy in the past few decades (Craft, 2003).

The aim of the D&T programme in the UK's national curriculum is that students learn to "think creatively and intervene to improve the quality of life, solving problems as individuals and members of a team" (Department of Education, 2007, p. 51). Similarly, in Singapore's D&T curriculum for lower secondary students, one of the aims is to enable students to "think and intervene creatively to become

autonomous decision makers" (Ministry of Education, 2006, p. 1). The design education curriculum in Mainland China, which was developed on the basis of international curricula, also has the aim of developing students' creativity, critical-thinking and problem-solving abilities (Gu, 2004).

Many curricula of design education have put their emphasis on creativity (Gu, 2004; Ministry of Education, 2006; Department of Education, 2007). Fostering students' creativity has become an important agenda in secondary school curricula worldwide and specifically in design education.

1.3.   DESIGN EDUCATION AT THE SECONDARY SCHOOL LEVEL

Design education refers to the learning and teaching of design at any level. However, this thesis focuses on design education at the secondary school level. At this level, design education often refers to the study of D&T, a subject whose inception lies in the UK about a hundred years ago (Eggleston, 1985). Design education, or the study of D&T, is also equivalent to the term 'technology education' (e.g. Volk, Yip, & Lo, 2003). It can be seen that D&T educators have spent years defining the identity of D&T (Eggleston, 1992). In this thesis, the term 'design education' is chosen because the term is more suitable in the context of design in this research.

Today, instead of focusing on woodwork and metalwork as it did in the past (Eggleston, 1985; Volk, Yip, & Lo, 2003), D&T involves activities and projects that enable students to realise conceptual ideas into tangible products. Students learn about materials, tools, machines, product design, manufacture and fabrication processes. They are required to design and make products by creating presentation sketches and drawings and using the different tools and machinery available in the workshop. This activity- and project-based subject also requires students to apply the design theories they learn to solve real problems (Siu, 1999). Design education enables students to apply mechanical, structural, and electronic knowledge to create artefacts through the design process (CDC, 2000a). This creative experience in the realisation of objects makes D&T distinct from other subjects in the secondary school curriculum (Eggleston, 2000a).

D&T is able to promote creativity because of its design-oriented nature. Many educators believe the subject has the potential to foster creativity through design activities that develop novel ideas and artefacts (Dow, 2004). D&T researchers also believe that creativity can be developed in the D&T classroom (Rutland & Barlex, 2008) because the design process relies on the development of novel, useful, and appropriate ideas (Dow, 2004). Furthermore, design is highly relevant to creativity, as it concerns the generation and realisation of new ideas and problem-solving for the made world (Dorst, 2003). According to Barlex's analysis (2007), the ability to design corresponds to the ability to create creatively. It is apparent that creativity is an integral and essential part of both design and D&T lessons (Howard et al., 2008; Rutland & Barlex, 2008; Spendlove, 2005; Siu, 2009).

D&T has also been acknowledged as a multidisciplinary subject that provides students cross-curricular activities (Wilson & Harris, 2004). Eggleston (1995) believes that the subject is welcomed by every society and government because it is key to "a developed economy and to growth in national income" (p.32).

D&T at the secondary school level not only holds possibility for fostering creativity education, but also features a number of other elements that possess educational value. A survey of the literature suggests that D&T:

- promotes higher-order thinking skills (Atkinson, 2000; Linton & Rutland, 1998; Siu, 1999; Wilson & Harris, 2004);
- improves performance in other academic subjects (Eggleston, 1998; Linton & Rutland, 1998);
- improves behavioural problems (Eggleston, 1998; Linton & Rutland, 1998);
- facilitates students in becoming active learners (Gattie & Wicklein, 2007);
- helps students to become creative and reflective problem-solvers (Wilson & Harris, 2004);
- facilitates students' cognitive development (Wilson & Harris, 2004);
- integrates subjects such as mathematics and science (Erekson & Shumway, 2006; Gattie & Wicklein, 2007);

- facilitates social interaction (Eggleston, 1998; Jarvinen & Twyford, 2000); and

- engages students both inside and outside the classroom by allowing them to formulate real solutions using real materials (Middleton, 2005).

D&T differs from other subjects that it integrates all these educational values in a single subject. Although these values can be achieved in other secondary school academic subjects, there is no other subject that incorporates all of them at once. According to Hansen and Froelich (1994), D&T is also the only subject that "is in harmony with the way people learn, with the natural and manufactured worlds, and with the way societies adapt to their environments" (p. 192). D&T possesses some educational values which are irreplaceable by other academic subjects.

Design education has been implemented in many countries around the world, and numerous governments have made it a compulsory subject for both primary and secondary school students. Governments have also put considerable effort into optimising the design curriculum, and significant changes have been made to the curriculum in many countries (Williams, Iglesias, & Barak, 2008). A variety of national organisations and annual international conferences have been established to connect D&T educators and researchers as a confluence of knowledge and experience. However, the seemingly optimistic development of D&T does not imply that international design education has come to be a success in its establishment over the years (Siu, Wong, & Feng, 2010). Researchers from countries in which D&T is well established have highlighted a number of problems that design education has encountered in their education systems (Wang, 2009; Wright et al., 2008; Yau & Ong, 2005).

Over the past few decades, D&T at the secondary level has sought a new identity, as industries no longer need a large number of skilled workers and the economies of developed countries all over the world have shifted away from the manufacturing industry. Many governments have also altered their curricular focus to either academic or general education in recent educational reforms. However, many problems and hidden issues still require resolution.

Hong Kong faces a number of problems that arise from its unique historical background. Examining the history of design education at the secondary school level in Hong Kong will afford an understanding of the current state of design education and the problems it has encountered in its development, which is also in line with the scope and focus of this study (for further details, see Section 1.8).

1.4. HISTORY OF DESIGN EDUCATION IN HONGKONG

In the decades up to the late 1970s, the Hong Kong government paid inadequate attention to design-related subjects. A number of technical schools offering subjects such as woodwork, metalwork, electronics and technical drawing were established, and students were able to take public examinations in these subjects. However, the first dedicated design-related subject, Design and Technology (D&T), was not established until 1975, and its official syllabus was not introduced until 1983 (Curriculum Development Committee, 1983; Siu, 2008). It took another 17 years for a new D&T syllabus to be introduced. In 2009, D&T at the senior secondary level was renamed Design and Applied Technology (DAT) following the structural reform of the senior secondary system in Hong Kong (CDC & HKEAA, 2007).

Along with the evolution of the design syllabus over the past three decades, the educational goals and objectives of design subjects have also evolved in relation to the changing societal and industrial needs of Hong Kong and technological improvements worldwide. The following sections outline the development of design education in Hong Kong in five distinct periods.

1.4.1. Pre-war

In the early 1900s and before, the major educational objectives of the schools established by the Hong Kong government were to teach students English and other academic subjects (Ng, 1997). Design-related subjects had not yet been introduced

into the Hong Kong school system, with most learning and teaching of design-related knowledge based on traditional Chinese-style apprenticeships (Siu, 2008).

As the 20th century progressed, many new factories producing materials and products such as wire, cement, rattan, and yarn were established (Nyaw, 1997). The Ottawa Agreement signed by Great Britain in 1932 further stimulated the industrial development of Hong Kong. Consequently, it is not surprising to find that the teaching of design-related knowledge gradually replaced traditional Chinese-style apprenticeships in Hong Kong schools. The Aberdeen Industrial School, which is regarded as the first school in Hong Kong to teach design-related subjects, was established in 1935 to provide apprenticeship courses in mechanics, cabinet making, tailoring, and shoe making (Siu, 2008).

At the time, however, the term 'design' was not commonly used to describe the knowledge conveyed by the masters in factories and teachers in the industrial school. School subjects associated with design, craft, and technical matters, which are elements of design-related subjects in today's terminology, were regarded as 'technical subjects' (Siu, 2002b, 2008; Turner, 1989). Moreover, the major educational objectives were to train skilled workers for industry, which may explain the inclusion of the word 'industrial' in the name of the Aberdeen Industrial School.

1.4.2. Post-war to 1950s

In 1952, the Aberdeen Industrial School was renamed the Aberdeen Trade School, and a wider range of subjects was offered to students. They included bookbinding, carpentry, metalwork, pottery, leatherwork, paperwork, and carving (Aberdeen Technical School, 1985). The provision of a wider scope of design-related subjects was no doubt an outcome of the rapid growth of industry in Hong Kong around 1950, which was the result of several historical events.

When Japan occupied Hong Kong during World War II, large numbers of people left Hong Kong to escape the chaos of war. The number of workers decreased dramatically in line with the decline in the Hong Kong population as a whole. In

1946, however, soon after the war had ended, much of the population began to return. Moreover, before and after the establishment of the People's Republic of China in 1949, many Nationalist party members sought refuge in Hong Kong (Nyaw, 1997). This huge influx of people left Hong Kong with a large amount of cheap labour. At the same time, a variety of entrepreneurs and technicians also moved to Hong Kong, together with their advanced technologies and machinery, and started to develop a range of industries. The plentiful supply of cheap labour allowed these largely labour-intensive industries to soon take off, and the textile industry became Hong Kong's leading industry in 1947, a position it held until 1958.

The advancement and development of design-related subjects also began to see progress in the 1950s. In 1955, public examinations were introduced for technical subjects, and in 1957 the Aberdeen Trade School was renamed the Aberdeen Technical School (Siu, 2008). Students could now choose two of the six subjects of pottery, toy-making, leatherwork, bookbinding, weaving, and embroidery, and they could also take woodwork, metalwork, geometrical and mechanical drawing, or dressmaking.

The development of design education in the 1950s was clearly associated with the industrial development of Hong Kong. For instance, the addition of weaving and embroidery as subjects at the Aberdeen Technical School reflected the rapid development of the textile industry at that time. The technological level of design-related subjects also rose after the war in concert with the advanced technologies introduced by the new entrepreneurs and technicians who arrived in Hong Kong. Technology advanced from the use of traditional hand tools (in mechanics, cabinet-making, tailoring, and shoe-making in 1935) to the use of newer tools and machinery (in pottery, toy-making, leatherwork, bookbinding, weaving, and embroidery in 1957). The subjects on offer also became more diverse, and more design elements were introduced.

Before the 1960s, the major goal of design education was to train skilled workers for industry. However, unlike their counterparts in the pre-war period, these trained workers now possessed higher levels of skill and technological knowledge.

1.4.3. 1960s to 1970s

In the 1960s and 1970s, the Hong Kong government began to understand that the sustainability of industrial growth depended on the supply of technicians and skilled workers (Nyaw, 1997). During this time, it established five 'modern schools' to teach crafts and technical subjects (Siu, 2008) that were considered essential in terms of their economic and societal value. In 1963, these modern schools were renamed technical schools, and began to offer woodwork, metalwork, practical electronics and technical drawing to students as individual subjects (Siu, 2008).

The introduction of 'practical electronics' in the technical schools was most likely related to the rapid development of the electronics industry in the early 1960s. The number of electronics factories increased from three in 1960 to 109 in 1968 (Nyaw, 1997). The textile industry, in contrast, encountered a serious roadblock in the early 1960s when a quota was applied to the export of cotton textile products from Hong Kong. To increase profits in the face of this quota, Hong Kong entrepreneurs introduced more advanced technology to increase the quality of, and add value to, their products. Moreover, in 1966 a number of factories started to produce artificial fibres, which were also used in the garment industry (Nyaw, 1997).

The plastics industry also underwent rapid development in the 1960s. Instead of producing plastic flowers and trees, as they had in the 1950s, plastics factories began to produce toys. By the 1970s, Hong Kong had become the world's largest exporter of plastic toys (Nyaw, 1997). The development of the electronics, artificial fibre, and plastics industries mirrored the overall development of technology in Hong Kong. The level of technology adopted in these factories was much higher than that used in the factories of the past, which in turn would influence the technologies later used in design education in the 1980s.

In line with these industrial changes, design education in Hong Kong also experienced a breakthrough in the 1970s. In 1975, the new subject of D&T was introduced in secondary schools (Siu, 2008). In contrast to conventional technical subjects, the aim of D&T was to enhance students' problem-solving skills. However,

these so-called problem-solving skills were still limited to the skills needed to complete assigned technical tasks, as D&T focused primarily on skills training in the 1970s. Nonetheless, the technology associated with D&T and other technical subjects was of a higher level than it had been, as increasingly advanced technology was being introduced into the industrial sector, and the core educational aims of the day were to provide skilled workers for industry.

1.4.4. 1980s to 1997

In view of the rapid industrial development that Hong Kong underwent during the 1970s, design education can also be seen as having advanced with societal trends. In the early 1980s, design and industrial education both saw significant advances. In response to the demands of local industrialists and businessmen, the Hong Kong government provided further educational opportunities for students to learn design-related subjects. In 1982, the number of technical institutes increased from two to eight (Nyaw, 1997), and in 1983 an official D&T syllabus comprising a variety of subjects was introduced to secondary schools (Curriculum Development Committee, 1983). The D&T subject included materials, the use of tools and machinery, the study of energy and mechanics, presentation skills, and design principles and processes. In addition, a wide variety of materials were used in practical subjects, including paper, wood, metal, plastics, clay, plaster, leather, vine, bamboo, silicon rubber, vulcanised rubber and plastic rubber.

In the 1980s, the Hong Kong government had a clearer idea of the educational aims of D&T than ever before. The syllabus stated that D&T provided developmental insights into how craftsmanship should be emphasised in woodwork and how metalwork should be transformed into a focus on the creative, aesthetic and ingenious use of materials (Curriculum Development Committee, 1983). Design was also explicitly described as a core-learning medium in teaching students to face, challenge and solve problems.

The development of design education in this era also clearly reflected the growth of different industries in earlier years. For example, in line with the growth of the

plastics industry, plastics and rubber materials became widely adopted in the D&T syllabus. Silicon rubber, vulcanised rubber and plastic rubber were all products of technological advancement. As the subject content of D&T originated in the UK, Hong Kong's schools also used tools and machines imported from the UK. The government planned for D&T to gradually replace conventional technical subjects (Siu, 2008).

The role of technology gradually shifted in the official D&T syllabus. In the past, training in the operational skills needed to manipulate technology had been the core of technical subjects, whereas in the 1983 syllabus, technology became a tool that students could use to solve problems. However, in practice, D&T remained very similar to the conventional technical subjects taught in schools in earlier times, and woodwork and metalwork were still the main design-related subjects. This situation persisted until 2000, when a new syllabus was introduced.

Although design education underwent active development in the early 1980s, it gradually lost the public's attention in the late 1980s, possibly because of Hong Kong's economic restructuring midway through the decade. The service sector developed rapidly in the 1980s, whilst industrial development was in decline (Nyaw, 1997). As a result, young adults needed higher levels of academic education to gain employment. In the mid-1980s, society also began to call for higher levels of education, and most students at the time had an opportunity to study at the senior secondary level. To fulfil this wider societal demand for a higher level of education, the Hong Kong government implemented a shift in educational policy from providing a skilled labour force to maintain economic growth to providing opportunities for academic study at a higher level (Nyaw, 1997). Consequently, the training of factory workers and technicians lost its social significance, and the growth of design education began to decelerate.

Furthermore, in the lead up to the handover of Hong Kong to China in 1997, the government instituted no new educational policies. Accordingly, there would be no further changes to D&T until 2000. Most schools still used the same machinery and tools that had been introduced from the UK 20 years earlier, although a few imported computer numerical control (CNC) machines in the 1980s, as computers had started

to become popular. Nonetheless, as a technical subject, D&T gradually came to be considered inferior to other academic subjects in the 1990s.

1.4.5. After 1997

After the handover to China, the HKSAR government introduced a number of new policies. Educational reform and revision of school syllabi were also on the government's agenda. In 1997, all technical schools were renamed secondary schools, and a D&T syllabus was established at the senior secondary level (CDC, 1997). In 1999, girls were given the same opportunities as boys to study the subject (Volk, Yip & Lo, 2003). The Curriculum Development Council (2000a, 2000b) also designed two alternative syllabi for the junior and senior secondary levels. These alternative syllabi covered a wider scope of technological issues, such as the nature and impact of technology and the prediction of future technological change (CDC, 2000a). The emphases of these syllabi were on problem-solving rather than skills training. Senior secondary school students were taught more advanced technologies, such as control technology and technological structures and mechanisms (CDC, 2000b). More advanced technologies were also made available for students' use, including computer-aided manufacturing (CAM) tools such as CNC and laser engraving machines. The latter were widely used in schools because of their operational simplicity. At the same time, a number of older types of machinery were phased out. For instance, in the past decade most schools have disposed of their woodwork and metalwork lathes, with only a few remaining for occasional use. The change in the use of tools and machinery may be due to the fact that schools were gradually switching to the alternative syllabi in the past decade, and teachers and educators' perceptions of D&T may also have changed. The use of older machines may now be considered out-dated.

Computers are widely used in teaching D&T today. As the HKSAR government has actively introduced computing facilities to secondary schools, students have gained more opportunities to learn different computer software skills. Computer-aided design (CAD) is widely taught in D&T, and has gradually replaced traditional

technical drawing using pencil and paper. Both two-dimensional software such as CorelDraw and three-dimensional software such as SolidWork and ProDesktop are assisting D&T students in their designs. The use of these software also facilitates the development of higher-order thinking and problem-solving skills (Blankson, Keengwe & Kyei-Blankson, 2010), although the machinery and tools being used are by no means more sophisticated in the operational sense.

The core educational aim of D&T is no longer to equip students with practical skills, but to provide them with technological literacy and the ability to solve technological problems (CDC, 2000a, 2000b). The development of D&T in the 21st century has begun to depart from the direction of industrial development. More importantly, educators become increasingly aware of the educational value of D&T in developing students' cognitive and social skills.

In view of the new senior secondary school structure implemented in 2009, Hong Kong's CDC and HKEAA (2007) have prepared a Curriculum and Assessment Guide for D&T at the senior secondary level, and have renamed the subject DAT, as previously noted. The new DAT course covers a wider scope of technology. In addition to the elements included in the previous D&T syllabus, new modules such as electronics, automation, and creative digital media are now offered as electives. Many schools which offer DAT to senior secondary students are likely to have better technological facilities than those which only provide D&T to students at the junior secondary level.

As more advanced machinery has been made available to them in the past decade, most students are now able to produce finer work with the help of technology. Students often spend less time working on projects, and are able to introduce more aesthetic and creative elements into their artefacts and designs. Moreover, the new machines are safer, as technological advances have allowed engineers and designers to pay greater attention to safety issues. Accidents in the D&T classroom have become rarer in the past decade.

The D&T curriculum at the junior secondary level is still based on the syllabus established in 2000. Its aim is to "develop the technological awareness, literacy,

capability and lifelong learning patterns" of the students (CDC, 2000). Students have to study four areas of learning: the nature and impact of technology for yesterday, today and tomorrow, design and communication, the tools and machines of technology, and the resources of technology. At the senior secondary school level, the latest curriculum, which involves more advanced technology such as electronics and automation, was established in 2007 and implemented in 2009. Students are required to study three core subjects (technological principles, design and innovation, and value and impact) and opt for another two from five elective modules (electronics, automation, creative digital media, visualisation and CAD modelling, and design implementation and material process) (CDC & HKEAA, 2007). Innovation and entrepreneurship are two core concepts emphasised in the new curriculum.

1.5.   ISSUES OF DESIGN EDUCATION IN HONGKONG

Despite its long history and well-designed curriculum, design education in Hong Kong faces many hidden problems and issues. Because the syllabus at the junior secondary level is not tied to a public examination, the government affords schools and teachers a high degree of flexibility in planning the curriculum in accordance to the funding and facilities available. In addition, D&T is not mandatory at any level of education. There are currently 524 secondary schools in Hong Kong, and only about half offer D&T, according to a curriculum development officer in the technology education section of the Education Bureau (EDB, 2007d). Furthermore, the only teacher training institute in Hong Kong offering D&T training closed its D&T teacher training programme in 2006.

Schools which offer D&T are reducing their facilities, and some have even turned part of their workshop into study rooms or computer rooms. Some storage rooms have also been renovated for use as meeting rooms or guidance rooms. With the exception of computers, the majority of machinery used in schools today has last for about 20 years.

Most textbooks used in junior secondary D&T lessons were published in or before 1997 and are thus not in line with the latest junior secondary curriculum established in 2000. Although some textbooks have been published more recently, they are of questionable quality. It seems that publishers are not willing to put effort into publishing a high-quality set of textbooks for a subject with a small market. Many teachers are thus forced to use self-designed worksheets and learning materials in their D&T lessons.

At the junior secondary level, most assessment is done by coursework, with teachers marking the artefacts or drawings created by students. Unlike academic subjects, for which students receive numerical marks on academic reports, most schools only give grades for design subjects, and these grades are often not taken into account in calculating students' average mark. Some schools even combine all technical subjects, such as Visual Art and Home Economics and award students a collective grade.

Most schools also heavily emphasise the technology element of the design curriculum. Projects that involve designing and making activities such as 'design and make a photo frame' or 'design and make a key chain' are very popular among junior secondary students. However, teachers and students generally devote more time and attention to the making element of the project than to the design process of the artefact. It seems that teachers are more concerned with the tangible outcomes of learning activities. Some better-funded schools with better facilities have introduced more advanced technology and equipment to design subjects. For instance, some teachers have incorporated robotics and electronics as core topics at the junior secondary level. Schools with a specific focus have also been able to help students to win international awards, and some have also placed greater focus on aesthetic design in technology education. However, these are exceptions, and the D&T design track remains a not very popular option in Hong Kong.

Regardless of the different emphasis of D&T in secondary schools, equal opportunities have been given to both genders in learning D&T since 1999. Previously, only boys could study D&T, with girls directed to home economics. After researchers in Hong Kong raised the issue of inequality, the Equal Opportunity

Commission of Hong Kong suggested that secondary schools that offered D&T should provide equal learning opportunities for boys and girls (Volk et al., 2003). Although the policy was enacted later than in neighbouring countries such as Singapore, it definitely constituted a breakthrough in the development of design education in Hong Kong. However, the inclusion of girls created another challenge for D&T.

In the past, boys did not have to study home economics, and girls did not have to study D&T. Now, both genders have to study both subjects, which have created scheduling issues. As the time slots available in the junior secondary school timetable are already occupied with numerous academic subjects, it is difficult for schools to make rooms for non-academic subjects such as D&T and home economics. Consequently, the curriculum time for each subject has been cut in half, and students can generally study D&T for only half the academic year (Volk et al., 2003). In the other half, they swap with the students taking home economics or opt for other non-academic subjects (Wong, Feng, & Siu, 2010).

As D&T is an elective at the senior secondary level, this scheduling issue does not arise. In 2009, the new academic structure for senior secondary education was put into practice, and the new DAT curriculum was established with a new focus. There is now much greater emphasis on students' future prospects than in the previous curriculum. However, the establishment merely shed a light onto the development of design education in Hong Kong. In practice, most secondary schools do not offer the subject at all because those that used to offer design education at the senior secondary level under the previous academic structure lack the facilities and machinery required by the new syllabus. Some D&T teachers are not even able to teach the elective modules in the syllabus. The result is that a number of schools have omitted DAT at the senior secondary level. At present, Hong Kong has only about fifty schools offering DAT at this level, and most of them were previously considered technical schools and thus do not attract students of higher academic ability.

Just a few decades ago, these technical schools were very popular among primary school graduates, and craft-based design education was once attractive to students

and parents. As Hong Kong's economy shifted away from manufacturing after the 1980s, students became more tempted by academic subjects that seemed to offer better prospects for the new knowledge-based society. Even though D&T has shifted towards a less skill-oriented approach, it has gradually been seen as a second-class subject for secondary school students of lower academic ability.

Design education in Hong Kong can be traced to the 1930s (Siu, 2008), but its relatively long tradition has not helped to raise the importance of D&T in recent decades. The reasons for the subject's decline are not only associated with the industrial decline of the 1990s, but also with internal factors in the current D&T curriculum and the beliefs held by Hong Kong people.

1.6. THE NEED FOR CREATIVITY RESEARCH IN DESIGN EDUCATION

In Hong Kong, the government, school administrators, teachers, parents and other stakeholders underestimate the value of design education. Some of the issues discussed in the previous section are also shared with other countries with well-developed D&T. Although many agree that D&T is an excellent platform for cultivating student creativity, and that creativity is crucial for our survival, creativity is being neglected in D&T in Hong Kong. The importance of creativity is also downplayed in practice despite the current shift towards greater emphasis on creativity in secondary school curricula. Particularly in Hong Kong, secondary school students are being trained for public examinations and taught how to perform well in academic subjects such as mathematics and science, as examination success is key to university attendance and obtaining a good job in future (Eggleston, 1998). This examination orientation encourages teachers and students to aim for greater achievements in a minimum of time. Although the effectiveness of learning and teaching are major concerns, other aspects of education that are also essential, such as creativity, are being neglected unconsciously.

Spendlove (2005) posited that what distinguishes human beings from other species cognitively is our creative capacity. The development of creativity runs parallel to

the development and evolution of culture and society. Craft (2003) believed the role of creativity to be one of the most important issues in education, and Spendlove (2005) regarded creativity as "the elusive and ultimate goal of education" (p. 9). However, as we have seen here, D&T in Hong Kong is currently threatened with extinction (Siu, Wong, & Feng, 2010). New schools tend not to offer the subject, and some schools that do offer it are planning to cease doing so. If the creativity element in D&T was significant enough to be noticed by stakeholders, then design education in Hong Kong would not be experiencing this crisis. Similarly, if the roles of creativity in D&T can be re-identified in the Hong Kong context, then it is possible that the value of D&T may regain the attention of stakeholders. Research addressing the roles of creativity in education is essential to draw the public's attention to its long-term importance. The public needs to realise that instant success in a public examination cannot be compared with the long-term benefits that accrue from creativity if society wishes to be equipped to solve the problems likely to arise in future.

It is interesting to note that people in Hong Kong are always eager to buy new products when they appear in the market, particularly new creative products. For example, whenever new versions of the Apple iPhone or iPad are released, Hong Kong people can be found queuing over night to be among the first to obtain them. There is also great interest in new technologies in Hong Kong, particularly those not seen before or those with special and creative specifications. It seems odd that Hong Kong is happy to follow the creative technologies of other countries, but makes no effort to develop home-grown creativity. Does Hong Kong lack the potential to design and produce creative products? Can creativity be incorporated in design education to allow Hong Kong to become a centre of creative design? Design education certainly has a role to play in cultivating creativity among students, and perhaps an investigation of creativity in D&T will show the way forward in developing a vision for instilling creativity in the next generation.

Researching on the roles that creativity can play in education will help to fill a number of current knowledge gaps. The roles of creativity in society are rather explicit. Although creativity can have the positive societal effects outlined in the previous sections, it also has the potential for negative repercussions if put to

purposes such as the invention of nuclear arms (Spendlove, 2005). In the context of education, creativity's roles may be more implicit. Although it is indisputable that teaching students to be creative has enormous benefits, it is not known what influences creativity-related issues will have on education in Hong Kong, given the current immature state of creativity education. These influences may be considered either benefits or roadblocks in the development of education and cultivation of creativity. They may also serve as a reference for educators in monitoring the processes of teaching for creativity and learning to be creative.

1.7. PURPOSE OF THE STUDY

The links among creativity, design and design education are apparent in both research and D&T secondary school curricula throughout the world. It is also fairly obvious that there is a significant relationship between creativity and problem-solving in the real world. Creativity has been shown to help solve problems in a variety of fields (Sternberg & Lubart, 1995). Its benefits should be apparent to educators to encourage efforts to foster creativity in the next generation. The role of design education in fostering creativity in providing an environment conducive to the promotion of diverse solutions to problems is also evident. Design education plays an important role in fostering creativity. However, design education is not currently valued in Hong Kong. The value of creativity in design education is not properly understood. Thus, rather than considering what design education can do for creativity, the concern of this study is what creativity can do for design education at the secondary level, i.e. the role of creativity in design education. Its role is critical in this context, as it has great influential power over the shape of design education.

In sum, the purpose of this study is to identify the roles that creativity plays in design education at the secondary school level in Hong Kong, and hence to determine how creativity-related issues affect design education. The study's key objectives are:

1. to review and investigate how teachers, students and policymakers understand creativity;
2. to understand the practical issues in the design education classroom or school;

3. to suggest possible methods of teaching creativity in design education;

4. to identify the roles of creativity in design education; and

5. to identify the issues related to the cultivation of creativity in design education.

In an attempt to achieve these objectives and address the related issues, the following research questions are formulated.

1. How do D&T teachers, students and policymakers understand creativity? What kinds of products and persons are regarded as creative in D&T? How do D&T teachers and students perceive and experience the creative thinking process? How are the current learning environment and societal atmosphere related to creativity?

2. How is creativity fostered and promoted in the D&T classroom? What are the experiences of teachers and students when they encounter creativity?

3. How should teachers teach creativity to ensure that it is successfully fostered?

4. What are the roles of creativity in design education? How does creativity benefit design education in particular and general education more widely?

5. What issues arise in the cultivation of creativity? What difficulties might teachers encounter in attempting to foster creativity?

1.8.   SCOPE OF THE STUDY

This study is limited by several constraints which circumscribe its scope. For example, it is confined to design education alone. Admittedly, creativity has a role to play in many other subject areas and activities, such as writing, the performing arts and scientific experiments. However, these activities do not possess a distinctive process in the creation of an idea, at least not to the same extent as design activities. The distinctive design process involved in the creation of a design and the general creative process involved in the generation of creative ideas are similar in a number of ways (Howard et al., 2008). In view of the similarities between the design process and the creative process, it is therefore believed that investigating creativity in design is more fruitful than investigating it in other areas.

Furthermore, this study focuses on design education only in the context of the secondary school curriculum. It thus neglects design education at the early childhood, primary and tertiary levels. The primary reason for the focus on the secondary level is that adolescents are in the growth stage of cognitive development. They are able to express themselves verbally and as individuals, and they are beginning to be aware of the limitations of their thinking (Slavin, 2009). They are thus more appropriate participants for semi-structured interviews than kindergarten or primary school children are likely to be. In addition, the teacher-student relationship is much stronger at the secondary level than at the tertiary level. The active and frequent interactions that take place between teachers and students at this level may contribute to a more holistic view of the roles of creativity.

Another possible limitation is that the discussion of design education in this study is restricted to D&T. It could be argued that D&T is not the only subject in design education, and that other subjects such as visual arts should be included in a discussion of design education at the secondary school level. However, in considering the definition of creativity and design in this study, it is deemed best to confine design education to D&T. Pahl, Newnes, and McMahon (2007) noted that creativity is "often confused with the generation of novelty which is not socially meaningful" (p. 7). In visual art, creativity could be seen as the equivalent of imaginative, which differs from creativity and the 4P's as defined here. Creativity should possess meaning beyond novelty if it is to be socially meaningful. D&T is thus deemed more suitable for the discussion of creativity in this research. Creativity is discussed in greater detail in Chapter 2 and Chapter 8.

The data for this study were collected in Hong Kong. The geographical area covered is fairly limited. Data collection was restricted to Hong Kong because of the infeasibility of conducting interviews in other countries. However, it is also believed that the case of Hong Kong is adequate to provide a comprehensive review of design education, as design education is well developed in Hong Kong, but faces a number of complex issues. The training and background of D&T teachers are diverse, and teachers have freedom of choice over the topics they teach at the junior secondary school level. Given these factors, it is believed that Hong Kong should provide more

fruitful data in identifying the roles of creativity compared with countries or cities with a more restricted design curriculum such as Singapore.

The research for this study is qualitative in nature, and thus it can suffer from limitations in validity and particularly reliability. However, Wiersma and Jurs (2005) believe that the traditional concepts of reliability and validity may not be applicable to qualitative research (see also Janesick, 2003). In this study, comprehensive procedures and results were presented to enhance the external reliability. Internal reliability is guaranteed by the consistent data collection carried out by a single researcher, as reliability in qualitative research is regarded as "a fit between what they record as data and what actually occurs in the setting under study" (Bogdan & Biklen, 2007, p. 40).

Wiersma and Jurs (2005) also noted that the internal validity of research relies on the logical analysis of the data performed by the researcher. External validity, which is also known as generalisability, depends on the level of comparability and transferability in qualitative research design (Cohen, Manion, & Morrison, 2007; Wiersma & Jurs, 2005). In this thesis, the detailed data collection procedures are presented, and detailed descriptions of the data and results are provided to allow other researchers to determine whether the results are transferable to other settings and other possible comparison groups. In fact, some qualitative researchers are not concerned with the level of generalisability of their findings, but rather with the other settings and subjects to which their findings are generalisable (Bogdan & Biklen, 2007).

1.9.   THESIS OUTLINE

This thesis is structured in coordination with the research methodology to make it easier for readers to understand the flow of thinking throughout the study. The following provides a brief outline of each chapter.

Chapter 1 outlines the rationale and background of the study. It presents a historical review of design education in Hong Kong, in addition to a roundup of the current situation and issues.

Chapter 2 gives an in-depth review of the literature. The 4P's framework suggested by Rhodes (1987) was applied to structure the content of this literature, and theories of creativity in design education were included.

Chapter 3 extends the literature review of Chapter 2 and provides two perspectives on understanding creativity: design and emotion. Both are believed to be closely related to creativity. Related issues in design education are also discussed.

Chapter 4 describes the methodology used in the five research stages of the study.

Chapter 5 reviews the perceptions and understanding of Hong Kong society towards creativity based on newspaper analysis. The chapter also describes the cultural factors that influence the way in which creativity is seen by Hong Kong people and how these factors affect design education.

Chapter 6 highlights the creativity in existing Hong Kong design education. Student artefacts and project briefs retrieved from a government website and project titles from the public examination authority were the two sources of data for this investigation and analysis. The primary focus is on the artefacts and projects, as they give a direct indication of the state of creativity in Hong Kong design education.

Chapter 7 presents the findings of the interviews with EDB and HKEAA officers, school teachers and students.

Chapter 8 analyses the interview findings and discusses issues worthy of concern. The data from Chapters 5 and 6 are also included to support the interview findings when necessary. This chapter also identifies the roles of creativity in design education and related issues, as revealed in the findings and analysis. Recommendations and suggestions for changes in design education are also suggested.

Chapter 9 concludes the study with a summary of the research findings, and provides possible directions for future research on the topic of creativity and design education.

Figure 1.1 illustrates the relationship between the thesis chapters and the corresponding research stages. More details of the research stages can be found in Chapter 4 Methodology.

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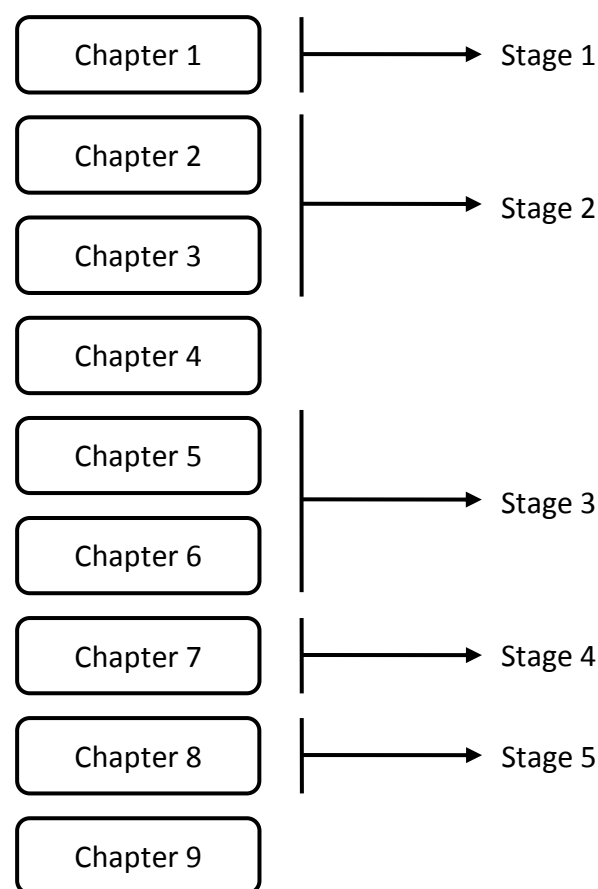
Figure 1.1. Thesis chapters and corresponding research stages

1.10. CONCLUDING REMARKS

This chapter outlines the rationale and background of the study. Creativity is crucial to human survival, as the complexity and quantity of problems we face are

intensifying and increasing. The importance of creativity inspired a considerable amount of creativity research in recent decades. Researchers have proposed a variety of theories and frameworks for understanding creativity from the perspectives of person, process, output and environment (or person, process, product and press in Rhodes' [1987] 4P's framework). Theories of creativity have also been linked to different types of knowledge to allow creativity to be understood in different contexts.

It is clearly essential that we educate young adults to apply creativity to problem-solving to equip them with the ability to solve the unexpected problems in future. The best platform for cultivating creativity is arguably design education. The school subject D&T is believed able to provide activities that are conducive to students' development of creative ability. In Hong Kong, however, the value of D&T is underestimated. Schools administrators do not value the subject, and fewer schools are offering it to students. This undervaluation of D&T may imply that the role of creativity in design education is being neglected in Hong Kong. Although the history of design education in Hong Kong and the societal perceptions of the discipline may have contributed to its current decline, D&T possesses unique values that are irreplaceable by other school subjects. It is essential that we investigate and scrutinise creativity's role in D&T to raise awareness and the value of design education as a whole. Such investigation also clarifies the role of creativity in education more generally, which is essential for its promotion.

The roles of creativity in design education constitute the main topic of investigation in this study. Following a discussion of the research methods adopted, the thesis begins with a review of the literature on the topics of creativity, design and emotion. It also reviews and identifies the roles of creativity in design education through documentary investigation and semi-structured interviews. Possible solutions and recommendations for optimising the cultivation of creativity in design education are suggested. Although the study is confined to design education at the secondary school level and limited by the scope outlined in this chapter, it is hoped that its results are beneficial to the development of design education in Hong Kong.

Chapter 2
Creativity in the Literature and this Study

Creativity is elusive with multi-facet attributes. Its definition varies, and it is not easy to comprehend the pathway leading to creativity. This section provides a general understanding on creativity in literature, including its definition on the 4P's creative output, thinking process, person and environment, followed by the topic of creativity in design education. The 4P's of creativity helps understand what creativity is. The section of 'Creativity in Design Education' highlights the discussions of creativity specifically in the context of design education.

2.1. CREATIVITY: THE DEFINITION

Howard Gardner, the Professor of neuroscience from Harvard University who developed the theory of Multiple Intelligence, suggested that creativity is associated with problem solving and raising new questions (Craft, 2001). Ruth Noller, Distinguished Service Professor Emeritus of Creative Studies at buffalo State College, suggested that creativity is "a function of knowledge, imagination, and evaluation, reflecting an interpersonal attitude toward the beneficial and positive use of creativity" (Isaksen, Dorval & Treffinger, 2011, p. 5). She had also developed a symbolic formula $C=f_a(K, I, E)$ for understanding creativity (where C = creativity, K = knowledge, I = imagination, and E = evaluation). Besides, it is associated with

different attributes such as motivation and social environment in Amabile's model of creativity (1983, 1986), sometimes a person's characteristics and cognitive ability in the traditional idea of creativity (Rutland & Barlex, 2008), and even the period of the non-thinking time when generating ideas (Wallas, 1926; Webster, Campbell, & Jane, 2006).

Different researchers had commented on the definition of creativity in different educational contexts, and there is a wide range in the definitions (De Miranda, Aranha & Zardo, 2009; Isaksen & Murdock, 1993; Spenlove, 2005). Besides, some researchers believed that there are different types of creativity (see Boden, 2004; Craft, 2001; Kaufmann, 2004; Kirton, 1994; Rutland & Barlex, 2008; Spendlove, 2005). The next section discusses some types of creativity as seen in the literature.

2.1.1. Different types of creativity

Creativity can also be categorised as 'big' and 'small' in accordance with the literature (Craft, 2001; Rutland & Barlex, 2008; Spendlove, 2005). Craft (2001) believed the big creativity, in which she regarded it as "big C creativity" (BCC), refers to the "extraordinary contributions and insights of the few" (p. 49). The "small c creativity" (LCC), on the other hand, is a kind of approach towards what a person can do in life when facing uncertainties. Similarly, Rutland and Barlex (2008) believed that big creativity develops something that possesses enduring value that contributes to or transforms existing knowledge. Small creativity gives a fresh and lively interpretation of an issue (Rutland & Barlex, 2008). What education needs is to teach students how to employ small creativity, because this small creativity is likely to be a pre-requisite for students to acquire big creativity in their future lives (Rutland & Barlex, 2008).

Researchers also employed different ways to define creativity. For instance, Boden (2004) defined two senses of creativity: psychological (P-creative) and historical (H-creative). The psychological sense of creativity is to produce or generate ideas or an output, which is novel with respect to the individual mind. If an individual combines ideas and generates a new output in a way which he/she has never done before, the

idea or the output is said to be P-creative. Alternatively, if an individual generates a new output in a way that no one has done before, the output is said to be H-creative. In that sense, the historical sense of creativity is to produce or generate outputs that are novel with respect to the whole of human history. What is of more concern in the psychological aspect, as well as in this study, is the P-creativity, as it is essential in finding how an individual carries out the creative thinking process. Other areas of studies such as engineers are more interested in the H-creativity (Howard et al., 2008).

Kirton (1994) categorised creativity in terms of two styles: adaptive creativity and innovative creativity. The former improves things within an existing framework, and the latter restructures both problems and framework, and is a different kind of response. One might argue that two different levels of novelty have been illustrated implicitly in the categorisation, though they are regarded as two different styles of creativity. However, it is unsure about which style of creativity is of higher level if the Novelty-Creativity Taxonomy developed by Kaufmann (2004) is studied.

The taxonomy understands creativity and novelty by separating novelty into two senses. One is the novelty of the stimulus, the Task Novelty, and the other is the novelty of the response, the Solution Novelty. A two-by-two matrix is then formed by the high and low levels of novelty of the task and the solution, and four different categories are identified. Two of them are associated with creativity. If the solution for a familiar task (low novelty) is of high level of novelty, it is regarded as proactive creativity. If the solution for a new task is also of high level of novelty, it is regarded as reactive creativity. According to Kaufmann, it is not necessary for reactive creativity to be more creative than the proactive creativity. On the contrary, the proactive creativity might sometimes possess more creativity, as the individual has to understand an existing problem differently to generate a solution.

The two styles developed by Kirton and the Novelty-Creativity Taxonomy developed by Kaufmann might not be totally distinctive in some circumstances. For example, the proactive creativity in the taxonomy is quite similar to the adaptive creativity of Kirton. Nevertheless, Kaufmann's taxonomy extends our understanding of the relationship between novelty and creativity. Also, unlike other categorisations,

which concentrate on the outcome of creativity, this approach also takes the stimulus (or the problem) into consideration. This taxonomy might be more applicable to research in design education, which emphasises design process and more particularly, the problem identification stage.

2.1.2. Possibility to Learn and Teach Creativity

Using the foregoing discussions, it can be argued that creativity can be learned and taught, and we human beings have the capacity to extend our cognitive system (Peterson, 2002). Isaksen and Murdock (1993) suggested that creativity is a set of complex human attributes that can be seen as a natural human phenomenon. Based on this assumption, it is possible to study, assess, and develop creativity. We can also enhance creativity (Isaksen & Murdock, 1993). Teaching creativity is important because it equips students to acquire the skills and knowledge necessary to solve problems in the future.

Also, researchers generally believe that it is possible to learn or teach creativity, as we human beings have the capacity to extend our cognitive system (Peterson, 2002). Creativity is a set of complex human attributes that can be seen as "a natural part of being human" and it is "not reserved for those people with some sort of special gift" (Isaksen et al., 2011, p. 3). It is possible to study, assess, and develop creativity.

Due to its multi-faceted nature, it is unsurprising to find that it does not have a single universal definition as do other well-established concepts. It is also inappropriate to give an exact definition to creativity in this study. On the contrary, it is more appropriate to understand creativity through different perspectives that are included in creativity, as creativity is like a basket which carries many concepts. Understanding what constitutes creativity might shed a light to our understanding at the moment. However, this does not imply that the perspectives, i.e. the 4P's, are equivalent to the definition of creativity. The 4P's serves as media to help us understand creativity.

2.2.   THE GENERAL AGREEMENT (CREATIVE OUTPUT)

Nonetheless, after years of research, there is a general agreement that creativity consists of two major elements: novelty and appropriateness (Atkinson, 2000; Howard et al., 2008; Howard-Jones, 2002; Mayer, 1999; Sternberg & Lubart, 1999). However, despite this notional consensus among creativity researchers, a concrete definition of creativity has yet to be achieved.

Synonyms such as 'original' and 'new' are used to describe the defining feature of novelty in defining creativity, while words such as 'significant', 'valuable', 'effective', 'useful', etc. are used to describe its appropriateness. Some other researchers add other elements to their research for different research contexts. The following explains novelty, appropriateness and the other elements in more details.

2.2.1.   Appropriateness

Appropriateness refers to refers to the value of the idea or output created. An output is said to be appropriate if it is valuable in its specific domain (Averill et al., 2001), which can be determined only by a field expert (Howard et al., 2008; Necka, 2003). Besides, it seems that the level of appropriateness has no explicit relationship with the level and the types of creativity, as an idea or an outcome has to be at a certain level of appropriateness and usefulness in order to be said to be creative. An idea that is more appropriate for solving a problem can be 'better' but not necessarily 'more creative'. Any ideas that are not appropriate enough are probably discarded in any problem-solving exercise, regardless of the level of creativity of those particular ideas.

Howard et al. (2008) claimed that assessing appropriateness is often simpler and easier, as if an idea fits the specifications or requirements of the problem, it is considered appropriate. As appropriateness greatly depends on the specifications or requirements of the problem, it is not difficult to judge whether something is appropriate by using specific steps and procedures (Howard et al., 2008). The judgement should be "based more on hindsight than on foresight" (Averill et al.,

2001, p. 172) because something that is beneficial in one way may prove to be harmful in other ways. However, appropriateness is not associated with a correct or wrong answer but rather a 'good' or 'poor' decision (Howard et al., 2008). Under these circumstances, research regarding appropriateness and creativity might not be as popular as the other element of creativity. Novelty is much more difficult to define than appropriateness, so it attracts the attention of researchers in many fields.

2.2.2. Novelty

Novelty exists in all discussions of creativity (Cropley, 2001). The novelty that researchers have been seeking is objective novelty (Kaufmann, 2004), and different researchers use this kind of novelty to understand creativity diversity. Boden (2004), based on the different perspectives of novelty, defineed creativity in two senses: psychological (P-creative) and historical (H-creative). The former refers to the generation of ideas or output that is novel with respect to the individual mind. The latter refers to the generation of new ideas or output with respect to human history. H-creativity has a broader sense of novelty than P-creativity. More regarding the categorisation of creativity is addressed in the Section 2.1.1.

Novelty is often less robust than appropriateness because of its definition. It is much more difficult and ineffective in analysing the novelty and originality of a product or an idea (Howard-Jones, 2002). It is believed that there are very few objective methods available in judging creativity and that it can only be done by a field expert (Hausman, 2009; Howard et al., 2008; Necka, 2003; Pigrum, 2009; Siu, 2002a).

The distinction between H-creativity and P-creativity of Boden (2004) might be able to explain why the assessment of creativity in terms of originality is perceived as difficult by some of the researchers. The difficulty of the assessment is primarily due to the H-creativity of the output in that there is no authority which can guarantee that a particular output is novel throughout the whole of human history. It is likely impossible to verify the H-creativity. However, P-creativity is rather assessable due to its definition. Verification can be done by either self-reflection or observation. In either sense of creativity, however, it seems unlikely to assess the level of novelty,

and this could be the substantial problem encountered when confronting the assessment of the novelty element of creativity.

In spite of the unlikeness of assessing the level of novelty, the level of novelty is by no means insignificant. A certain degree of the novelty has to be achieved so that an output (a product or an idea) can be regarded as creative. Researchers claimed that an output should be new in a way that others are not able to recognise its origins and antecedents. Those outputs, in which its origins and antecedents can be recognised, can only be regarded as intelligent, but not creative (Kaufmann, 2004; Peterson, 2002). This belief defines creativity as an attribute which has a higher ranking than intelligence in terms of novelty. Novelty might be one of the criteria in dividing creativity from intelligence. However, the critical distinction between intelligence and creativity is open to question, and it is unknown where the dividing line should be placed in the spectrum of novelty (Kaufmann, 2004).

The distinction between intelligence and creativity might accidentally resolve a paradox which is noted by Boden (2004). Boden noted that coexisting with novelty, we also expect creativity to have origins and antecedents. Kaufmann in the above discussion used the concept of intelligence to explain this paradox. On the other hand, Peterson (2002) approached the issue through a cognitive perspective. He explained and rationalised this paradox by applying the concept of explicitation, explored by Dartnall (1996), to creativity. Peterson claimed that the original procedure of producing output (e.g. drawings, writing) and the knowledge used in the cognitive system is old. However, by using new way of assessing the old procedure and knowledge in the cognitive system, new and creative output is produced. This concept resolves the paradox that creativity is about novelty.

These elements of creativity precisely describe the characteristics of a creative output/outcome (Diakidoy & Kanari, 1999; Nicholl & McLellan, 2008; Siu, 2002a). Creative output, whether it is a tangible product or an abstract idea, should be novel in the sense that it is 'different from the ordinary' with respect to the individual's experience or that of a reference group.

A creative output refers to the ideas or items generated from the creative thinking process (Warr, 2007). It is also one of the four major areas of the study of creativity diagnosed by Rhodes in 1961 (Runco, 2004). The theory developed by Amabile (1983, 1996) identifies the factors that affect the level of creativity of an output. In accordance to the theory, three components are essential in creating creative output. They are "task motivation", "domain-relevant skills" and "creativity-relevant skills" (1996, p. 94). They are inter-related and affecting each other in the creative thinking process (which is depicted in Section 2.3.). Different combinations of the initial level of the domain-relevant skills, the permanent repertoire of creativity-relevant skills and the level of intrinsic task motivation might result in a different level of creativity of an output. In this sense, the creativity of an output which is created by an individual might be predictable.

2.2.3. Other Elements

Some researchers sometimes add the third element to the two, based on the focus of the related disciplines. Howard et al. (2008) compiled different keywords involving creativity. The third elements in the table are "unobvious", "adaptive", "leap", "change", "unexpected", "communicated", "transformation", "comparisons", and "resourceful" (p. 173). They are considered as supplementary elements to the major elements in that they are less distinctive in contrast with the major ones.

In the study of emotions and creativity carried out by Averill et al. (2001), creativity is held to be pertinent to novelty, effectiveness (which is comparable to appropriateness), and authenticity.

Authenticity is one of the many elements held by researchers to be associated with emotion. Authenticity means that the output reflects the values and beliefs of the creator. Averill et al. (2001) explained the significance of this element using a simple example: a computer is capable of producing a new and valuable graphic, yet one would probably not consider the graphic to be creative, because computers have no 'life' and lack authenticity.

Although novelty, effectiveness, and authenticity may seem common and reasonable aspects of creativity, De Dreu et al. (2008) took a different approach, and suggested that originality, fluency, and flexibility are the three measures of creativity. Flexibility can be achieved through originality and fluency; originality is simply a synonym of 'novelty'; and fluency refers to the number of new ideas or outputs generated. Flexibility is the measure that determines how many cognitive categories are involved in generating new ideas. De Dreu et al. believe that greater flexibility allows more information to be correlated, which leads to the generation of more new ideas (originality and fluency). The approach of De Dreu et al. seems to be less 'emotional' than that of Averill et al. (2010), and indeed none of their criteria is related to emotions.

It is clear that different researchers had different definition towards creativity according to the topic of the research. However, as a matter of fact, there are still many uncertainties in defining and assessing creativity. Understanding the process which directs individuals to generate creative ideas might help in understanding creativity.

2.3.   CREATIVE THINKING PROCESS

2.3.1.   Different Understanding on the Process

The creative thinking process developed by Graham Wallas in 1926 might probably be the most well-known among all other models (Howard et al., 2008; Howard-Jones, 2002). His creative problem-solving process consists of 4 stages: preparation, incubation, illumination, and verification. At the stage of preparation, information relating to the problem is investigated in all directions (Wallas, 1926). The individual analyses the problem and the surrounding issues with respect to the problem (Howard-Jones, 2002). Next, the individual comes to a period in which unconscious thinking takes place. This is the period of incubation. After the incubation period, the effortless and inspirational solution, which is normally associated with the remote knowledge relating to the problem, suddenly illuminates the individual's mind. This is what is referred to as illumination. At the fourth stage, the verification stage, the

individual evaluates, analyses and extends the idea. The consolidated idea is formed at this stage.

However, the 'unconscious' belief is not welcomed by some researchers, as it has no explanatory value (Guilford, 1987) and is outdated (Howard et al., 2008). Other researchers developed their model of creative thinking process without emphasising the period of incubation. For instance, Amabile (1996) developed a model of creative process with five stages: problem or task presentation, preparation, response generation, response validation, and outcome. Osborne developed the Osborne-Parnes Creative Problem Solving Model with six stages: mess finding, data finding, problem finding, idea finding, solution finding, and acceptance finding (Baer, 2003). Evidenced by the groupings of different phases of 19 different models of creative thinking process done by Howard et al. (2008), it is obvious that models developed by researchers are of a similar pattern, regardless of the 'unconscious' belief. Various phases are grouped as analysis, generation, evaluation, and communication/implementation (Howard et al., 2008). However, some of the creative thinking processes are very similar to the design process. More regarding the design process is depicted in Section 3.1.1.

Howard et al. did not indicate the possible looping-back route of the 19 processes in their research findings. It might be possible that the creative process can be cyclic in which the stages of analysis, generation and evaluation can repeat if the solution generated is not adequate in solving the problem. The room to have a looping-back route is not limited in any sense. For example, Amabile's creative thinking process also indicates that a long series of loops might be involved if the task gets complicated or only some progress had been made towards the goal.

Regardless of the discussing of the loops in the creative thinking process, there are still many unresolved questions regarding the generation phase. It seems unlikely that a general consensus can be obtained among researchers on how creative ideas are generated. However, there are researchers who explain what happens in the period of incubation in Wallas' creative process model, based on one of the oldest theories in psychology: associationism (Sawyer, 2012). It is believed that during the period of incubation, the individual is able to combine the information analysed in

the previous stage and produce new combinations, which lead to illumination. Therefore, if more combinations can be produced, it is more likely that a creative and original solution or output can be conceptualised (Howard-Jones, 2002).

The number of combinations depends on the amount of knowledge that can be gathered in the analysis stage. The more the amount of information associates with the problem available, the greater the likelihood of producing more combinations. Also, he will be able to access more remote information related to the problem when the individual is not focused on the problem in the incubation period (Howard-Jones, 2002). Therefore, an incubation period is essential in combining remote associates to generate a more creative and inspirational idea at the stage of illumination.

Alternatively, in addition to the researchers who adopted the stage-fashion processes of creativity, there are other researchers who claimed that creativity is dual application of the two mental states: convergence and divergence. It is apparent that the creative thinking process involves divergent thinking; however, the divergent thinking is indeed most effective when it is paired with convergent thinking (Eris, 2003; Runco, 2003). In creative thinking processes, idea generation, or the ideation, is pertinent to divergent thinking, and the evaluation, which is associated with convergent thinking, exists as a part of ideation. Whenever an individual generates an idea, he/she will evaluate it unconsciously. It is only in the experimental control that ideation and evaluation are being separated for the ease of investigation. Creative thinking process is considered as the interaction between convergent and divergent thinking (Baer, 2003; Eris, 2003; Isaksen et al., 2011; Roberto, 2000). Creativity might then be seen as the ability to switch from one thinking mode to the other thinking mode without difficulty (Howard-Jones, 2002).

Necka (2003) developed a model without any stage or phase; instead, it is a conceptual schema of creative interaction for creative processes. However, instead of arguing if stage or phase should be imposed in the creative process, it is believed that a process with different stages is easier to be comprehended, and a simple illustration of a creative process is easier to be applied in the context of education.

2.3.2. Summary of the Creative Thinking Processes

Based on the literature mentioned, an illustration that summarises and also simplifies the general idea of the creative thinking process depicted below (Figure 2.1).

Analysis   Generation   Evaluation
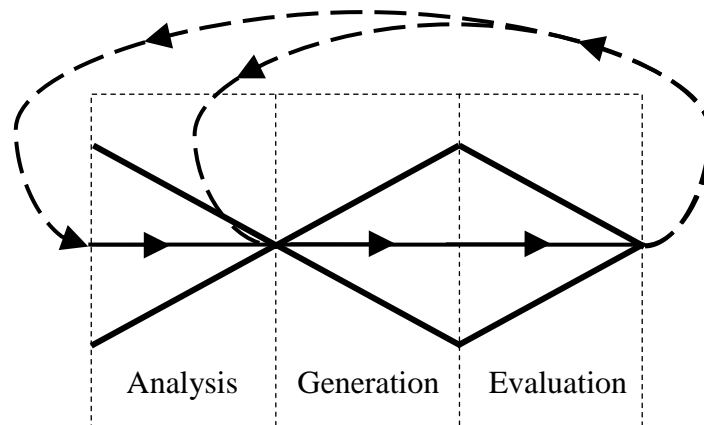
Figure 2.1. Illustration of the general idea of the creative thinking process
(Broken lines indicate the looping-back route. Solid lines indicate the sequence of the
process. '>' and '<' symbols indicate the convergent and divergent natures of that particular
stage/phase)

This illustration adopts the categorisation of different stages of the creative process by Howard et al. (2008). However, the last stage 'communication/implementation' is not included in the illustration because this stage has seemingly overstepped the area of creative thinking process. Communication and implementation are rather inclined to the practical work done in design.

In the summarised creative thinking process, both the analysis and evaluation stage are associated with convergent thinking processes as they both collect information, and decide which information (analysis stage) or decision (evaluation stage) should be chosen. The generation stage is considered as divergence as widely accepted in the literature (Runco, 2003). The two looping-back routes indicate the possibilities in which the individual might need to go backwards to the previous stages after the creative process. However, no looping-back appeared towards the end of the generation stage as generation and evaluation are two stages, which are closely connected.

The illustration constructed conceptualises the general understanding on creative thinking process, and serves as an alternative guide in understanding creative thinking process more effectively. Besides, it also suggests where the path of looping-back might exist precisely. It gives a clearer interpretation on the possible thinking path in the creative thinking process.

As mentioned earlier, creativity is closely related to design activities (Barlex, 2007; Dorst, 2003; Howard et al., 2008; Rutland & Barlex, 2008). How is this summarised creative thinking process compared with the design process if the latter is regarded as the basis to form the creative design process?

2.4. CREATIVE PERSON

When 'person' is discussed in the context of creativity, the information about "personality, intellect, temperament, physique, traits, habits, attitudes, self-concepts, value systems, defence mechanisms and behaviour" are concerned (Rhodes, 1987, p. 218). The review here primarily focused on personality as it is the core discussion of a creative person.

Personality characteristics are essential in determining if a person can be creative (Dellas & Gaier, 1970). In most of the research it is suggested that creative persons possess similar personality characteristics. These personality characteristics might be essential to creativity or they facilitate the creative behaviour (Cropley, 2001). Nevertheless, it is clear that creative individuals possess some distinctive characteristics which are different from less creative individuals.

2.4.1. Personality of Creative Persons

It is easy to understand creative personality from creative individuals because it is expected that some distinctive characteristics should be found among creative individuals compared with the ordinary people. However, it is difficult to identify

them from the less creative group, and those who can be easily identified, the creative geniuses in the world, are nearly unapproachable. Yet research on creative geniuses was carried out by Howard Gardner (1993). Seven influential persons who were representative and creative in different areas in the half century roughly from 1885 to 1935 were investigated. They are Sigmund Freud (neurologist-turned-psychologist, 1856-1939), Albert Einstein (theoretical physicist, 1879-1955), Pablo Picasso (painter, 1881-1973), Igor Stravinsky (composer, 1882-1971), T. S. Eliot (poet, 1888-1965), Martha Graham (dancer, 1894-1991), and Mahatma Gandhi (political and spiritual leader, 1869-1948). He concluded that these seven creators were self-confident, self-absorbed, attached to self promotion, alert, unconventional, hardworking, committing obsessively to their work, having immaterial social life or hobbies, having an amalgam of the childlike and the adult-like (both in the sphere of personality and in the sphere of ideas). However, different creators might vary in different degree in each characteristic.

Gardner is not the only researcher who researched in the personality of creative individuals. Many other researchers also found that personality is related to creativity. Dellas and Gaier (1970) believed that "a particular constellation of psychological traits emerges consistently in the creative individual, and forms a recognizable schema of the creative personality" (pp. 67-68). They concluded that the properties of creative people are radical, open to stimuli, intuitive, flexible, resolute, confident, and independent in attitude and social behaviour. The creative people also have superior ego strength, a strong sense of identity and self-acceptance, strong aesthetic and theoretical interests, and a strong intrinsic motivation.

Barron and Harrington (1981) concluded from the empirical work of 15 years that the core characteristics emerged in different research of creativity and personality are stable. These characteristics include: "high valuation of esthetic qualities in experience, broad interests, attraction to complexity, high energy, independence of judgment, autonomy, intuition, self-confidence, ability to resolve antinomies or to accommodate apparently opposite or conflicting traits in one's self-concept, and a firm sense of self as creative" (p. 453).

Batey and Furnham (2006) also concluded that early research indicated that creative individuals are more autonomic, independent, less socialised, more aggressive, less agreeable, and less concerned with convention.

Cropley (2001) summarised different creativity and personality tests and constructed a list of test-defined personality properties of a creative person. The properties are "desire to go beyond the conventional, active imagination, flexibility, curiosity, independence, acceptance of own differentness, tolerance for ambiguity, trust in own senses, openness to subconscious material, ability to work on several ideas simultaneously, ability to restructure problems, and ability to abstract from the concrete" (p. 124).

Motivation is also another property which is essential to the creative behaviour of a creative person. In the motivational theory of creativity developed by Amabile (1983, 1986), she claimed that intrinsic motivation is conducive to creativity but controlling extrinsic motivation is not. Extrinsic motivation is conducive only when it is informational and particularly when the intrinsic motivation is high. The motivational state of a person is primarily influential to the level of creativity generated. Cropley (2001) summarised the motivational properties (which are very similar to the personality traits) from different creativity and motivational tests. The properties are "goal-directedness, fascination for a task or area, resistance to premature closure, risk taking, preference for asymmetry, preference for complexity, willingness to ask many (unusual) questions, willingness to display results, willingness to consult other people (but not simply to carry out orders)" (p. 124).

Instead of finding a universal set of distinctive creative personality of creative individuals, Feist (1999) concluded from different empirical research on creativity in different occupation and compared the creative people in different fields. He suggested that the personality of creative artists and scientists might be different even if they both demonstrate creativity. In the review, it is suggested that artists (including visual artists, literary, performing artists, and students who show interested in related fields) are "imaginative, open to new ideas, drives, neurotic, affectively labile, but for the most part asocial and at times even antisocial" (p. 279). Scientists (including professional scientists or students in different fields of science,

engineering and mathematics) are "open and flexible, driven and ambitious, and although they tend to be relatively asocial, when they do interact with others, they tend to be somewhat prone to arrogance, self-confidence, and hostility" (pp. 282-283). The difference between scientists and artists might be lucid on the impulsivity, emotional lability, conformity, and conscientiousness. Artists tend to be more impulsive and emotional labile than scientists, as they have to be more sensitive and expressive of their emotions in their work. They are also less conforming than scientists, even though scientists are also nonconforming. Scientists, on the other hand, tend to be more conscientious than artists, and it seems not surprising as of the nature of the work of scientists. However, in the review it seems that the conclusion of Feist did not include creative designers into the group of artists. Empirical research regarding the personality of creative designers is lacking in the current literature.

Research suggested that creative persons possess a particular set of personality traits. Particular personality characteristics, such as openness, intuition, etc., might be essential in triggering the creative behaviour. However, it is also possible that some personality traits of a creative person, such as arrogance, unfriendliness, etc., are the result of the creative behaviour of the creative person. As suggested by Feist (1999), only longitudinal studies are able to clarify the relationship between personality and creativity. In his review, different longitudinal studies showed that the personality traits which distinguish young creative people are consistent with those which distinguish the same group of creative adults from the less creative adults.

2.4.2. Thought Disorder and Creativity

In some of the mysteries of creativity, creativity might be seen as a kind of 'madness' or thought disorder (Isaksen & Murdock, 1993). It is unsurprising that researchers had been investigating in this area as early as 1960s (Barron & Harrington, 1981), whereas the expansion of creativity research started in 1950s (Gardner, 1993; Isaksen & Murdock, 1993; Mayer, 1999; Sternberg & Lubart, 1999). Researchers suggested that creativity is related to psychopathology, and many concluded that some famous creators possess the signs of psychopathology (Batey & Furnham,

2006). However, this does not mean that creative persons are psychotic. Creative persons might only possess the "dispositional trait underlying susceptibility to development of psychotic symptoms" (Eysenck, 1993, p.155). The relation of creativity and abnormality was claimed by many researchers (Batey & Furnham, 2006; Eysenck, 1993), even though it seems like an out-dated belief. Many other studies were conducted to support the idea that creativity is related to psychoticism as quoted by Eysenck (1993).

However, in the research of Chávez-Eakle, Lara and Cruz-Fuentes (2006) which compared the creative individuals, psychiatric outpatients, and people without mental disorders, they found that the creative group has no sign of psychopathology and found no significant difference with the control group. They suggested that it might be because the creative individuals in their creative group are at the peak of their creative achievement and career, and they are not at the moment of the psychopathological distress. It might be also possible that there are other variables which contribute to the relationship between creativity and psychopathology.

2.5. CREATIVE ENVIRONMENT

Research regarding creativity also concerns with environment, which is regarded as 'Press' in the 4P's of creativity (Rhodes, 1987). Rhodes regarded the studies of environment as the attempt "to measure congruence and dissonance in a person's ecology" (p. 220). In other words, the studies focus on what kind of environment affect a person in performing creative behaviour. They generally study the reaction of a group of people towards an environment. In order to contribute, the environment that fosters (or discourage) creativity is always the centre of attraction (Mackinnon, 1978; Isaksen et al., 2011).

2.5.1. A General Discussion

In ancient times, human life was not as comfortable as nowadays. For example, a fisherman has to sail on boat and catch fish by their own hands and handmade tools.

Sometimes if one fails to solve the problems they encountered, he might lose his life. It is unsurprising that the death penalty would have the power to boost one's creative ability in solving problems in this case. The living environment nowadays is much easier than the older times. Osborn (2001) believed that we lose what we do not use, and we lose the ability in thinking out of the box when encountering problems in the world with advanced technologies. Most of us have become less and less creative in this regard. Besides, he believed that urbanization discourages the development of creative ability of the human beings. People who live in the countryside are more likely to be creative. Urban life seems to weaken the imagination power of most people except those who work in creative careers such as arts. Easy life is detrimental to creativity. Guilford (1977) hypothesised that people who need to face a number of problems, such as people with a difficult life or an older child for a family, have more opportunities in developing problem-solving skills. These people might have a high potential in their creative ability.

Creativity would not emerge until a person is under a certain environment that there is a need for creativity. De Miranda et al. (2009) regarded the environment as an 'opportunity' from a business point of view. However, unlike the problems which are related to life safety issues as mentioned earlier, sometimes the environment is not noticeable by all the people. Someone might notice a certain environment as an opportunity to be creative while some might not.

However, there are some environments which are regarded as helpful in promoting creativity. In the conclusion of Isaksen et al. (2011), they believed that the environment which is conducive in fostering creativity should possess the followings:

- Freedom
- Emphasis of the value of individual differences
- An open, safe atmosphere by supporting different ideas
- A feeling of individual control over what is going to be done
- The use of appropriate creative problem solving tools
- Enough time for accomplishing the task
- Positive attitudes towards mistakes and errors
- Recognition of the unrecognised work and potential

- Respect the need of working alone or in a group

- Encouragement of self-initiated projects

- Tolerance of complexity and disorder for a period of time

- Respect among individuals

- A higher quality of interpersonal relationships in a group

(Summarised from pp. 18-19)

In the motivational theory of creativity developed by Amabile (1983; 1996), environment and social factor is also one of the concerns. She believed that there are factors which affect the intrinsic motivation and also creativity in performing activities individually or in an organization setting. Also, she listed out the social-environment factors which have negative effects on intrinsic motivation and creativity.

For individual work, the negative factors are:

- threatening critical evaluation connoting incompetence;

- expectation of critical evaluation;

- surveillance;

- contracted-for reward-connoting;

- restricted choice/constraint control;

- arbitrary/unrealistic deadlines; and

- competition with co-workers.

(Extracted from Amabile, 1996, p. 120)

For the work done in an organization setting, the negative factors are:

- lack of communication;

- lack of cooperation;

- emphasis on the status quo;

- emphasis on extrinsic motivators;

- win-lose competition within the organization;

- rigid procedures; and

- apathy toward project from others in organization.

(Extracted from Amabile, 1996, p. 120)

In her theory, she believed that competition within a setting and critical evaluation would be detrimental to creativity. Also, if the individual works only for a reward, creativity would unlikely exist. On the contrary, if rewards are for the recognition of good work, and strong encouragement is given to the individual, he would be able to be creative. These social-environment factors not only provide a suggestion on how the environment should be, but also suggest how the individual interacts with other individuals so that creativity can be promoted.

While the above discussions are concerning creativity in a particular learning or working environment, a more comprehensive view of 'environment' should also be considered. For instance, different culture would have different impact on creativity due to the differences in the tradition and social practices. Creativity is related to the environment and also the culture, and it cannot be detached from the cultural system (Rudowicz, 2003). Different culture might even have different understanding towards creativity (Kim, 2005). Creativity not only is a psychological event but also a cultural and social event (Csikszentmihalyi, 1999). Csikszentmihalyi (1999) also proposed a system approach in discussing the relationship among the individual, the society, and the culture. However, in this study, the creativity in East Asian is discussed, as it is the area where the study is conducted.

2.5.2. In the Context of East Asia

The researchers which study the concept of creativity in East Asia underscored the societal difference between the Confucian nature of East Asian thought and individualism of the West. The Confucian collectivistic culture differs greatly from the Western individualistic culture with respect to the objectives of learning, curriculum and the teaching methods employed by teachers (Kim, 2005). The former places greater emphasis on "morality, conformity, instrumental roles of education but less on personal and creativity development of students" (Cheng, 2004, p. 137). It is "highly examination-oriented, authoritarian with rigid and centralised curriculum" (p. 137). In addition, the Chinese understand creativity in a different way: they see creativity as a slow process, which requires effort, repetition and a

strong knowledge base. Consequently, Chinese education often delays the development of creativity, by focusing early education on drilling for skill and knowledge (Cheng, 2004; Siu & Lam, 2003). Besides, the creative output generated by creative individuals in East Asian should be "adhere to the socio-cultural norms and at the same time detach from them" (Rudowicz, 2003, p. 276). The East Asian form of creativity might be closer to modification and adaptation. All these are very different from the Western approach to fostering creativity.

In the Western world, it seems natural to teach and learn creativity, whereas Chinese education is criticised for being detrimental to students' creativity development. Confucian education in East Asia discourages "the expression of individual opinion, independence, self-mastery, creativity, and all-round personal development in learning" (Cheng, 2004, p.139). Students who have personal characteristics that indicate creativity are not welcomed by teachers in Confucian education. Chinese teachers prefer students who are docile, passive and submissive, instead of individualistic, skeptical and egoistic (Ng & Smith, 2004). Despite these cultural differences, D&T in the UK also has a similar problem in that teachers dislike creative students, and creative students have unpleasant experiences at school (Atkinson, 2000; Dow, 2004).

The foregoing notions about classroom structure, teacher-student relationships, and teaching strategies accurately represent some educational situations in Chinese societies. However, current learning and teaching in East Asia pertains not only to the Confucian beliefs described above, but also to the traditional thinking derived from these Confucian beliefs, which have been further exemplified in Chinese history by civil servant examinations since the Tang Dynasty. This idea obviously requires further demonstration in the literature on both the sociological and philosophical aspects of traditional Chinese beliefs.

The creativity situation in East Asia is more severe, as students' creativity has often been suppressed in early schooling (Siu & Lam, 2003). Creative students in areas such as Hong Kong may be encountering more frustration and ignorance because of the low value given to creativity in Chinese classrooms. Also, students tend to seek commonalities among their peers and prevent appearing difference from others.

Nevertheless, there is inadequate empirical data, and these ideas have not yet been proved by substantial research studies that should be conducted in the future.

Cheng (2004) suggested that it is possible that Chinese communities endure greater difficulties in fostering creativity than Western countries, which do not need creativity reform as much because creative elements exist in both school curriculum and culture. This difficulty might also be because teachers' implicit beliefs are greatly influenced by personal and professional experience, which has important implications for their views on learning and teaching (Dow, 2004).

Teachers' beliefs, which are based on implicit theories, have significant impacts on teachers' teaching strategies and their conduct in the classroom. Teachers who are implicitly governed by notions of the transmission of knowledge and control in learning are resistant to creative constructs that promote creativity (Dow, 2004). Further, because teachers in East Asian societies are often authoritarian and treated with respect by their students, and their relationship is hierarchical, it is unlikely that the majority of teachers can successfully foster creativity in the classroom (Ng & Smith, 2004).

Introducing creativity might break the harmony of an East Asian classroom (Ng & Smith, 2004). Creativity is sometimes sacrificed for ease of teaching (Dow, 2004), as a controlled classroom is easier for teachers to handle. Torrance (1995) also commented that if teachers challenge students to be creative, they will probably lose control of the classroom. The impact of breaking the harmony should not be underestimated because this challenges teachers' beliefs in their years of teaching and understanding of educating young adults.

Reading between these researchers' lines, none say that either East Asians or Westerners are more creative, although Ng (2001) commented on this. He believed that Asians can be very creative, and are more creative than Westerners in terms of culinary skills. He also supported his view by using the creative ideas presented in the artistic Taoist work, such as landscape painting, poetry and great scientific inventions such as gunpowder, paper and painting, the compass, etc.

Despite the possible detriment to creativity in East Asian society, it is essential to promote creativity among school students, as creativity is crucial for mankind to create a better future in the face of abundant problems and difficulties. It is still debatable how East Asian society perceives creativity, as many concepts and thought of Western society are borrowed and adopted by young people in East Asian society. Thus, a review of creativity in Hong Kong society and also in D&T was conducted and presented in Chapter 5.

2.6. CREATIVITY IN DESIGN EDUCATION

Designing is one of the activities that is able to foster creativity in the context of D&T. Researchers have linked design activities with creativity. For example, Atkinson (2011) claimed that designing which involves creativity is central to D&T. Barlex (2007) suggested that what designers do corresponds to the nature of creativity. This idea is supported in his later research findings (Rutland & Barlex, 2008) that the integral part of designing is to solve problems creatively. However, there is still unresolved doubt whether school children can directly practice the activities performed by professional designers.

2.6.1. Models of creativity in D&T

Many researchers used different models and definitions of creativity when analysing and explaining creativity. However, in the context of D&T, Rutland and Barlex (2008) commented that the definition of creativity developed by Teresa Amabile is the most suitable among all the others being applied in discussing creativity (Amabile, 1983; 1996). In her model, creativity is novel, useful and heuristic. This definition is consistent with the view held by Rutland and Barlex (2008) that designing can be seen as a creative activity because it is heuristic (learning by discovery) rather than hegemonic (controlled by a ruling elite).

Amabile developed a model to reveal the nature of creativity, describing it as the confluence of intrinsic, or self-motivated, domain-relevant knowledge and ability,

and creativity-relevant skills (Amabile, 1983; 1996). Without intrinsic motivation, creativity would not able to appear in the process of learning. Extrinsic motivation, on the other hand, is detrimental to students' creativity. Creativity only occurs when interests and skills overlap, which Amabile regarded as creativity intersection. In her theoretical framework, creativity is supported by the social environment and can be influenced by teachers. The idea is in contrast with the traditional idea that creativity is a factor pre-determined by a person's characteristics and cognitive ability (Rutland & Barlex, 2008). Based on this model, Rutland and Barlex (2008) developed and formed a three-feature model of creativity. The three features are domain relevant features, process relevant features, and social/environmental features. The person or the individual involved is central to all these features.

The domain relevant features are pertinent to a specific subject domain and the other two features are more generic in any school subject. To address the applicability of this model in D&T, Rutland and Barlex (2008) mapped the domain relevant features in the three-feature model of creativity in D&T. They identified four criteria for creativity in the domain of D&T: concept or idea, aesthetic creativity, technical creativity, and constructional creativity. These provide a guide for teachers considering the domain-relevant feature in the three-feature model. Rutland (2009) further modified the four criteria into five, and generated a pentagon model. Rutland offered this model to assess the creativity of a design, as she claimed that a creative design decision should possess these five interrelated requirements. The five criteria are conceptual, technical, aesthetic, constructional, and marketing. Even though this model provides inadequate information on assessment criteria, and assessment using this model depends largely on teachers' professional judgement, it provides an objective and scientific approach to dealing with creativity in design education.

2.6.2. Implicit Theories

As Amabile's model of creativity supports the idea that creativity can be taught and learned, teachers have an important role to play in fostering creativity. Dow (2004) related creativity to implicit theories that the extent to which creativity is fostered in the classroom depends on teachers' beliefs and their influence on students. If a

teacher believes that creativity is an innate talent, he/she will probably fail to set up a classroom structure that fosters the development of creativity. In contrast, if the teacher believes that creativity can be developed through the influence of the environment and social interaction in the classroom, intrinsic motivation, and the willingness of taking risk and error, he/she will be more successful in fostering creativity among students. This has serious implications in D&T, as the beliefs held by D&T teachers govern the extent to which creativity is developed. To foster creativity among their students, teachers should be able to discover new potential ideas, take risks, push limits and take steps into the unknown (Rutland & Barlex, 2008).

2.6.3. Problems Encountered

However, teachers who possess these abilities and skills are lacking in classrooms, as pointed out by Rutland and Barlex (2008) in the case of British classrooms. They claimed that current practices in British classrooms fail to cultivate creativity or a creative environment. There is a shortage of teachers who are able to foster students' creativity. In addition, teachers often feel frustrated when they challenge students to be creative because this can result in a loss of control in the classroom. Teacher shortages and this frustration in classroom management are exacerbated in Asian counties because of the East Asian educational beliefs.

A similar problem was addressed by Atkinson (2000). Her research indicated that some students have high creativity ability but low performance, or low creativity ability but high performance. One of the possible reasons is that many teachers in the study do not value creativity. Students' creative thinking is not welcomed by these teachers and those students who are considered as being highly creative are actually identified as being unmotivated in class. In her other research (2007), she also pointed out that there are some difficulties that trainee teachers might face in the designing activities. For example, some students struggle to have a successful product development in design activities, even though they are familiar with similar activities for several times (Atkinson, 2007). Teachers' experience and capability in design activities might also affect their teaching for creativity as well.

While Atkinson's study regarding creativity was conducted over a decade ago, according to the study by Rutland and Barlex (2008), creativity in D&T remains problematic from the perspective of some advocators of creativity. As yet, there is no empirical research data to show the progress of fostering creativity in school D&T.

Currently, the creativity concerned in design education should be the P-creativity, as the P-creativity is also the type which educators should focus (Howard et al., 2008). While in terms of Kirton's categorisation of creativity (1994), both adaptive and innovative creativity should be included in design education at different levels of study. At the lower level, adaptive creativity should be the major consideration, as students might feel more comfortable with the existing problem framework. It can be a good start to motivate students in thinking. At the higher level, innovative creativity is more important, as students often have to identify a problem and find the corresponding solutions in a project. Students are expected to develop a new framework for their project in design education. Similarly, in the Novelty-Creativity Taxonomy developed by Kaufmann (2004), both reactive and proactive creativity are of concerns at different secondary levels of design education.

However, if we reflect on the past, when industrial development was rapidly growing, the core educational aim of design education was not to encourage students to be creative and problem-solvers, but rather to train them in skills such as drilling in woodwork and metalwork (Eggleston, 1985). It is only recent shifts that have emphasised design students' creativity. The shift of Hong Kong design education is discussed in Section 6.1.

2.7. CONCLUDING REMARKS

This chapter gives a brief review of the 4P's (output, process, person, and environment) of Rhodes (1987) ideas about creativity. The 4P's cannot be considered individually, as they are all related, and they often exist in a context. According to Rhodes (1987), most research into creativity focus on these four areas. Besides, the 4P's helps understand what is considered essential in creativity.

Attributes in the 4P's are reviewed in the chapter, and finally, related research of creativity in the context of D&T is studied.

The review of this chapter stated that creativity consists of two major elements: novelty and appropriateness. These two elements are not enough for us to understand creativity thoroughly because creativity is not only the properties of an output, but also a process and a person. Investigating how people think creatively helps us understand creativity in a cognitive way. The creative thinking process consists of analysis, generation and evaluation stages. It facilitates learning and teaching creativity among students. A summary of a creative thinking process was illustrated in this chapter. It also incorporates other concepts such as converging thinking and diverging thinking involved in the thinking process.

Over years and decades, many famous creators in the world have changed our values or life in different perspectives by their inventions. These people, who are regarded as creative persons, possess similar personality traits such as openness and nonconformity. Some research shows that the creativity of creative people is related to psychopathology. Investigating creative individuals' personalities might provide a better understanding of how to cultivate creativity among students.

In reality, person, process, and output can only exist in a certain context or environment in which the creativity takes place. In this chapter, the topic of environment was reviewed. Some kinds of environments, for example, an environment with freedom and respect, may be conducive to creativity. Besides, culture also plays an important role on how people perceive creativity. The current perception of East Asian culture may be detrimental to creativity in comparison with other western cultures.

As many researchers have linked design activities and D&T to creativity, researchers developed different educational models of creativity in the context of D&T. The model developed by Rutland (2009) is considered appropriate to this thesis, as it addresses the domain relevant features of D&T specifically. Besides, implicit theories of D&T teachers were also discussed in this chapter. The implicit theories held by teachers governs the possibility of fostering creativity among students in

classroom (Dow, 2004). However, there are many problems encountered in the cultivation of creativity, such as the undervaluing of creativity, the frustration of teaching for creativity among teachers, and teachers' ability in teaching for creativity.

From an educational viewpoint, focusing on solely creative output (or creative person) may not contribute to the promotion of creativity. A shift from the output and person to the process and environment should take place to teach students applying creative thinking process and facilitate an environment which is conducive to creativity. In terms of education, especially design education at the secondary level, concerns should not only be the quality of the product but also the experience, the related domain skills, and creativity skills that students need to acquired.

Chapter 3
Creativity from Other Perspectives

This chapter discusses creativity through the perspective of design and emotion, followed by the reviews in the context of design education. As design is one of the major foci of this research, and creativity is central to design (Lawson, 2006), it is necessary to investigate creativity in the context of design. Researchers had also found that emotion is related to creativity (Averill et al., 2001; Baas et al., 2008; De Dreu et al., 2008; Filipowicz, 2006; Perry, 1989; Russ & Schafer, 2006; Sung & Choi, 2009; Van Kleef et al., 2010). Under this circumstance, it can be argued that emotion plays a role in the process of design. The chapter examines the relationship among design, emotion, and creativity.

3.1. A PERSPECTIVE OF DESIGN

Design possesses several similarities with creativity (Howard et al., 2008). Designing involves activities in solving problems using creative solutions (Middleton, 2005). Barlex (2007) suggested that what designers do corresponds to the nature of creativity. This idea is in accord with his later research finding (Rutland & Barlex, 2008) that the integral part of designing is to solve problems creatively. This section discusses design process and the creative design process which generates creative design output and also highlights the issues regarding creative design process in design education.

3.1.1. Design Process

Designers design artefacts, products, services or concepts for their clients. Unsurprisingly, they aim at designing creative output; either the output is an end product or an idea during the design process. In order to understand more about design, we have to look at the design process or the design product (Cross, 2006). However, only the design process can provide information on how professional, amateur, or student designers generate creative output. Consequently, the design process should be the centre of investigation.

3.1.1.1. At Pragmatic Level

The process of design begins with a problem (Chand & Runco, 1992; Dudek & Côté, 1994). The problem is solved by the output designed through the design process (Aspelund, 2006; Hicks, 2004; Siu, 2009). Using the design process helps designers identify solutions towards problems, and design process is the logical plan that facilitates designers in design (Wise, 1990). In the last few decades, the design process has become more systematic, so that novice designers are capable of applying the suggested procedures in making their designs (Aspelund, 2006; Peto, 1999; Tunstall, 2006; Wise, 1990). Among all, Wise (1990) suggested a logical approach to solve design problems with four stages: identify the problem (the need); investigate and design possible solutions (designing); test the results (testing and evaluation); and make the chosen design (realisation). Similarly, Brainard (2003) suggested that design process involves four procedures: define the problem; look at the possibilities; produce the details of better solutions; and finalise the choice.

More theoretically, Jones (1984) suggested a three-stage process consisting of analysis, synthesis, and evaluation. This three-stage process is a widely accepted model of the design process. Other researchers, such as Archer (1984) had a more complex model. His model has six stages: programming, data collection, analysis, synthesis, development, and communication. Some also had a non-linear model

which stresses that design is continually cycling through the three stages, from a brief style to a more specific one throughout the problem solving process (Luckman, 1984). Sometimes return loops are also included in the three-stage model to indicate that at any stage of design, it is very frequent for the designer to go back to any previous stages if further analysis or synthesis is necessary, especially when the problem is ambiguous or not totally described (Lawson, 2006).

Lawson (2006) suggested that there is no firm route through the design process. The design process resembles "those chaotic party games where the players dash from one room of the house to another simply in order to discover where they must go next" (p. 39). Wise (1990) also supported the idea that design process, instead of a rigid framework that guides designers, is a set of reminders that reminds us what is involved in the design activities. In this circumstance, Lawson (2006) extended the widely accepted three-stage model and suggested that the design process is a negotiation between problem and solution through analysis, synthesis and evaluation. He illustrated a three-dimensional diagram in explaining their relationship. His illustration does not have any starting and ending points, or any directions indicated. He also commented that any visual diagrams are too simple in explaining the complicated design process, and the figure should not be read in a very literal way.

There are also other approaches to defining the design process. For instance, the Function-Behaviour-Structure (FBS) framework (Gero & Kannengiesser, 2004) was constructed based on the three aspects (function, behaviour, and structure) of a design product. These three aspects show what the product is for (F - function), what it does (B - behaviour), and what it is (S - structure). In this framework, design is composed of a set of processes linking the three aspects together. Instead of 'stages' that other kinds of design processes possess, the FBS framework suggests that designing is a set of processes, and eight processes are fundamental to design. These eight processes are formulation, synthesis, analysis, evaluation, documentation, reformulation type 1, reformulation type 2, and reformulation type 3, and they are explained as follows.

- Formulation (process 1): transforms the design requirements (expressed in F) into expected behaviour (Be)

- Synthesis (process 2): transforms the expected behaviour (Be) into structure (S)

- Analysis (process 3): derives the actual behaviour (Bs) from the synthesised structure (S)

- Evaluation (process 4): compares the expected behaviour (Be) and the actual behaviour (Bs) to see if the design solution is acceptable

- Documentation (process 5): produces design descriptions for manufacturing the product

- Reformulation type 1 (process 6): address changes in the structure (S) if the result of evaluation process (process 4) is unsatisfactory.

- Reformulation type 2 (process 7): address changes in the expected behaviour variable (Be) if the result of evaluation process (process 4) is unsatisfactory.

- Reformulation type 3 (process 8): address changes in function (F) if the result of evaluation process (process 4) is unsatisfactory.

(Extracted and simplified from Gero & Kannengiesser, 2004)

The last three processes address the changes made to the three aspects of the design product respectively. They are considered to be the relevant ones, as they do not exist in most of the traditional design process models in terms of the change of the function, behaviour, and structure. However, it seems that these three processes are comparative to the return loops of the conventional design process models.

3.1.1.2. In Secondary School Curriculum

In addition to the professional level of design, design processes at the educational level in secondary school curriculum also follow the non-linear and the loop-back approach. According the syllabus of Design and Technology in Singapore, the design process, or the design method, suggested by the Ministry of Education (2006) emphasises that "design is not always a linear process but is dynamic in nature" (p. 4). The design model consists of 5 stages: situation, research (which also contains activities like data collection, decision making, and evaluation), ideation, development, and realisation. The loop-back routes in the Singapore model primarily

associates with the stage of research and the other four stages that it is required to loop back to the stage of research, as well as other stages along the design process. Although this model of design process greatly coincides with those in the literature, it differs from others in that the emphasis of the research stage and its relationship among other stages is remarkable. The process also suggests that designer can go to any stage of the process at any point through the 'Research' (Yau, Siu, & Wong, 2010). Figure 3.1 below shows the suggested design process of Singapore D&T curriculum.
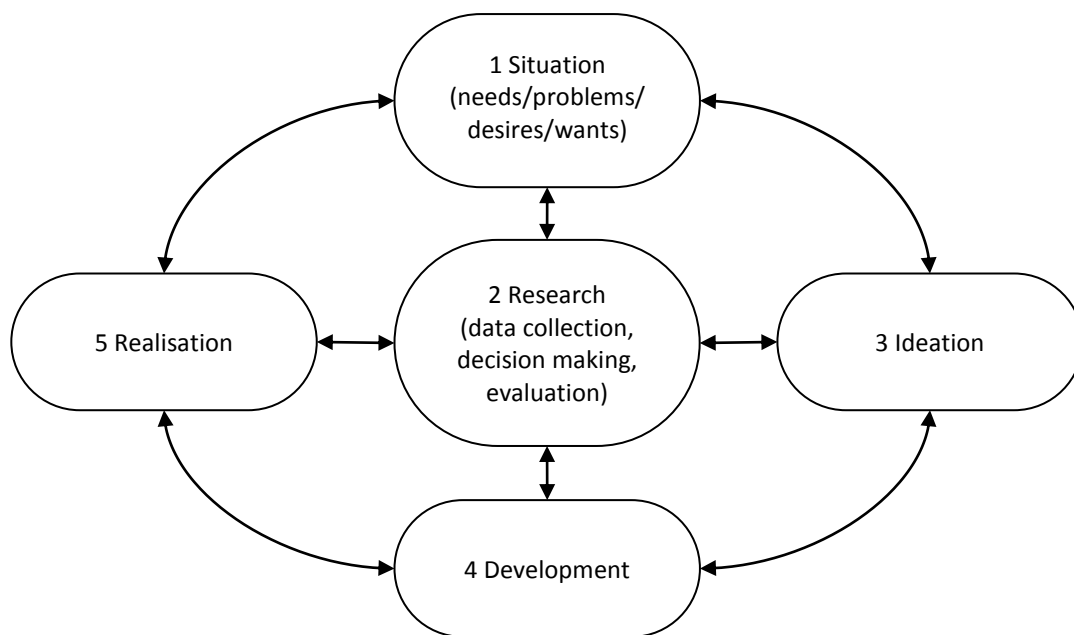
Figure 3.1. Suggested design process of Singapore D&T curriculum (Extracted from Curriculum Planning & Development Division, 2006, p. 4)

Different from the design processes discussed, the suggested design process in DAT of Hong Kong new senior secondary structure in Figure 3.1 does not stop at the realization or evaluation. Instead, after the stages of realization and evaluation, the process proceeds to the stage of 'Client Presentation' which further leads to the 'Product and Commercialization'. The process includes the elements of entrepreneurship. Besides, no return loops are indicated in between the stages. A return loop exists only outside the area of design process, i.e. from 'Production and Commercialization' to 'Consumer Generating Further Needs'. An interesting point should be noted that between 'Conceptualization and development' and 'Realization', the arrow is double-sided. This might mean the student designer needs to go back

and forth in these two stages (Figure 3.1). The two-way relationship between 'Conceptualization and development' and 'Realization' might indicate that designers need to compromise with the client and change the design before the design can be realised.
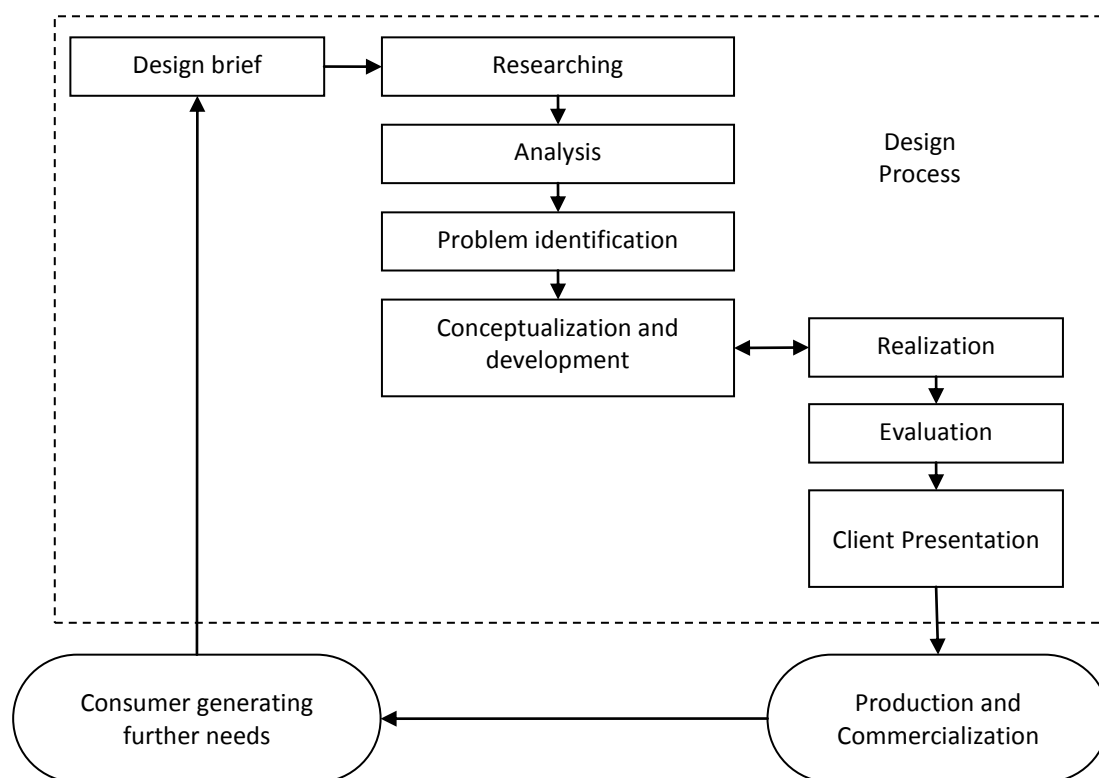
Figure 3.2. Suggested design process of Hong Kong DAT curriculum (Extracted from CDC & HKEAA, 2007, p.34)

The design process of junior secondary level D&T in Hong Kong is simpler than that of DAT (Figure 3.2). Different D&T textbooks suggested different design processes; however, the general idea is still the same. Also, the stages are very similar to the processes discussed earlier. The whole process highlights the flexibility on repeating different stages more than once by the return loops. It is possible to repeat the process if any stages are unsatisfactory. Figure 3.3 below shows a design process extracted from a widely used D&T textbook in Hong Kong.

```
                    ┌──────────────────┐
              ┌────▶│    Situation     │
              │     └──────────────────┘
              │              │
              │              ▼
              │     ┌──────────────────┐
              ├────▶│   Design Brief   │
              │     └──────────────────┘
              │              │
              │              ▼
              │     ┌──────────────────┐
              ├────▶│  Specifications  │
              │     └──────────────────┘
              │              │
              │              ▼
              │     ┌──────────────────┐
              ├────▶│     Research     │
              │     └──────────────────┘
              │              │
              │              ▼
              │     ┌──────────────────┐
              ├────▶│     Solution     │
              │     └──────────────────┘
              │              │
              │              ▼
              │     ┌──────────────────┐
              ├────▶│   Realisation    │
              │     └──────────────────┘
              │              │
              │              ▼
              │     ┌──────────────────┐
              ├────▶│     Testing      │
              │     └──────────────────┘
              │              │
              │              ▼
              │     ┌──────────────────┐
              └─────│    Evaluation    │
                    └──────────────────┘
```
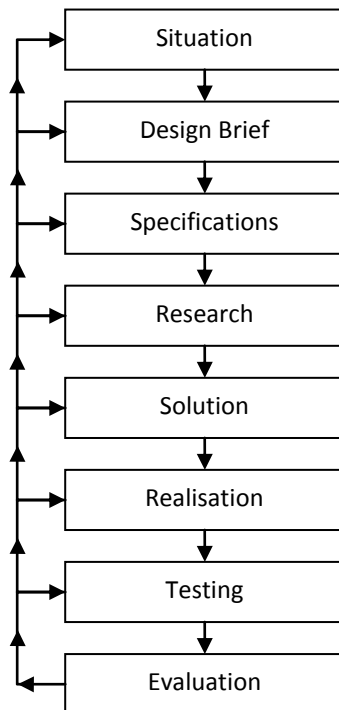
Figure 3.3. Suggested design process in a Hong Kong D&T textbook (Extracted from Poon et al., 1992, p.55)

In Mainland China, guideline is also given to the design process. In a textbook of General Technology, it was suggested that design is a process of dynamic development. Unexpected change might happen at any stages of design, and it might be necessary to repeat certain stages. Simplifying and standardising the design process is not recommended. The textbook suggested that there are few stages of design process that students can follow. However, instead of giving a figure as a summary of the design process, the textbook suggested a design process with different return loops for students' discussion. Figure 3.4 below shows the design process shown in the textbook for discussion.

```
┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│    Needs     │──▶│    Design    │──▶│   Possible   │──▶│    Models    │──▶│   Test and   │
│Investigation │   │   Analysis   │   │   Solution   │   │    Making    │   │  Evaluation  │
└──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
```
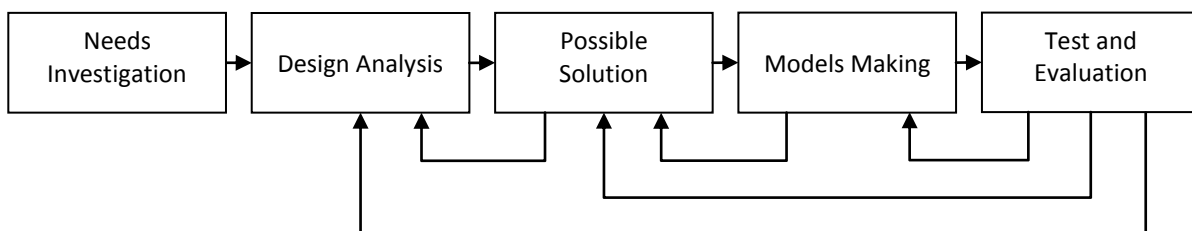
Figure 3.4. Design process shown in a Chinese Mainland General Technology textbook for students' discussion (Extracted from Gu, 2005, p.56)

Unlike the design processes of Singapore and Hong Kong D&T curriculum, the return-loop does not include the path from the stages to the first stage 'Needs Investigation'. As the figure is open for discussion in class, it might not mean that return-loop cannot exist at the stage of 'Needs Investigation'.

Analogous models of design process can be found in design at the professional level and educational level, though there is no assigned route of design at both levels (Yau, Siu, & Wong, 2010). Nevertheless, these design processes help designers to generate design output; alternatively, designers generate outputs through design processes. These models are aimed to produce design outputs which satisfy the specifications of the problems or the needs. Some of the solutions might be creative while some others might be neither P-creative nor H-creative, despite the notion claimed by Lawson (2006) that creativity is central to design.

Applying the creative thinking process outlined in Section 2.3 into the field of design and design process will generate creative design outputs through creative design process (Moore, 2007; Siu, 2002a). However, how do we understand creative design outputs?

3.1.2. Creative Design Output

Among the design outputs in any design field there are bound to be some routine designs and some creative designs. The creative design is regarded as creative design output (Howard et al., 2008). However, this does not imply that any creative output that appears in the design field can be referred to as creative design output. It is notable that what psychologists are concerned about in the creative output and what designers are concerned about in the creative design output are different. Creative output refers to any single creative idea (Howard et al., 2008). However, as design output often consists of a combination of several ideas, creative design output refers to a complex product idea, which contains at least one creative idea.

In the research regarding creative design output, Pahl and Beitz (1996) provided a broad classification of design output in terms of novelty. Design output includes original design, adaptive design, and variant design. If an existing task is solved by a new solution, the solution can be regarded as original design. On the contrary design, adaptive design focuses on the geometrical, production, and material perspective. In this kind of design the established solution is used to a changed problem. The variant design solves problems by changing the dimensions of original design to meet the needs of the problem.

Howard et al. (2008) adopted the categorisation of design outputs by Pahl and Beitz (1996) as creative design outputs. Together with the routine kind of outputs, they further generalised that there are four types of design outputs: original design, adaptive design, variant design, and routine design. They then mapped these types with the FBS framework offered by Gero and Kannengiesser (2004) and defined their natures. The original design, which is an original solution to a known problem, is behavioural creative. The adaptive design, which adapts a known solution to a new problem, is functional creative. The variant design, which varies the attributes of a known solution, is structural creative. The routine design is not creative in any aspect of the FBS framework.

Although their categorisation is based on engineering design products, it is not limited to a specialised design field. It is quite possible to apply these categories to the products made by students in design education. In general, there are very few students who are able to create original or adaptive designs. Students who can create any variant design are considered to be creative among their classmates.

These three kinds of creative design outputs suggest that creative output can exist at any stage of the design process. For instance, in order to be functional creative, creative output should have existed at the analysis stage of the design process, and the resulting design output is regarded as adaptive design (Howard et al., 2008). Similarly, in order to be behavioural or structural creative, creative output should have existed at the synthesis stage of the design process, and the resulting design output is regarded as original and variant design, respectively.

However, due to the complexity of the design process it is difficult to define the kind of creative design output if creative outputs exist at two or more stages. Nevertheless, for educational purposes, the most crucial concern is to examine how to generate creative design output.

3.1.3. Creative Design Process

3.1.3.1. Current Creative Design Process in the Literature

It is lucid enough that there are many similarities between the creative thinking process and the design process, despite the differences in the nature and complexity of the outputs. Howard et al. (2008) compared the two processes and found that both processes require the analysis and understanding of information at the initial phase. Also, both processes require evaluation towards the end of the processes. In between analysis and evaluation, both processes require generation of ideas. Furthermore, Lawson (2006) commented that "the control and combination of rational and imaginative thought is one of the designer's most important skills" (p. 138), and Webster et al. (2006) also commented that creativity can be fostered in classrooms if students have the ability to think divergently and convergently. Both processes seem to require divergence and convergence. It seems that the two processes are analogous.

Based on the similarities of the two processes, Howard et al. (2008) developed an integrated creative design process model which combines the FBS framework and the three-stage creative process. However, in view of the scrutiny of the creative design product in the previous section, it might not be appropriate to combine the two. Also, provided an individual is capable of generating different types of creative outputs by being creative at different stages of design process, combining the two processes directly might seem inapplicable, especially when we consider that the design process is complex, not because of the number of steps that an individual has to go through, but because of the cognitive steps that the individual has to experience. Therefore, it is apparent that the creative process, which means to generate a single idea, is not comparable with the design process, which aims to generate a design output combined with many ideas under numerous constraints and limitations. This

implies that there is a need to formulate a model of a different creative design process in which the number of creative thinking processes should be able to be incorporated into the design process.

3.1.3.2. A Model of Creative Design Process

A model which consists of three variations of a simple design process is illustrated below (Figure 3.5).
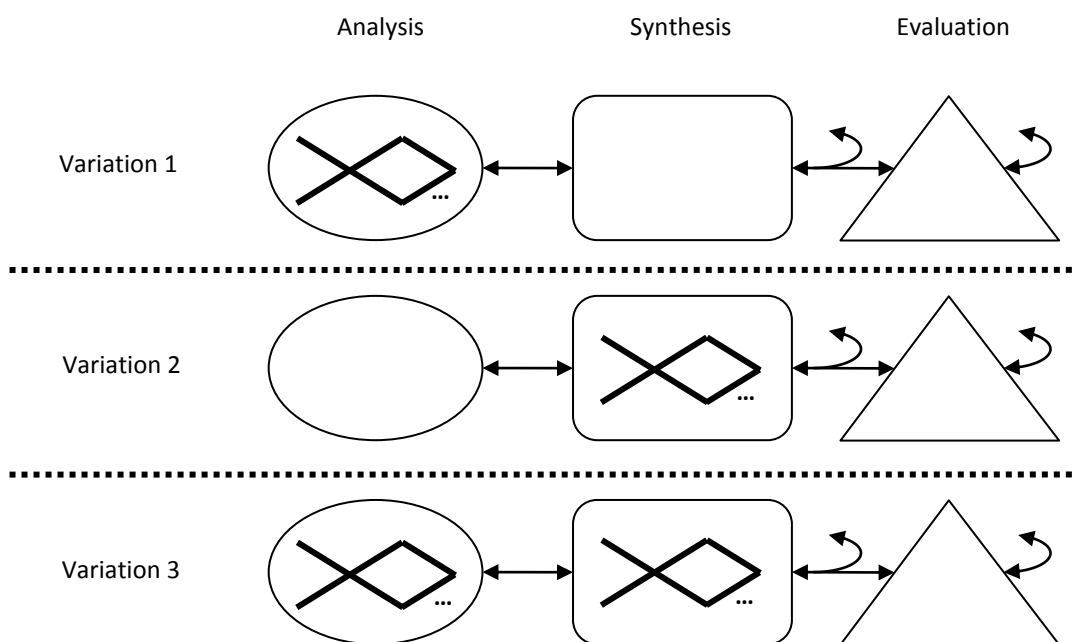
Figure 3.5. A model of a creative design process with 3 variations (creative processes simplified) (Wong & Siu, 2011)

This model adopts the three major stages of the design process with a number of loops (Wong & Siu, 2011). Different shapes (ellipses, rectangles and triangles) used in different stages of the design process are just for better illustration. The arrows in Figure 4.5 indicate the unexpected loops and procedures of the design process. It is notable that the design process, even though presented in a linear format, is not linear but has many possibilities in the choice of different paths. The '⋈…' symbol represents the simplified creative process. The broken lines, i.e. the loops, which are

included in the creative process in the previous section, are omitted here solely for easier understanding and simpler illustration.

There are three variations in this model. These variations indicate the possibility that the creative process might exist at different stages of the design process. The creative design output that can be generated in different variations might possibly be mapped with the categorisation of creative design outputs (see Howard et al., 2008). For example, Variation 1 of the creative design process might be possible in generating the adaptive design, and Variation 2 might be possible in generating the original and variant design. Variation 3 of the creative design process might generate an output which is much more complicated, and is unknown even if we are able to identify it, as not much literature addresses design output that possesses creativity in both generation and synthesis stages of the design process.

It is not surprising to find that there is no creative process involved in the evaluation stage of the design process, as this stage only involves convergent and analytical thinking. However, attention has to be drawn to the creative process at the analysis stage. It is arguable that the analysis stage of the design process should be considered as a phase similar to that of the creative process, and it should be regarded as a kind of convergence in which it is quite impossible to be 'creative'. However, the analysis stage in the design process is not entirely equivalent to that in the creative process. Analysis in the design process is not merely an information collection procedure that analyses the problem. Additionally, it governs the decisions on what kind of information should be included for solving the problem. It is rather a practical activity, instead of a cognitive one. Therefore, in the process of defining the problem at the stage of analysis in the design process, it is possible to be creative. Also, it is the stage that judges whether an adaptive output is produced (Howard et al., 2008). Another terminology might have to be used for the analysis stage of design to avoid confusion.

This model might be able to give a better understanding on the existence of numerous looping-back routes in the design process (Wong & Siu, 2011). Some of these looping-back routes might not direct to different stages of the design process, instead, to another loop of the creative process at that particular stage. As of the

similarity of the design process and the creative process, it is reasonable that such confusion exists.

It is obvious that design is concerned with the manipulation and control of convergent and divergent thinking, and a good designer should be able to swap between the two modes freely (Howard-Jones, 2002; Lawson, 2006). Subsequently, in teaching students to be creative in design education, there are some issues that should be of concern.

3.1.4. Implications for Design Education

There are diverse suggestions in the literature for fostering students' creativity in design education. In terms of the activity planning, Webster et al. (2006) suggested that it is essential to provide an incubation period of two to three days in order to enhance students' creativity. Sometimes interrupting the generation of ideas might also improve ideation productivity (Howard-Jones, 2002). In terms of teaching consideration, Rutland and Barlex (2008) found that knowledge and skill have to be provided to students so that they have the capacity to be creative. Rutland (2009) suggested that the design brief used for the project in D&T should be open-ended without any definite destination towards the solution, so to avoid idea fixation (see also Siu, 2009). Sociologically, activities are best to be finished by working groups instead of individuals, as creativity involves a collection of ideas. Socialisation of ideas among family members and classmates can help support students' creativity (Webster et al., 2006).

These methods appear to help foster students' creativity. However, these methods are more focused on the creative design output produced. Instead of helping students to generate and produce a more creative output, more researchers advocate that it is essential to increase the capability to act and think creatively (Adair, 1990; Meador, 1997; Saaty, 2006; Siu, 2009). The creativity competency should be developed so that students can solve problems not only in the context of design education, but also in their future life (Eggleston, 2001; Leung, 2004; Siu, 2002). Therefore, in view of the model of the creative design process developed in the previous section, it is

recommended that any activities that aim at fostering students' creativity should possess any of the following purposes:

1. reducing the frequency of repeating the creative thinking processes at each stage of the creative design process, and

2. sharing the burden of repeating the creative thinking processes in brain capacity with other classmates in the design process.

(Wong & Siu, 2011)

The activities that are capable of fulfilling either of these two purposes should help novice designers practise their creativity.

Webster et al. (2006) reported that when young children engage in analytical thinking, they are more unlikely to generate new ideas. This reveals the fact that once students are involved in analytical thinking after generating output it is not easy for them to re-engage with generative thinking. This further implies that novice designers are not capable of switching their thinking modes between convergent and divergent thinking as frequently as practising designers. Therefore, reducing the frequency of repeating the creative processes or sharing the burden of repeating the creative processes with others will help them practise alternating the thinking mode, and thus simplify the creative design process in which they need to go through while designing. Howard-Jones (2002) also suggested that it is essential for students to practise the interchange of analytical and generative thinking models and practise the mode that they are not familiar with. Novice designers should practice creativity by increasing the frequency of repeating the creative processes in the design process gradually and increasing the level of individualisation, so that they can go through the creative design process smoothly with minimal hindrances and difficulties. For example, brainstorming, developed by Osborn (2001), which encourages deferring evaluation and treating group work as a supplement to individual ideation to obtain more ideas is an activity that fulfils the two purposes. Deferring evaluation might mean excluding evaluation in the stage of generation. In other words, it can reduce the alternation of generation and evaluation in the creative process, as stated in the first purpose. Group work in brainstorming also can facilitate a simpler creative design process in a way that more creative processes can be exercised by different

individuals (Siu, 1998; 2000), and thus the burden of repeating the creative thinking process is then shared.

The model of the creative design process differentiates the process, which leads to creative design from the one which leads to routine design (Howard et al., 2008). It may not be useful to suggest which particular teaching tools or methods should be used at different stages of the creative process or the design process. However, it is helpful to consider and assess which strategies should be chosen and used (Wong & Siu, 2011). For instance, teachers can ask students to work in groups, and focus on the creative processes in the analysis stage of the design process together, and then work on their individual project afterwards. Alternatively, teachers can plan small activities which only focus on each stage of the design process, and integrate what students have learned in small activities by working on an extensive design project.

3.2. A PERSPECTIVE OF EMOTION

Research showed that emotion is associated with creativity (Averill et al., 2001; Russ & Schafer, 2006; Spendlove, 2008; Van Kleef et al., 2010). A certain kind of emotion might be conducive to different thinking in the creative thinking process. Besides, if creativity is central to design (Lawson, 2006), and different types of emotion contribute to the pathway to creativity (De Dreu et al., 2008), emotion also has a role to play in the design process. Emotion should also be considered in the discussion of creativity in design education. Subsequently, this section discusses creativity in the perspective of emotion. This section addresses the nature of emotion and its relationship with creativity, design and also design education.

3.2.1. Emotion

Emotions were once considered "phylogenetically primitive responses, closely attuned to physiological arousal and divorced from higher thinking processes" (Averill, 1999, p. 332). However, a growing number of researchers believe that there is a link between emotions and higher thinking processes. For example, Spendlove

(2008) believed that emotions are "messy, natural, primitive and often difficult to define yet they provide us with a reflexive ordinance system which influences our behaviour, decision making and creative thinking" (p. 12). Emotions are also the "biologically primitive responses that interfere with deliberate, rational thought" (Averill et al., 2001, p. 165).

In analysing emotions and understanding their constituents, Averill et al. (2001) provided a comprehensive framework that links biological and social perspectives with the emotional responses of everyday life. Basic emotions, such as fear, are framed as the "remnant of our biological heritage" (p. 166), and the representation of an individual's emotions in biological systems is due to his or her 'genotype.' Another aspect that affects the emotional pattern of an individual is the social system, which is "encoded in the symbols, artefacts, and customs of society" (p. 166). The representation of an individual's emotions in social systems is his or her 'sociotype.' The genotype and sociotype together make up an individual's 'emotional traits.'

Emotional traits affect the individual's emotional syndromes and emotional schema. Emotional syndromes are the 'folk-theoretical constructs' that depend on the social rules to which an individual adheres and the existential beliefs that he or she holds. These rules and beliefs are internalised and form emotional schemas. Emotional schemas determine the individual's emotional state in a certain initiating condition. Thus, an individual, in different situations and under different constraints, has different responses that correspond to his or her emotional state.

This framework clearly describes the attributes and factors that contribute to an individual's explicit emotional states and behavioural responses, and suggests that different people display different responses to the same event or scenario. As these responses also depend on the social rules and existential beliefs of individuals, some may respond more intelligently than others. Researchers have developed various concepts to describe such emotional ability.

One of these concepts is emotional literacy, which is "the ability to recognise, understand, handle, and appropriately express . . . emotions" (Sharp, 2000, p. 8). There is growing research interest in emotional literacy in the context of learning and

behaviour (Haddon, Goodman, Park & Crick, 2005). Sometimes the term 'emotional literacy' is substituted with the term 'emotional intelligence' (Haddon et al., 2005). Beyond simple emotional literacy, critical emotional literacy is "a pedagogy of discomfort" that "requires individuals to step outside their comfort zones and recognise what and how they have been taught to see (or not to see)" (Zembylas & Vrasidas, 2005, p. 74). This implies that individuals also need to be emotionally literate in risky situations.

Researchers made considerable effort to distinguish creativity from intelligence (see Kaufmann, 2004), and, given the accepted existence of cognitive creativity and cognitive intelligence (see Averill, 1999), it is not surprising to find that just as there is a concept of 'emotional intelligence,' there is also a concept of 'emotional creativity.' Emotional intelligence is "the capacity to reason about emotions, and of emotions to enhance thinking" (Mayer, Salovey & Caruso, 2004, p. 197). It incorporates different cognitive and reflective abilities that "promote emotional and intellectual growth" (p. 197). In contrast, emotional creativity, according to Averill et al. (2001), is the ability to give emotional responses creatively. Any emotional response that meets the criteria for or displays elements of creativity (which are discussed in Section 2.2.) is considered to be 'creative.'

Discussions and research on emotions are on-going in academia. Although emotions are primitive responses, they play a role in our higher thinking processes, including the creative thinking process (see Averill et al., 2001; Spendlove, 2008). The link between creativity and emotions is discussed in details in the next section.

3.2.2. Creativity and Emotion

As previously noted, emotions are often considered to be the primitive responses of human beings (Averill, 1999). However, they are also increasingly associated in the literature with the creative thinking process, which is viewed as the highest of all of the thinking processes and one that is uniquely human (Averill et al., 2001). The involvement of emotions in the creative thinking process is supported by a number of studies (Russ & Schafer, 2006), and a considerable amount of research has

focused on the influence of certain emotional states on creative performance (Van Kleef et al., 2010).

3.2.2.1.   Relationship between the Nature of Emotions and Creativity

De Dreu et al. (2008) reviewed the relevant literature and report that numerous researchers concluded that positive emotions favour divergent thinking in the right hemisphere of the brain, which "leads individuals to experience their situation as safe and problem free, to feel relatively unconstrained, to take risks, and to explore novel pathways and new possibilities in a relatively loose way, relying on heuristic process styles" (p. 741). In contrast, negative emotions favour convergent thinking, as they "facilitate left hemispherical, secondary process cognition, which is more verbal, sequential, and analytical" (p. 742). Similarly, Russ and Schafer (2006) suggested that there are two types of affect process that are important in creativity: "the access to affect-laden thoughts" and "the actual experience of the affect state" (p. 347). The former reflects "the ability to think about and express ideation with affect-laden content," whereas the latter process reflects "the ability to experience affect or mood state" (p. 347). The existence of access to affect-laden thoughts and the positive affect (Filipowicz, 2006) associated with divergent thinking suggest that emotions determine the number of ideas that an individual can generate.

In addition to the relationship between affect processes and creativity, research shows that a particular emotional state can either facilitate or hinder creativity. In general, positive affect is conducive to creativity (Baas et al., 2008; Filipowicz, 2006; Sung & Choi, 2009), although it can also have a negative effect (Filipowicz, 2006). Negative affect can similarly have both positive and negative effects on creativity (Van Kleef et al., 2010). Research by Van Kleef et al. (2010) showed that anger facilitates creativity when a person has a high epistemic motivation, and hinders it when a person has a low epistemic motivation. Surprise may also promote creativity (Filipowicz, 2006), and futility may have some relationship with creativity within a group of artistic professionals (Perry, 1989).

Other researchers not only related positive or negative affect to creativity, but also took the arousal nature of affect into consideration. According to Russell (1980), affect can be categorised into two dimensions: the pleasure-displeasure dimension and the arousal-sleep dimension. For example, 'excitement' is a pleasure-arousal affect and 'contentment' is the corresponding pleasure-sleep affect. De Dreu et al. (2008) adopted a similar approach to link emotions and creativity. They regarded the pleasure-displeasure dimension as the hedonic tone of the affect, and the arousal-sleep dimension as the activation of the affect. They believed that an activating affect, regardless of tone, is beneficial to creativity, as moderate activating affects may increase an individual's motivation to seek more relevant information and consider different alternative ideas. In other words, activating affects facilitate divergent thinking. From a neurological perspective, a state of activation also increases the working memory capacity. The only difference between positive and negative activating affects is that they generate creativity through different pathways (De Dreu et al., 2008).

The framework suggested by De Dreu et al. (2008) clearly shows the possible paths to creativity associated with different tones and levels of activation. It also applies a dual pathway model. Flexibility, fluency, and originality are the main measures of creativity, and flexibility and perseverance are the two pathways that lead to fluency and originality. They also suggest that a positive activating affect leads to cognitive flexibility and inclusiveness, which finally lead to creative fluency and originality, as they help an individual to consider more information and make use of that information flexibly to generate creative ideas. Conversely, a negative activating affect leads to perseverance and cognitive persistence, which means that creative ideas are generated after a longer period within a given context.

3.2.2.2. Emerging Literature on Emotions and Creativity

A vague contradiction can be observed when comparing the understanding of emotions and the creative thinking process from a cognitive perspective. As noted, De Dreu et al. (2008) suggested that a positive mood supports a heuristic way of thinking and a negative mood a systematic way of thinking. Their research findings

further suggest that a positive activating affect can lead to creativity through the path of flexibility, and conversely that a negative activating affect can lead to creativity through the path of perseverance. However, it is unclear whether this implies that either a heuristic or systematic way of thinking alone leads to creativity (See Figure3.6). In contrast, in the literature on creativity, the creative thinking process involves the interaction of convergent and divergent thinking (Baer, 2003), and neither type of mental activity alone is able to achieve creativity.
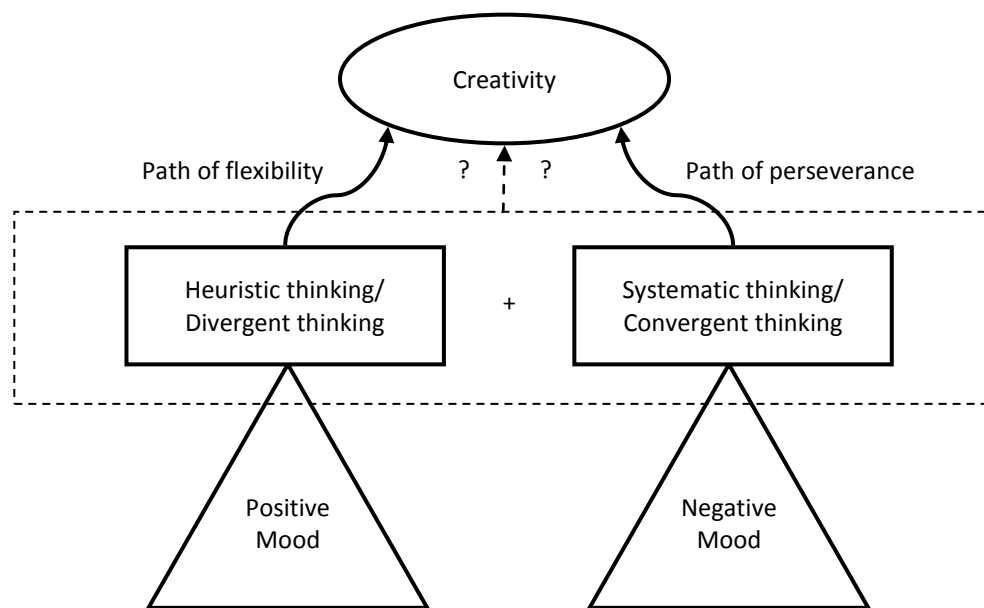
Figure 3.6. Vague contradiction of the literature of emotions and creativity (dotted lines represents the literature of creativity; solid lines represents the literature of emotion)

According to this line of thought, the only possible way to verify the contradiction is to examine if divergent thinking or convergent thinking alone can lead to creativity. However, Runco (2003) stated that only in a controlled experimental environment, ideation and evaluation can be separated for ease of investigation. That means pure divergent or convergent thinking is unlikely possible in the reality, and this might make the verification difficult. Consequently, it can be argued that the literature on emotions and the creative thinking process appears to be contradictory on this point.

This review reveals that the literature on the association between emotions and creativity fails to address the importance of the interaction between convergent and divergent thinking. Both positive and negative activating affects can lead to

creativity through different thought processes (heuristic or systematic), yet creativity can ultimately only be achieved through simultaneously positive and negative activating affects.

3.2.3. Interaction of Creativity and Emotions in Design

In the context of design, creativity and emotions are closely related, because different emotions are triggered throughout the design process, and emotions affect the production and generation of creative ideas. It is suggested that a design process involves more than two or more emotional changes. A design process that incorporates several creative thinking processes suggested in Section 3.1.2. may be more applicable for the involvement of emotions in the context of creativity.

Figure 3.7 shows the dual relationship between emotions and creativity in design, which correlates with the concepts of Russ and Schafer (2006) mentioned in Section 3.2.2.1.
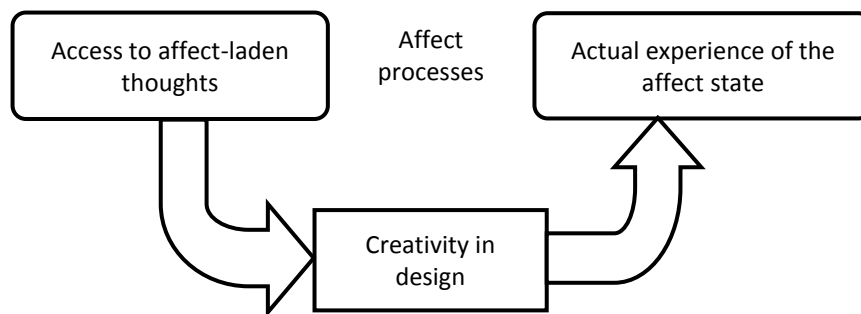
Figure 3.7. Dual relationship between emotions and creativity in design (based on the affect processes of Russ and Schafer, 2006)

During the process of design, designers experience various emotional states. Given that emotion is associated with creative design activity, creativity in design should affect 'the actual experience of the affect state' (Russ & Schafer, 2006). That means after accomplishing a creative design activity, the designers would experience a certain kind of emotions. In addition, 'the process of the access to affect-laden

thoughts' should contribute to idea generation and creation in design, as this process is beneficial to divergent thinking. In other words, the ability to express emotion might affect the idea generation in design activity. Creativity in design, as shown in Figure 4.7, may then serve as the path that links the two processes together. It can also be argued that the two processes are not discrete.

It can be argued that the actual experience of the affect state would affect the ability of an individual in understanding and expressing emotions, i.e. the access to affect-laden thoughts. If an individual is able to experience different emotions in different situation, his emotional experience would increase with time, and he should be more capable of accessing his affect-laden thoughts. In this circumstance, the illustration of Figure 3.7 might represent a creative idea generation in design activities, and through a series of design activities which involve creativity, the two affect processes might be enriched (Figure 3.8).

Enrichment

| Access to affect-laden thoughts | Affect processes | Actual experience of the affect state |

Creative idea generation in design activities
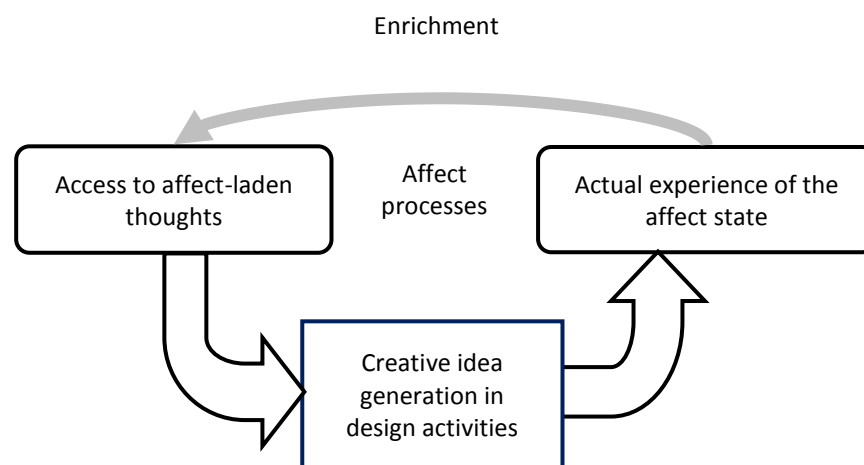
Figure 3.8. Possible cycle between the affect processes and creative idea generation in design activities

These issues may be even more challenging in the context of design education, during which teachers encourage students to generate creative ideas. If it is true that in the design process mood changes affect student creativity, then it may be meaningful and interesting to investigate teachers' awareness of students' emotions, and determine whether they are aware of students' mood changes and provide adequate guidance and help throughout the design process.

3.2.4. Implication for Design Education
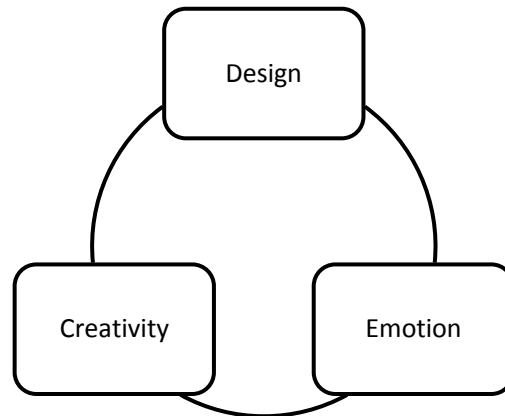
Figure 3.9. Relationship of design, creativity, and emotion

Emotion is associated with creativity and thus design (Figure 3.9). Mood changes in design process might affect students' creativity. It can be argued that the awareness of emotion is crucial in generating creative ideas. Thus, it is inevitable in considering the influence of teachers on their students, as they are the facilitators and guides to students in generating creative ideas. Students learn how to deal with different problems in the creative design process under teachers' supervision. Therefore, the ability of teachers to recognise students' emotions becomes an issue. It might be influential to students' emotional change and also the design process and the artefact in design lessons, and have a secondary effect on students' creativity (Figure 3.10).
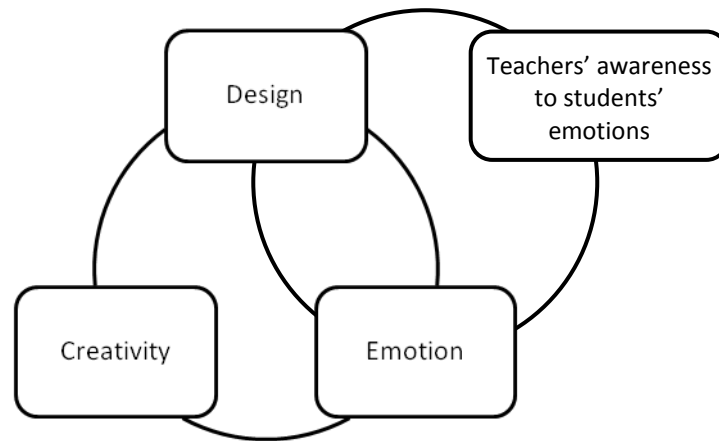
Figure 3.10. Influential role of teachers' awareness to students' emotions

If teachers fail to address the emotional needs of students, then the artefacts that they produce in school projects are less likely to be creative, and will be only routine designs. It is necessary for teachers of design to take into account both the positive and negative emotions of their students. Careful guidance and support from teachers in this respect will increase the chances that students will generate more creative ideas and produce more creative designs.

If a teacher is said to possess the awareness of students' emotions, it means the teacher should be able to notice that students are having different emotions in the design process. However, this description is too elementary, and any analysis related to awareness should not stop at this level. Correspondingly, Figure 3.11 shows the cycle of teacher's awareness to students' emotion, and it shows what comes further if the teacher is able to recognise students' emotions.
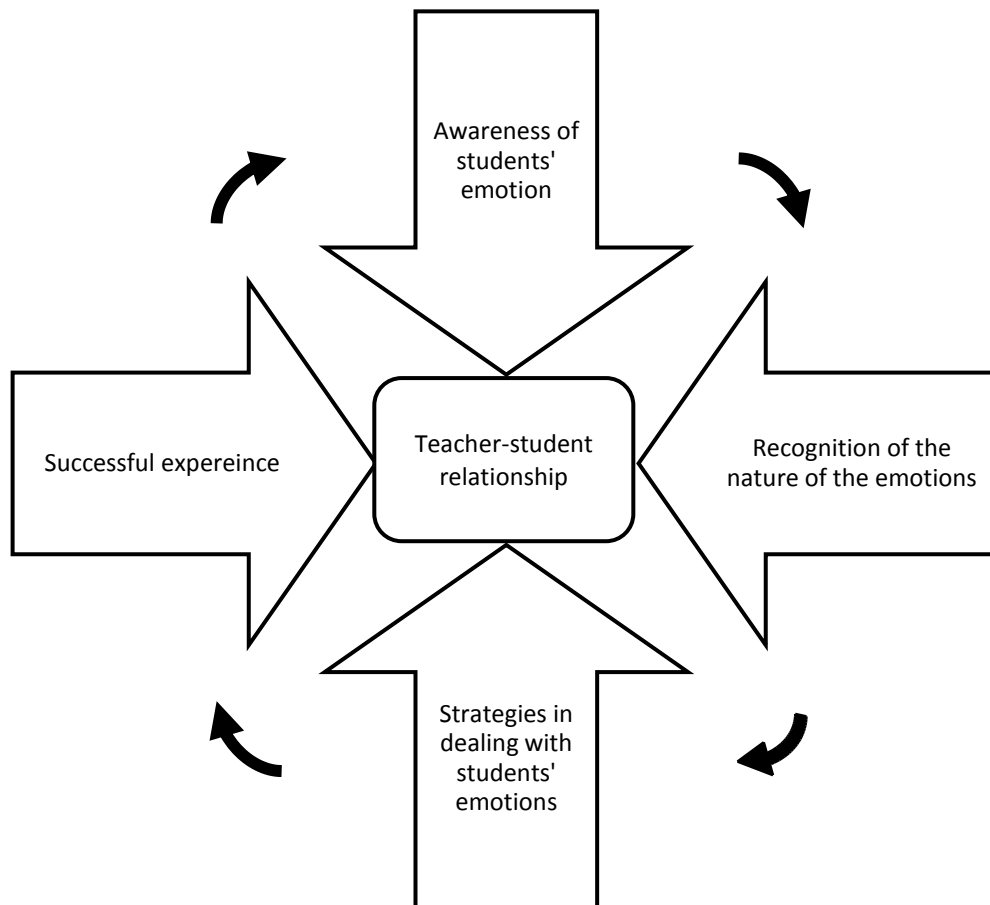
Figure 3.11. Cycle of teacher's awareness to students' emotion

In Figure 3.11, teachers should be aware of students' emotion in the first place. After the teacher is able to observe and notice the emotional change among students, the nature of the emotions among students should be noticed as well. That means teachers should be able to recognise the hedonic tones and the activation level of emotions. As indicated by Schutz and Pekrun (2007) in their study of emotion in education, sometimes it is more important for teachers to pay attention to the negative or deactivating emotions because these emotions are often more difficult to be noticed and handled. Problems often rise from the negative or deactivating emotions among students, and more guidance might be needed in comparison with positive or activating emotions. On the contrary, teachers could make use of the positive or activating affect among students and help promote creativity.

Teacher should use appropriate strategies to guide students in different emotional states. Teachers may need to apply their own understanding and life experience here. Strategies may vary widely with situation and for different teachers and students.

Teachers with a greater emotional ability should be more effective in this regard, and how they interact with students is crucial in helping to promote creativity in the design process (Schutz, Cross, Hong & Osbon, 2007). If the strategies used successfully guide students along the right track, then teachers will gain successful experiences that will help them to further develop their emotional ability and awareness of students' emotions.

In dealing with students' emotions, the teacher-student relationship is an important factor that affects whether a teacher is able to recognise students' emotions and thus guide students (Zambrana-Ortiz, 2011). Indeed, the whole process rests on the relationship between teacher and students. Each action in recognising and dealing with students' emotions will affect the teacher-student relationship. If the relationship is not sufficiently close, then the students may hide their emotions from the teacher. The teacher will then be unable to deal with the students' emotions.

The proposed cycle gives suggestions as to how teachers can become aware of the emotions of students. Undoubtedly, teachers may sometimes experience situations that may not exactly fit the cycle. The cycle cannot cover all cases, as design activities, emotions and relationships among human beings are complicated. However, the cycle should serve as a guideline for analysing teachers' emotional ability to notice and deal with students' emotions.

In discussing students' emotions among East Asians, numerous studies have found that East Asians tend to be more introverted and reserved when dealing with emotions (Averill et al., 2001). Hence, Chinese students may be less likely to express their emotions than Western students, and, in turn, awareness of students' emotions may be more difficult for Chinese teachers. The social system in East Asian countries also differs from that in Western countries, and is generally more collectivist in nature (Averill et al., 2001). As mentioned in Section 2.5.2., collectivism places more emphasis on "morality, conformity, instrumental roles of education, but less on personal and creativity development of students" (Cheng, 2004), which means that an individual is liable to emphasise group harmony over individual interests (Averill et al., 2001). Students in such societies may be less likely to express their emotions if they think that the act of doing so could disrupt the

harmony of the group. Students may thus suppress their emotions when designing a project in a group, and their creativity might then be affected.

The individualism of Western societies, in contrast, may be more naturally accommodating to students' emotions because Western students feel freer to express themselves, which facilitates teachers to address their emotional needs, and to direct and guide them to think in an emotionally intelligent way. It can be argued that there is a need to cater to students' emotions more carefully in Chinese societies. Chinese teachers may require training in emotional awareness, because they are also adults in a social system that favours collectivism. However, the framework developed by Averill et al. (2001) suggests that training teachers to become more emotionally aware is no easy matter, as the sociotype, existential beliefs, and social rules held by teachers and the wider society underpin the formation and construction of their emotional syndromes and schemas. In this case, teachers must consciously understand their own emotional constructs before they can take action to deal with students' emotions in the classroom.

In answering the question of how teachers should engage students' emotions in design education, the triadic schema developed by Spendlove (2007) may be a suitable framework for product-oriented design education. He believes that three domains of emotions should be recognised: "developing emotional capacity in the learner to engage in a creative process (person)," "stimulating emotional engagement through appropriate learning contexts (process)," and "facilitating the emotional interfacing of the learner with the outcomes of a creative process (product)" (p. 49). The illustration which presents the relationship among the three domains suggests that the three domains are in a form of fluid. The three domains are interrelated, and a complete engagement within the domains is essential in developing design education effectively.

Teachers need to make greater efforts to take care of the emotional needs of their students and thus help to foster their creativity. It is important for teachers to create and induce the appropriate activating affects among students to increase the chances that they will display creative behaviour (De Dreu et al., 2008).

3.3.   CONCLUDING REMARKS

The chapter discusses creativity through a perspective of design and emotion, and also design and emotions in the context of design education. It reviews the design process used by designers and suggested in different secondary school curricula. The review suggests that the design processes at different levels are comparative, and the processes are very similar to the creative thinking process mentioned in Section 2.3. Besides, the chapter offers insights into what the creative design process can be and introduces some points worth considering in choosing the kind of activities that help students to be creative in design education.

The model suggested in Section 3.1.3.2 identifies the route to create creative outputs. It provides guidelines for teachers to facilitate students along the creative thinking process. Also, it suggests criteria for teachers to choose ways to facilitate students to be creative. All these are meant to help foster creativity in the next generation, optimise the quality of the solutions to unknown problems. One might argue that strategies for creativity should not be definite and straightforward, as it seems irrational to use an uncreative method to teach creativity; however, knowledge is needed to understand the pathways leading to creative design products, and is necessary in increasing students' creative competency.

From the perspective of emotions, the chapter suggests that even though emotion is considered as one of the primitive responses of human beings, it is correlated to the higher thinking processes such as creative thinking (Averill et al., 2001; Russ & Schafer, 2006). Subsequently, in a design process, which is neither direct nor simple in any sense, emotion plays an important role, especially when the designer encounters difficulties. Sometimes positive emotion might be conducive to creativity, and the hedonic tone of affect might have an impact to creativity through different pathways (Baas et al., 2008; De Dreu et al., 2008; Filipowicz, 2006; Russell, 1980; Sung & Choi, 2009).

The chapter also suggests that a possible relationship between the two affect processes, 'access to affect-laden thoughts' and 'actual experience of the affect state'

(Russ & Schafer, 2006), exists through creativity in design. It is noted that relationships between the integral elements of design, creativity, and emotions require greater awareness of students' emotions in design education. The possible relationship between emotions and design affects the cultivation of students' creativity. It might be possible that teachers are unaware of students' emotions, and East Asian societies might need to face more challenges in this regard.

Chapter 4

Methodology

This chapter outlines the way in which the study was conducted and the limitations of the study. The study adopted a qualitative research design to investigate the research questions posed in Chapter 1, as a quantitative approach may not have been appropriate for an exploratory study of the roles of creativity in design education. As a matter of fact, quantitative research has been predominating over the research communities of design education (Zuga, 1994).[1] This limits the range of research contexts (Petrina, 1998). This qualitative study might provide other perspectives in scrutinising design education and its creativity.

Qualitative data were collected in Hong Kong using a variety of methods to capture the perceptions of creativity in Hong Kong society and in design education from the viewpoints of EDB and HKEAA officers, teachers and students.

4.1. RESEARCH STRUCTURE AND FRAMEWORK

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[1] Even though Zuga's review is about technology education, technology education (and also design education at secondary school level) is equivalent to D&T in this thesis.
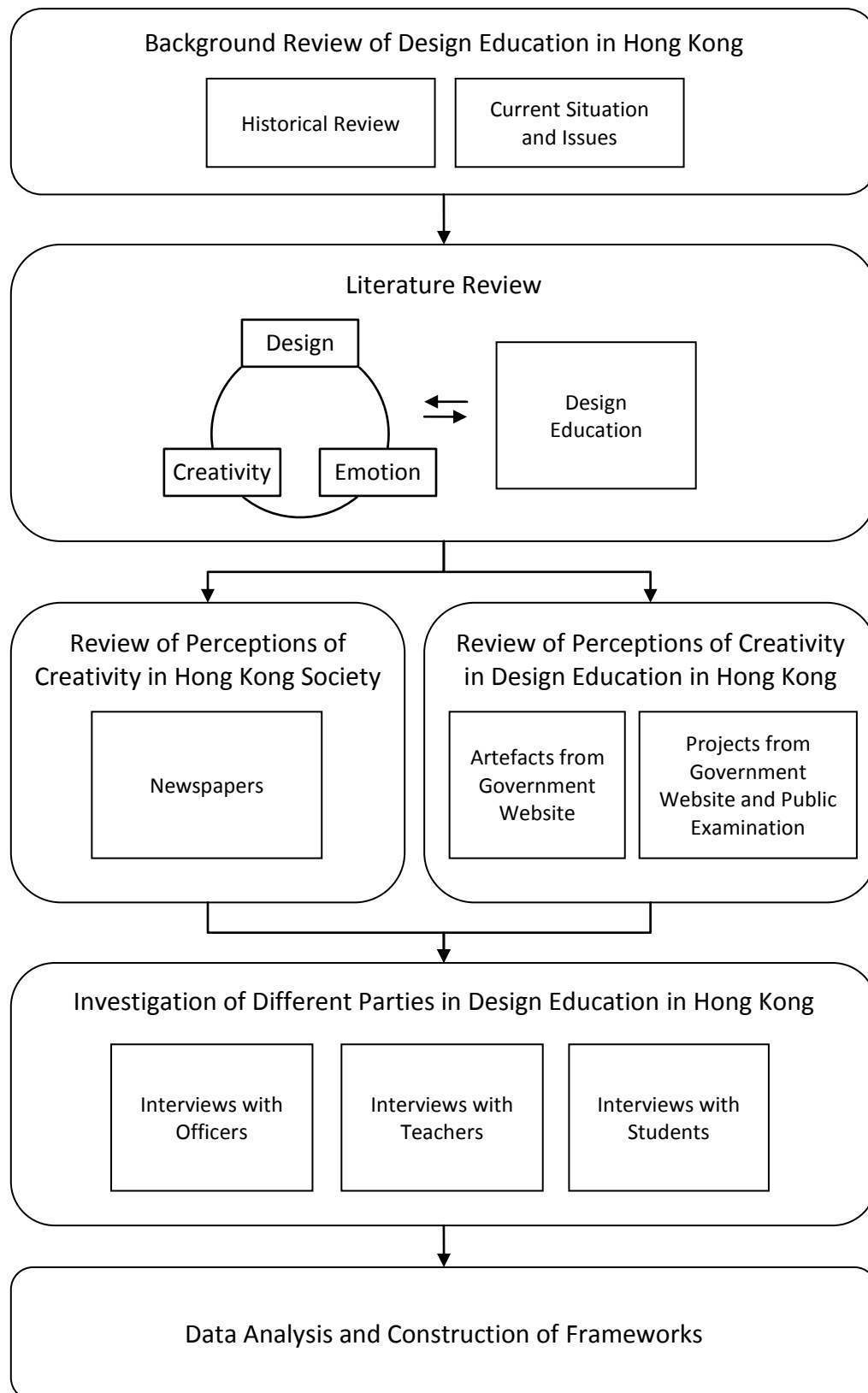
Figure 4.1. Research Framework

Figure 4.1 presents the research framework. The research was divided into five stages: a background review, review of the literature, review of the perceptions of creativity in Hong Kong society and design education based on documentary evidence, interviews with different parties involved in design education, and data analysis and framework construction. The background review and literature review informed the later stages of the study. The stages are closely related with each others, and different stage represented different kinds of data collected or activities performed.

Phenomonology is the kind of qualitative research employed in this study. This research approach is used because 'the aim of phenomenology is to seek the meaning of the world and the basic meaning of objects" (Selvi, 2008, p. 40). It also focuses on the experiences of people on "how they perceive it, describe it, feel about it, judge it, remember it, make sense of it, and talk about it with other" (Patton, 2002, p. 104). It is coherent with the objective of the study which is to understand interviewees' perceptions on creativity and the 4P's and find out the roles of creativity. This is also the most appropriate approach in describing the method used in the study.

Besides, data triangulation was used in this study to enhance the validity of the findings. Flick (2009) defined triangulation as the "combination of different methods, study groups, local and temporal settings, and different theoretical perspectives in dealing with a phenomenon" (p. 444). According to Denzin's (1989) categorisation, data triangulation refers to "the use of different data sources, which should be distinguished from the use of different methods for producing data" (p. 237). In this study, both documentary and interview data were collected. Data triangulation was considered important because, according to Rhodes (1987), creativity is often approached from four distinct areas, which implies that data from a single source may be inadequate. However, triangulation here does not mean validating the results as it was first conceptualised, but rather enriching and completing the data and knowledge regarding the topic of study (Flick, 2009). The data obtained in each stage of the research thus informed the subsequent stages.

4.1.1. Stage 1

Stage 1 constituted a background review of design education in Hong Kong, including the history and current situation and issues of design education. Its findings provided a foundation for the entire study. Obviously, it is essential to have a full understanding of the topic of study before discussing further. The current issues involved in design education are relevant to any discussion of the roles played by creativity, and also influence the interpretation of the research results. This background review encompassed the workshops and other facilities available in schools for design activities, teaching materials, assessments, gender roles and issues, the junior and senior secondary design curricula, and the overall image of design education in Hong Kong.

As the history of design education in Hong Kong has a direct relationship with the design curricula and other issues, the background review also included a thorough historical review beginning with the birth of design education and ending with the most recent changes made to the design curricula. This review revealed distinct stages in the history of design education, as outlined in Chapter 1. Further discussion and analysis of this history and other background information can be found in Chapter 6.

4.1.2. Stage 2

Once the history and current issues of design education had been made explicit, the research entered the literature review stage. The aim of which was to reveal researchers' understanding of the research topics from different theoretical perspectives. To limit the scope of the review, three major areas were chosen for investigation: creativity, design and emotion.

As the study's major focus is the roles of creativity, the review of the creativity and related literature was the most extensive. Without a comprehensive understanding of creativity, it would be difficult to identify the roles it plays in a complicated educational setting such as design education. As mentioned in Chapter 1, researchers have approached creativity from four main perspectives: person, process, output and

environment (see Rhodes, 1987). The literature on creativity is thus approached and discussed from these four perspectives. The other major focus of the literature review was design. The emphasis has placed on the relationship between creativity and design rather than on design alone, as research has shown the two to be closely related (Barlex, 2007; Howard et al., 2008; Lawson, 2006; Middleton, 2005; Rutland & Barlex, 2008). This part of the review also encompassed research on creative design output and the creative design process. The third area of focus was emotion. The inclusion of the topic of emotion is due to the fact that emotion is known to have overlaps with both creativity and design (see Section 3.2). Emotion plays an important role in creativity (Averill, Chon, & Hahn, 2001; Baas, De Dreu, & Nijstad, 2008; De Dreu, Bass, & Nijstad, 2008; Filipowicz, 2006; Perry, 1989; Russ & Schafer, 2006; Sung & Choi, 2009; Van Kleef, Anastasopoulou, & Nijstad., 2010) and thus in design. Both the nature of emotion and its relationship with design and creativity were investigated.

To ground the study in the existing research, the relationship between design education and each major area of the literature is addressed in the literature review section of this thesis. Related theories and issues regarding creativity, design and emotion in the context of design education were discussed.

However, literature that explicitly addresses the roles of creativity in design education was not directly discussed, and in fact there are very few studies on its roles in any specific educational context. It does not imply that the current literature review has nothing related to the roles of creativity. The review also encompasses related topics such as how creativity is unwelcome in East Asian classrooms (Chapter 2) and how creativity is related to design education in the contexts of design and emotion (Chapter 3). These topics provide some insight into the roles that creativity plays in design education.

The knowledge gained in Stage 2, particularly that regarding creativity, informed the selection of research methods for the next two stages of the study.

4.1.3. Stage 3

The literature review made it clear that creativity is often approached from the perspectives of what Rhodes (1987) called the 4P's: person, process, product and press. Hence, to gain a comprehensive understanding of creativity in a given context, 4P's are investigated. In Stage 3 of the research, the latter two of the 4P's were addressed, that is product (output) and press (environment).

The environment and output aspects of creativity were the first to be investigated because the sources of information about them are artefacts and documents rather than individuals or organisations. This information can be accessed through databases and a variety of publications. Undoubtedly, there are other methods of accessing this information, such as interviews, but documentary investigation was deemed more appropriate, as interviews were to be carried out in the fourth stage of the study. In addition, in researching the output of creativity, it is simpler and more direct to view the output itself rather than asking the individuals who created it to describe it. Furthermore, their descriptions will by nature be subjective, and thus introduce the possibility of bias.

This stage of the research involved investigation of primary sources which are capable of providing first-hand information (Cohen et al., 2007; Wiersma & Jurs, 2005). They included newspapers, student projects and artefacts on the online government website, and past public examination papers. The validity of the data obtained in this stage was assured by choosing only authoritative sources, including a government website and newspapers. No secondary sources were consulted at this stage.

4.1.3.1. Environment (Hong Kong Society)

With reference to the environment ('the creative press', in Rhodes' [1987] 4P's framework), rather than look at that of the individual design education classroom, this study examined the overall societal environment of Hong Kong. Although the classroom environment is also related to creativity cultivation, it is likely to vary from school to school and even from classroom to classroom. It is greatly dependent

on how teachers teach D&T. If the classroom environment were considered at this stage, then teacher-related factors would also need to be considered. It would then lead to a less robust investigation. In considering culture as one of the important elements of the environment, investigation of creativity in the environment of Hong Kong society should be appropriate for the purposes of this study. This investigation was considered likely to reveal cultural beliefs about creativity in an East Asian society.

Newspapers are major communication media in Hong Kong. The Centre for Communication Research at Hong Kong Baptist University (2010a) conducted a survey on the use of traditional and new media in Hong Kong. Nearly 1,000 respondents selected via random sampling took part. Seventy-seven per cent reported reading newspapers, and the average time they spent reading them is about 38 minutes per day. Add in those who read newspapers online, and it is clear that many people in Hong Kong read newspapers. It suggested that this news medium has power and influence in society. The information disseminated in newspapers is thus likely to affect perceptions. As a result, the way in which newspapers and journalists describe creativity may be related to the way that Hong Kong society perceives creativity.

News stories and reports appearing in a randomly chosen week (21 to 27 March 2010) and containing the keywords 'creativity' or 'creative' in either headlines or the body of the text were extracted from all Chinese newspapers in Hong Kong using a newspaper database system, WiseNews (http://wisenews.wisers.net).[2] Terms such as 'creative industry' and 'creative culture' were excluded from this search, as they have specific meanings other than the subject of interest here. Traditional Chinese, instead of simplified Chinese, is used in the search, as it is the Chinese that all Hong Kong newspapers use. Each extracted news story was examined, scrutinised and analysed to identify what kinds of ideas about creativity were being described or implied under different contexts. Similar ideas were categorised into the same group, and the major ideas are discussed in Chapter 5.

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[2] The keywords 'creativity' and 'creative' have the same characters in Chinese. The Chinese term used in the search is '創意'. This term is universal in different situations and contexts.

4.1.3.2. Output (Design Education in Hong Kong)

In order to investigate the output of creativity in design education, the exemplar coursework presented on the Education Bureau (EDB) website was examined. This coursework can be considered representative of students' work, as it is chosen for D&T teachers' reference in planning projects.

Unquestionably, students' design artefacts are important in investigating the output of creativity in design education. However, in considering the D&T context, the project itself is also important because students' designs are based on the project brief given to them by their teachers, or the HKEAA in the case of the public examination. In other words, the projects designed by teachers or the exam authority have a great influence on student artefacts. Therefore, in addition to these artefacts, the projects on which they were based and also the projects included in the D&T public examination in recent years were also examined. The results and analysis of this stage of the research are presented in Chapter 6.

The consistency and authority of the public examinations guarantee the validity of the project work scrutinised. Evidence from non-public examinations, such as subject examinations in school, might be insufficiently cogent, as requirements often vary a lot from school to school. Examining the projects assigned to students in the public examination thus considered to be able to provide a more robust investigation of creativity in Hong Kong design education at the secondary school level.

4.1.4. Stage 4

The other two elements of the 4P's, person and process, were examined in Stage 4 of the research. In order to gain a better understanding of how creative students and teachers are, the design process that students follow in designing creative artefacts and how teachers guide students in the creative design process, creative teachers and students were invited to participate in interviews. Officers from relevant departments were invited to give a holistic view towards the issue. Because design education

concerns the creative process and whether students can learn creativity through this process, the elements of person and process are central to this study. The interviewees involved in this stage of the research were also asked to provide comments on and describe their understanding of creative output and the environment in which creativity takes place, so to complement the data gathered in Stage 3. It was thus possible to obtain some interesting data that had been overlooked in the earlier stage. Consequently, Stage 4 was the key data collection stage.

4.1.4.1. Sampling

As noted, interviews were conducted with teachers, students and officers. As the point of the interviews was to obtain information pertinent to the creative experience, it was necessary to invite teachers and students who had experienced or witnessed creative events. Therefore, purposeful sampling should be most appropriate (Wiersma & Jurs, 2005). Three kinds of D&T teachers fulfilled the selection criteria:

- those who had led students in winning international competitions related to creativity or D&T,
- those who had won a local teaching award, or
- those who were representatives of the local design education association.

These teachers were approached in person, and six teachers in six different schools agreed to participate. They were interviewed individually, and each interview lasted about an hour. The competitions that the teacher interviewees had led students in winning were as follows.

- Odyssey of the Mind (international creative competition held in the US)
- RoboCup (international robotics competition held in a different locale each year)
- VEX Robotics Competition (international robotics competition held in the US)

One of the teachers was the honorary editor of a local D&T design education association, and two were awardees of the Chief Executive's Award for Teaching Excellence in Hong Kong.

Students who had creative experiences in the six schools were also interviewed. As the researcher did not know any of the students in these schools, the teachers were invited to nominate students to participate in interviews. They were each asked to select a creative student from their team or class. Most of the students were interviewed individually. However, because some of the teachers (Teachers A, E and F) nominated two students, the students in Schools E and F were being interviewed in a small group due to administration problems and time constraints resulted in the setting (see Table 4.1).

All of the teacher interviewees were men. The dominance of male interviewees is unsurprising, as, according to an EDB curriculum officer, the male-to-female D&T teacher ratio is relatively high in Hong Kong, with only a few female D&T teachers currently employed.

There were also more males in the student sample. Six boys and one girl were interviewed. Even though more boys opt for DAT at the senior secondary school level, boys and girls have equal opportunities to study D&T at the junior secondary level at schools that offer the subject. This has been the case since the Equal Opportunities Commission advised the Education Department at that moment that the subject should be made available to both genders as discussed in Chapter 1 (Equal Opportunities Commission, 1999; see also Volk, Yip & Lo, 2003). Because the teachers were not restricted to nominating students at the senior secondary school level and also had girls in their teams and classes, the male dominance of the student sample may imply that boys are generally more creative than girls. However, as this is just an initial assumption, and the role of gender in creativity is not the focus of this study, further research is needed to verify it.

In addition to the teachers and students, a government officer from the Curriculum Development Department of the EDB and an officer from the Assessment

Development Department of the HKEAA were also invited to participate in this research. In Figure 4.1 and in this thesis, they are referred to collectively as 'officers'. The teachers and students were able to provide information from the perspective of the implementers and direct beneficiaries of the design curriculum. The two officers were able to provide information from the perspective of those who design, develop and assess the curriculum. Both of these interviewees had experience in D&T.

The interviews with all three groups provided useful data for the later stage of analysis and suggestions about the roles of creativity. Table 4.1 presents information on all interviewees in Stage 4 of the study. Thirteen interviews were conducted with 15 interviewees.

Table 4.1. Information on the teachers, students and officers interviewed

School/Institution/Authority	Teacher/Officer	Student
A	A	Ab, Ag
B	B	-
C	C	Cb
D	D	-
E	E	Eb1, Eb2 (group)
F	F	Fb1, Fb2 (group)
O1	O1	N/A
O2	O2	N/A

Note 1: The student codes are a combination of the relevant code of the teacher and the gender of the student. For example, Ab and Ag are a boy and girl selected by Teacher A respectively. The number in the code differentiates students in the same school. For example, Eb1 and Eb2 are two boys selected by Teacher E in School E.

Note 2: O1 and O2 are the interviewees from the EDB and HKEAA respectively. At the same time, they also represent officers from two departments. The shading thus indicates that they provided data from different perspectives than those collected from schools or other institutions.

4.1.4.2.   Demographics of the Interviewees

After conducting the interviews, some more information regarding their demographics were collected. Teachers' teaching experience, students' learning

experience in D&T and DAT, and their experience in participating and winning championships allow interviews giving validity to the findings presented in the latter part of the chapter. Demographics of teachers and students are presented here; however, due to the anonymity issue, the demographics of the two officers are withheld.

Teachers

Six male D&T teachers were interviewed in the study. All of them are experienced, and they have taught various subjects in secondary schools. Figure 4.2 and Table 4.3 below show the year of teaching and the subjects that they have ever taught in their teaching life.
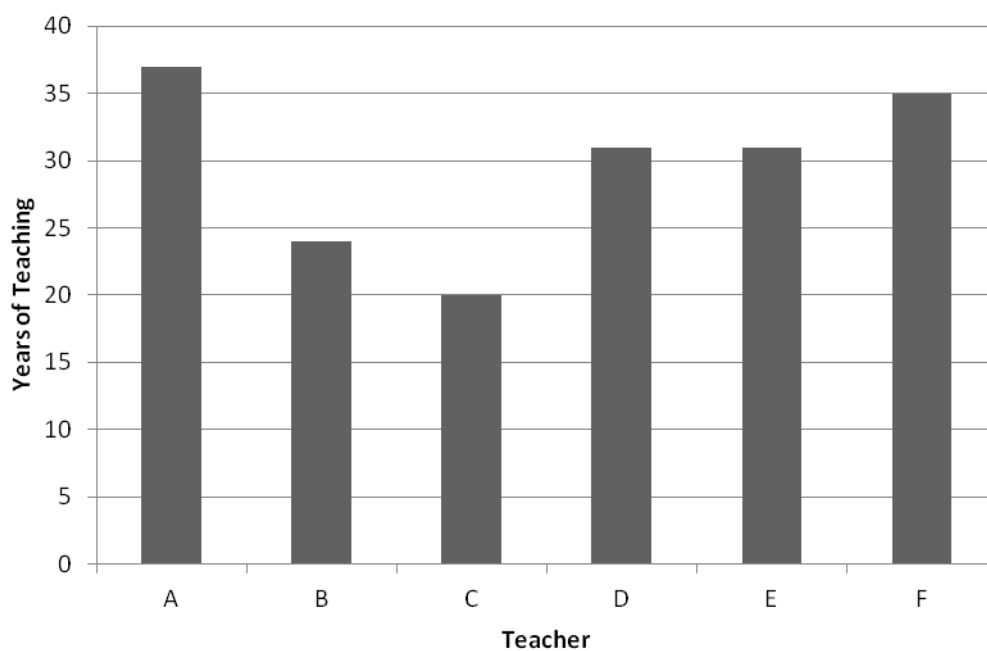
Figure 4.2. Teaching experience of Teacher A to F

Teacher with the least teaching experience in the study is Teacher C, who has 20 years of teaching in D&T related subjects. Most teachers in the study have over 30 year of teaching experience. Their experience in participating and winning

championships in different competitions and teaching D&T in schools should allow them to provide sounding opinions on creativity in D&T in the interviews.

Table 4.2. Subjects (only those related to D&T) that Teacher A to F ever taught in school

Teacher	D&T	DAT	Metal-work	Wood-work	Technical drawing	Graphic Communi-cation	Technology Fundamental
A	✓			✓			
B	✓						
C	✓	✓	✓		✓		
D	✓			✓			
E	✓	✓	✓	✓	✓	✓	✓
F	✓	✓	✓		✓	✓	✓

In Table 4.2, it is obvious enough that teachers involved in the study have experienced the evolution of D&T from its precedent in 1980s. Most of them have been teachers of metalwork or woodwork before. Even though Teacher B has only taught D&T before, he has also studied Metalwork, Woodwork, and Technical Drawing in his teacher training. Currently, except D&T and DAT, all other subjects in Table 4.2 are extinct in Hong Kong secondary school curriculum. These teachers should be able to provide insightful comments on creativity from multi-directional perspectives in the interviews.

Students

Seven students were interviewed. One of them is female and others are male. Only two of them (Students Fb1 and Fb2) study DAT among the four senior secondary school students. The youngest student is Eb1 who is studying at secondary 2. Table 4.3 shows the demographics of the students.

Table 4.3. Demographics of the students interviewed in the study

Student	Gender	Secondary Level	Studying DAT?
Ab	M	S. 4	✘
Ag	F	S. 3	N/A
Cb	M	S. 4	✘
Eb1	M	S. 2	N/A
Eb2	M	S. 3	N/A
Fb1	M	S. 6	✔
Fb2	M	S. 6	✔

Note: For the code of the students, please refer to Table 4.1.

All students have the experience of learning D&T and participating in different competitions related to creativity. The competitions are:

- Odyssey of Mind (International creative competition held in US);
- RoboCup (International robotics competition held in different place each year);
- VEX Robotics Competition (International robotics competition held in US);
- World Robot Olympiad (International robotics competition held in different place each year); and
- Hong Kong Youth Science and Technology Invention Competition (Competition held in Hong Kong by Hong Kong New Creation Cultural Association).

Even though some students are relatively young (S. 2 and S. 3), they were able to provide comments on creativity based on their D&T and competition experiences. As some of them have participated in international competition, they have witnessed creativity from different countries. Their responses to the interview questions should contribute to the study.

4.1.4.3. Data Collection Method

Interviews were used for the data collection in Stage 4 because they are the most common and effective means of extracting opinions (Fontana & Frey, 1994). All interviews were semi-structured, as this design allows interviewees to express their opinions "in a relatively openly designed interview situation than in a standardised interview or a questionnaire" (Flick, 2009, p. 150). This type of interview also guarantees a certain level of validity by allowing questioning and answering. The interviews were guided by interview guides which consist of a list of questions. However, sometimes the questions in the interview guide may not be always followed. Some of the interviews were interviewee-directed, and in some cases the interviewer asked questions prompted by an interviewee's responses (Bryman, 2008). The interview process was kept flexible to allow the interviewees to express themselves freely and openly.

The interview questions in the initial draft of the interview guide were designed based on the 4P's, i.e. output, process, person and environment. Questions which are related to interviewees' implicit theories, such as whether creativity is an acquired ability, are included. Since D&T is the context of the study, there are some questions about teaching and assessing creativity in D&T, how they connect creativity with D&T, and how the school environment facilitates the cultivation of creativity in D&T. It is hoped that the questions are able to collect abundant data regarding interviewees' perceptions, understandings and experiences in creativity and creativity in D&T.

A pilot interview was conducted with one secondary school teacher using the initial draft of the interview guide. One pilot interview was considered sufficient because the purpose of the pilot interview is to spot questions which are easily misunderstood. After modifying the interview guide based on the pilot interview, it is believed that more pilot interviews may not contribute further to the precision of the interview guide. Other minor adjustments to the wordings of the questions are made based on the backgrounds and understandings of the target interviewees in the subsequent semi-structured interviews. Besides, it is noted that there was no student pilot interview, as the interview guide for students was modified based on the guide for teachers. The questions for teachers were rephrased to fit the student context. The

interview guide for students was also sent to or viewed by the students' teachers before the student-interviews were held.

The results of the pilot interview and also the subsequent interviews with some of the teachers revealed that it is difficult to answer abstract questions such as 'What is creativity?' or 'What elements do you think a creative product should possess?', particularly at the beginning of an interview. The question list was thus modified to begin with questions related to concrete experiences, for example, 'Have you ever received any creative artefacts from your students. If so, please describe them'. This kind of question revealed data on the teacher's experience and helped him to feel more comfortable about answering abstract questions later.

Two different interview guides were used for both teachers and students in Stage 4. Two specific guides were designed for teachers and students who had participated in competitions, and these guides included more questions related to competition experience. The questions were phrased to fit the teacher or student context as appropriate.

The questions in the interview guides for teachers and students were divided into three parts covering their own experience, the literature, and the relationship between creativity and D&T. Both groups of interviewees were asked to reflect on their own experience and views, and also to share what they had observed in their class or team. The teacher and student interview guides are presented in Appendix I and II, respectively.

The questions for officers addressed the roles of creativity more directly. As both had more experience in this context, they were expected to be able to provide a bird's eye view. Both were also highly educated, and it was thus believed that they would be capable of dealing with more abstract questions. The questions for the officers were in English (see Appendix III).

All interviews were recorded and transcribed for analysis. Unlike Stage 3, Stage 4 included no analysis. Analysis of the Stage 4 data was left to Stage 5, in which the roles of creativity were also identified.

4.1.5. Stage 5

As noted, the data collected in the interviews in Stage 4 were analysed in this final stage of the research. A thematic approach was adopted in this analysis. Transcripts of the interviews were first coded with the help of NVivo computer software, as coding is the common starting point in most qualitative data analysis (Bryman, 2008). Because the initial coding was often loose, secondary coding was performed to organise the data in a more systematic manner. NVivo was very useful in coding the transcript content into different coding categories. Connections between the Stage 3 and 4 findings were also made at this stage.

The ultimate goal of coding in this study was to identify emerging themes that describe the roles of creativity in design education. The Stage 5 thus identified these roles on the basis of the Stage 4 findings. Issues related to creativity in design education were also consolidated, and suggestions for what teachers and educators should be aware of in addition to creativity were formulated. These suggestions were given to teachers to help them to successfully foster creativity in the design classroom. The roles, issues and suggestions identified also provided guidelines for teachers and education in monitoring and assessing creativity in design education.

4.1.5.1. Code Categorisation

Interview data from teachers, students, and officers were coded. Even though a different interview guide was used for officers, all the interview data were coded in the same set of coding categories. Officers sometimes might also lead the discussion to other topics in the interviews. Some of these topics overlap with the topics mentioned by teachers and students. Consequently, using the same set of coding categories for teachers, student and officers should be more practical in the data analysis.

After the initial coding of the interview data, 146 coding categories were identified. The coding categories were reviewed and eventually condensed into 21 coding categories with some sub categories. The 21 categories are:

- After creativity
- Assessment
- Competition
- Creative activities in school
- D&T and creativity or creative education
- Definition of creativity
- Emotion
- Environment
- Facts
- Importance of creativity
- Important element of D&T
- Issues in D&T
- Learning to be creative
- Others
- Output
- Person
- Prerequisite of creativity
- Process
- Regarding D&T
- Related to other subjects
- Teacher-student interaction

A large amount of data was collected from the data collection process through interviews. Some data addressed the topic and some might not be useful for the study at all. The most importance in the data analysis is to sort out the data which correspond to the research questions and are useful for the study. Consequently, only some of the coding categories which are related to the research questions and the roles of creativity are presented in this study.

4.2.   STRENGTHS AND LIMITATIONS OF THE STUDY

This study has some strengths and limitations. The strengths and limitations are summarised as follows.

4.2.1. Background and Theme

The study is significant because of the context of Hong Kong and its educational systems. There are many issues of creativity education and also design education in Hong Kong that have not been examined. This study has its strength in providing knowledge and understanding towards creativity in design education.

Given the points of view discussed in the introduction, it is clear that design education and creativity education are beneficial to the future development of our society and the world. However, it can be argued that even though it is the best for design education to cultivate students' creativity, whether creativity should only be cultivated by formal education in secondary school is open to question. Other kinds of education or other activities may also be able to cultivate creativity among students.

Besides, the theme of creativity and design education in this study may also impose limitations to the research. Even though the term creativity is well known by people worldwide, its research and research of creativity education are still at their early stage compared with many other academic disciplines such as educational psychology. Similarly, in spite of the long history of design education, its research may not be extensive as other school subjects such as languages. Many concepts in creativity and design education have not yet come to concrete theoretical conclusions. This may limit knowledge construction in this research.

4.2.2. Objectives

In the five objectives stated in Section 1.6, creativity in design education was examined through the perspective of the 4P's. Some practical issues related to creativity were also addressed, and shifts which could help teachers in fostering creativity in design education were suggested. Creativity roles and related issues were also identified. It is fairly exhaustive that many topics regarding creativity in design education were covered. However, there was still a limitation.

Due to the excessive coverage, the responses to the issues of creativity roles were not included in the objectives of this study. It is due to the fact that the issues are related to many factors that relate not only to the discipline of education, but also to disciplines like psychology and anthropology. Such a broad analysis is not ideal for this kind of educational study. The objectives were limited in not providing ultimate solutions to the issues.

4.2.3. Scope

The study used Hong Kong as a case to understand and identify creativity and its roles in design education. Even though this seems appropriate, it limits the perspectives of the data collected. International or regional perspectives on the roles of creativity are lacking. The study would have been more holistic if more interviews had been conducted in other East Asian cities and Western countries.

This study was confined only to design education and D&T. Even though investigating creativity in design process and design education is more fruitful and purposeful as of the similarities between the design process and creative thinking process, the study of creativity can be extended to other subject areas and activities such as visual arts, performing arts, and music. This may reveal more about creativity, and the information collected from other areas may contribute to creative and design education. Group creativity may be more important in these discussion areas compared with this study of design education.

In addition, the study only focused on the secondary school level. This limits the applicability of the research findings and frameworks, as curricula and teaching

practices may differ at different levels. More interviews could have been conducted at the tertiary and/or primary education levels to overcome this limitation.

4.2.4. Literatures

The study reviews various western literatures in discussing creativity and design education. However, the interviews were conducted in Hong Kong, and some of the research results are specific to East Asian countries only. Understanding creativity in East Asian countries through a western perspective is a limitation. It can be argued that using more literatures in East Asian context should be more appropriate in this research. Yet, literatures regarding the creativity definition and design education in East Asian contexts are limited. Even though some curricula of East Asian countries, such as the curricula of Singapore and Mainland China, are also discussed, it may not be enough for an East Asian research study like this.

4.2.5. Methodology

The study used a qualitative research method. Interviews comprised the major method used to examine creativity and collect opinions from teachers, students, and officers in Hong Kong. Even though interviews are effective for extracting opinions (Fontana & Frey, 1994), other methods can also be used to assist and compensate the data. For example, classroom observation may be used to examine how creativity is being fostered in classrooms. Understanding real interactions between teachers and students could assist in analysing the data collected from interviews. However, the research design used in the study is suitable in answering the research questions.

Besides, teachers and students with previous creative experience were invited to be interviewed in this study. The subjects selected for the study is appropriate. However, the number of interviewees was limited because of the nature of the research and the number of researcher involved in the study. Besides, the interviewees provided data which primarily contributed to the discussion of promoting creativity in design education. However, data reflecting the issues of neglecting creativity in real settings

were not addressed. The data set would have been more complete if teachers and students with no creative experience had been involved. As they have not or seldom experienced creativity, their opinions may be useful in investigating classrooms without creativity. Comparison between classrooms with and without creativity could be made to make the roles of creativity more explicit.

Furthermore, only one researcher is involved in all data collections and data analyses in the study. Analysis of Hong Kong newspapers in Chapter 5, design projects and the pentagon models of design artefacts in Chapter 6, and interviews findings and its analysis in Chapter 7 and 8 are carried out by the sole researcher in the study. Even though this may ensure the internal reliability of analysis, this may also limit the objectiveness of the study.

4.2.6. Findings

This study is rather explorative. It does not tend to prove any hypotheses or generalise any phenomenon. On the contrary, it explores the situation and roles of creativity in design education. An explorative study like this may not be able to extend its research findings to any theories which explain a general phenomenon. Some findings in the study may not be applied in all settings even with similar East Asian contexts. Further extensive quantitative research may be needed so that the findings can be generalised. Therefore, suggesting potential issues is more important than generalisation in this study.

Besides, it is noted that in the Chinese history there are many creative writers, poets and artists. The argument that Confucian education may have detrimental effects on the cultivation of creativity in this thesis seems a bit over generalisation. However, the argument here refers to the effects to the typical secondary school students nowadays but not any particular creative individuals. The argument does not mean to deny the possibilities that creative persons can be found under Confucian education.

However, the study has a strength that the data sources are rich, and from the interviews many useful data can be extracted to understand interviewees' perceptions on creativity and the 4P's.

4.3.   CONCLUDING REMARKS

This chapter provides a comprehensive description of how the research for this thesis was conducted and the strengths and limitations of the study. The structure of the thesis is also outlined with reference to the study's five stages. In sum, a qualitative research approach was adopted. The history of and issues related to design education in Hong Kong were first examined, followed by a review of related topics in the literature. The literature suggests that creativity is often approached from the perspective of the 4P's, i.e. person, process, product and press (environment) (Rhodes, 1987), and the 4P's thus guided the subsequent stages of data collection. The data collected from newspapers, a government website and public examination papers primarily further the understanding of the environment and product of creativity. The interviews with officers, teachers and students are related to the 4P's as a whole, but are particularly relevant to the person and process. All of the data collected were coded using a thematic approach, as it is believed that coding categories and themes are useful in identifying the roles of creativity in education and related issues.

Besides, there are some limitations in the study which restrict the research findings and also confine the research area. First, though this study answers the research questions, it does not suggest corresponding solutions to the issues of creativity, which would excessively enlarge its coverage. In addition, the study investigates only D&T at the secondary level in Hong Kong. This limits the applicability of the research findings to a certain extent. The major method used and the interviewees involved in the study could also have been extended to make the data more complete. Also, this explorative study does not tend to prove any hypotheses or generalise any phenomenon.

At the same time, there are some strengths of the study. The context where the study is situated contributes to the significance of the study. The research design is suitable in answering the research questions posted in Chapter 1. The interviewees selected in the study are appropriateness that they can provide meaningful data to the research. Last but not least, the data sources are rich that are able to provide useful data in examining interviewees' perceptions on creativity and the 4P's.

Middleton (2006) stated that "using the correct research tools is as important to achieving the research aims for technology education as researching the right topics" (p. 54). It is believed that the research methods adopted in the study suit the research topic, and are thus also able to achieve the study's aims and ultimately benefit design education.

Chapter 5

A Review of Creativity in Hong Kong Society

Much has been discussed in the context of creativity from the literature. The literature reveals how researchers understand creativity from different perspectives. However, the understanding of the researchers might not be the same as that of the society. This chapter provides a general understanding about creativity in the society of Hong Kong. It examines how the society perceives creativity. The newspaper was chosen to be investigated for Hong Kong society because it is one of the major communication media.

5.1. RESULTS AND ANALYSIS

From Chapters 2 and 3, it is clear that many researchers also found that there is a close relationship between design education and creativity. In recent years, theories regarding learning and teaching creativity proliferated. However, it seems that both society and design education are not enjoying the benefits of the research results. Under these circumstances, this section aims at finding out how our society perceives creativity in newspapers, so that the study at the later stage can acknowledge the needs of Hong Kong and also the East Asian cities or countries.

Based on the research method described in Chapter 4, results and analysis were depicted in this section. Eighteen newspapers were found having the keyword

appeared. In total, 268 news stories were extracted; only 135 of them involved ideas were associated with creativity. The rest of them gave no hints about any concepts on creativity. On average, there was one creativity news story each day, which suggests that creativity is an important issue for Hong Kong Chinese newspapers.

5.1.1. Distribution

About thirty-six percent of the news stories (48 out of 135 news stories) was from the three newspapers which have the highest credibility rated by readers (newspaper B, F, and A) among all Chinese newspapers in 2009 (Center for Communication Research, 2010b). About thirty-three percent of the news stories (44 out of 135 news stories) was from the three most popular Chinese newspapers (newspaper D, C, and B) in Hong Kong (Guo et al., 2008). Table 5.1 shows the frequency of the keywords appeared in each newspaper, and the corresponding credibility and popularity of the newspaper.

Table 5.1. Frequency of the Keywords Appeared, Credibility and Popularity of the Newspapers Involved in the Study (Extracted from Center for Communication Research, 2010b; Guo et al., 2008)

Newspaper	Frequency of the Keywords Appeared	Credibility Rated by Readers (1= Highest Credibility)	Popularity (1= Most Popular)
A	21	3	5
B	17	1	3
C	15	9	2
D	12	12	1
E	11	15	N/A
F	10	2	6
G	10	16	4
H	6	13	N/A
J	6	4	7
K	5	6	N/A
L	5	11	N/A
M	5	7	N/A
N	3	5	N/A
P	2	10	N/A
Q	2	8	8
R	1	N/A	N/A
S	1	N/A	N/A
T	1	N/A	N/A

In the five most popular newspaper, the keywords appears at least once a day on average, and in the newspaper A, the words appear three times a day on average. Besides, in the news stories, whenever an individual produces something worthy of attention, they are said to be creative or to possess creativity. These suggested that the word 'creativity' and 'creative' were over-used. Some news stories did not explain implicitly or explicitly why a person or an idea is creative, and a few of them even used the world blindly (Wong & Siu, 2010). The following paragraphs summarise the concepts associated with creativity in Hong Kong society as seen in newspapers. The ideas vary, and some of them are opposed to each other.

5.1.2. Concepts associated with creativity

Novelty: In most of news stories, as in the literature, novelty might seem to be the essential element in creativity. It is not surprising to find that some ideas that have been given a new interpretation, a new application, or a modification from the old ideas are considered to be creative. However, in the newspapers, the interpretation of 'novelty' might deviate slightly from its original meaning. The judgment whether something is novel depends on the knowledge and perceptions of the observer (e.g. The Sun, 2010, March 27). That means if the observer or the news writer has never seen or heard of an idea before, the idea might be considered new and sometimes creative, regardless of human history and the individual who generated the idea. On the other hand, if the observer has a wider knowledge and experience, the same idea might not be considered creative.

Appropriateness: The concept of appropriateness, the other key element of creativity in the literature, varies greatly, as it largely depends on how the purpose is defined in generating an idea. Some 'creative' ideas are obviously very appropriate and useful for solving some problems. However, some ideas that were also regarded as creative might not be lucid enough in their appropriateness and usefulness, as the context in which the idea was generated is not explicit or definite enough (e.g. The Sun, 2010, March 23). Also, sometimes an idea needs not to be objectively appropriate or useful in order to be considered creative, for example when it seems appropriate or useful subjectively with respect to the individual who generated the idea (e.g. Apple Daily, 2010, March 22). Sometimes it is unknown by how the 'creative' idea is appropriate for the individual, as the ideas which are regarded as creative might not aim at solving a particular problem (e.g. Metropolis Daily, 2010, March 23).

Freedom: In newspapers, creativity is always associated with freedom. For instance, giving blank paper for children to draw whatever they want will foster children's creativity (Ming Pao Daily News, 2010, March, 21). Letting children add any toppings they like onto a cup cake will develop creativity of the children (am730, 2010, March 24).

Limitation: Constraints and limitations dampen creativity. For example, some organisation complained that the government has failed to provide sufficient resources and performance venues, and this kill creativity (Sing Tao Daily, 2010, March 23a). However, creativity can help creators work beyond these constraints and limitations. Creativity has no boundaries. For example, a creator believes that creativity exists when an individual has successfully evaded a boundary, which is called 'thinking outside the box' (Sing Tao Daily, 2010, March 23b).

Bravery: To be creative might sometimes require bravery, as creativity implies breaking away from or overcoming a boundary. For example, a journalist believed the braver an individual is in trying on the things no one has tried before, the more likely the individual is able to generate new creative ideas (Sing Tao Daily, 2010, March 25c).

Sarcasm: Sometimes saying that an idea or an act is creative might be sarcastic in Hong Kong society. For instance, while commenting on the production of a food product using inedible ingredients, the producer was said to be 'creative' (Oriental daily News, 2010, March 21). Using the word 'creativity' sarcastically did not deny the novel aspect of the food, but instead is sarcastic about the immoral act of the producer. Also, this notion also highlights the originality and minimal possibility of success with an ironic meaning.

In-born talent: Creativity is an in-born talent that cannot be fostered or developed. Any efforts to foster creativity might be unconsciously detrimental to creativity (Sing Tao Daily, 2010, March 25c). What we need to do is not to foster creativity, but to try not to dampen creativity when children are still young.

Learned ability: Creativity is not an innate talent, and it can be learned and developed (Sing Tao Daily, 2010, March 25a). What we should do is to guide and develop children's creativity.

Ability of a group of people: Creativity is regarded as the natural ability of children and adolescents in general (e.g. Ming Pao Daily News, 2010, March 27; Wen Wei

Po, 2010, March 24). Adults are seldom regarded as creative unless the individual is able to produce some artwork or a creative idea.

Diligence: In-born talent alone does not explain an individual's creativity. The individual also has to be hard-working in order to be creative. Hardworking has been seen has one of the elements of being creativity (Sing Tao Daily, 2010, March 25b).

The 'null' origin of creativity: Creativity is regarded as generating or developing something without any basis. For instance, an actor commented that a groundless news report is creative. (Headline Daily, 2010, March 23).

Prior knowledge: Creativity is associated with prior knowledge and past experience. Knowledge and experience are beneficial to being creative. For instance, a journalist believed that the creativity possessed by an artist is closely related to the previous attainments in art (Sing Tao Daily, 2010, March 25d).

Meaninglessness: Some journalists commented on ideas or objects as creative but some other people might call the same ideas or objects as meaningless. For instance, a journalist commented that the invention of the category names of different type of men in the society was meaningless, whereas some others thought it was creative (am730, 2010, March 23).

As the study of newspaper clippings is a kind of explorative study on how society perceives creativity in mass media, the quantity of the newspaper clippings or the frequency of a particular concept related to creativity appeared might not be the most important issues (Wong & Siu, 2010). Also, these concepts are believed to be just a part of the societal perception towards creativity. However, some of them are worthy of discussion.

5.2. DISCUSSION

The newspaper clippings offer an over-simplified view of creativity. They suggested that anything that is different must be creative, which is a very different approach to academic discussions.

5.2.1. The two major elements

In the newspaper clippings, usefulness and appropriateness were seldom addressed. One possibility in explaining this issue is that most people take appropriateness in creativity for granted. However, in view of the over-use of the term 'creativity', this possibility might not be true of writing in newspapers. A more possible explanation is that most journalists understate or sometimes neglect the significance of appropriateness when they are discussing a creative idea. Whether they are ignorant or unmindful, this inattention to the appropriateness dilutes the meaning of 'creativity' in newspapers.

Sometimes creativity was used sarcastically. The idea or the act that is described as 'creative' might only be purposeful from the perspective of the individual who generates the idea. However, from the perspective of other people, the idea or the act might not be appropriate. These sarcastic uses of the term 'creativity' highlight the importance of objectivity in assessing appropriateness in creativity. Also, if the purpose of a new idea or act is not widely accepted as appropriate and useful in a specific group that holds common knowledge and beliefs, some might regard it as meaningless, even though others might still use the term 'creative' in describing the idea. The objectivity of appropriateness is crucial in determining if something is really creative, or whether it is just a case of using the word 'creativity' as sarcasm or to indicate meaninglessness.

As mentioned in the earlier section, appropriateness and usefulness vary with the objectives and purposes. A more specific definition has to be given to the objectivity element of creativity, as appropriateness is, to a certain extent, subjective to individuals. Especially when the context where the idea is generated is not a definite problem that must be solved, it is more difficult to assess appropriateness. It might not be possible to assess appropriateness directly by applying structured steps and

procedures in a complex context such as artistic creation or expression if objectivity is concerned. Perhaps different ways of categorising creativity have to be employed in resolving this issue.

The other element of creativity, novelty, requires objectivity in defining which idea is new. From the newspaper clippings, novelty is often determined by the observers and the journalists. This can be regarded as subjective novelty. However, the literature indicated that objective novelty, either H-creativity or P-creativity developed by Boden (2004), is more relevant to the creativity we calling for. The subjective novelty which depends on a third party is not reliable in describing creativity, as experience and knowledge vary among individuals.

This subjective novelty might explain why creativity is over-simplified by newspapers. As 'creativity' in newspapers is determined by subjective novelty, and it is the fact that each individual has limited knowledge and experience, everything can be regarded as 'new' if creativity is determined only by an individual and that individual does not have adequate knowledge. If, as in the newspaper clippings, appropriateness is neglected, any idea can be called 'creative'. However, in assessing novelty, subjective judgment is inevitably taken into account, as it is difficult for ordinary people to assess novelty and originality, and no one is able to ignore the subjective judgment when an idea first comes to the sight. Howard et al. (2008) commented that this can only be done by a field expert who can provide a more objective comment based on a thorough knowledge in a certain context (also see Necka, 2003).

The discrepancies in the two elements of creativity between the newspaper clippings and the literature highlight the need for objectivity in assessing creativity. What is at issue in the literature is no doubt a more sophisticated way of defining creativity. However, this is not the only discrepancy found, and there are also some other issues worth discussing.

5.2.2. The possibility to learn and teach creativity

In the research, there seemed to be general agreement that creativity can be taught and learned. Some of the clippings agreed with this approach, but some disagreed. As creativity researchers had experimental findings indicating success in fostering students' creativity, the notion that creativity cannot be fostered seems to be a common misconception about creativity. However, there are bound to be some children who are very creative from their first day of school, even if the majority of teachers are not able to foster creativity (Ng & Smith, 2004). Regardless whether their creativity is an innate talent or developed under some special conditions, a more interesting question is how we should re-foster and redevelop creativity if it is ever dampened in their past experience. Redevelopment might not be the same as fostering creativity in a normal way, in that more concerns have to be considered.

5.2.3. Diligence

Furthermore, it is interesting to observe in the clippings that people believed diligence helps developing creativity. As Hong Kong is a Chinese society, diligence is emphasised as a virtue and widely accepted as a positive value in judging if a student is 'good' or not. The connection between creativity and diligence might be due to the blind belief that being diligent is beneficial in all aspects of study. However, the point of diligence might be related to one of the pathways which lead to creativity. As De Dreu et al. (2008) believed that creativity can be achieved through the pathway of perseverance if the individual is associated with activating negative mood. Also, it might be possible that creativity and diligence is connected based on the necessity of adequacy of prior knowledge (see Howard-Jones, 2002). There is no clue to finding if it is a meaningful and conscious connection or just a chance matching in the newspapers.

5.2.4. Antecedents

In addition, the idea that creative ideas are originated from a 'null' entity is arresting. It may reveal something in the nature of creativity that is distinct from intelligence. Even though every idea has an origin and can be traced to its antecedents, creative

ideas possess a novelty that stops people from identifying the antecedents (Kaufmann, 2004; Peterson, 2002). If the antecedents involved in the idea can be easily noticed, the idea might only be considered as 'intelligent' rather than 'creative'. The 'null' entity used in describing creativity in the clippings precisely hints the relationship between antecedents and the creative idea.

Other concepts extracted from the newspaper are quite compatible with the literature. They are of the same importance as other issues discussed earlier in identifying different means of fostering students' creativity in design education.

5.3.   IMPLICATION FOR DESIGN EDUCATION

The news stories provided different concepts about creativity and extent the understanding of the usage of creativity in daily life. Some concepts in the news stories might not be mapped perfectly to the knowledge in the creativity literature, as what are understood by ordinary people are more diverse and distinctive. This explicates that the literature only tells what creativity is, but not able to give an idea what creativity is not. This is essential in understanding creativity, as it might be one of the ways to tell where intelligence ends and where creativity starts in the spectrum of novelty, and explain what creativity truly is.

Some kinds of 'creativity' in the news stories might not be advantageous in solving problems. Some concepts extracted from the newspaper clippings might be inappropriate in a lesson about fostering the beneficial creativity. It is very possible that teachers and students receive these concepts from reading newspapers and bring them to the classroom, as those newspapers that mention creativity are the more popular ones (Wong & Siu, 2010). Under this circumstance, there are some issues that teachers have to be cautious in teaching creativity in D&T classrooms.

5.3.1. Assessment of creativity

In assessing the creativity of students' designs, or commenting on students' creativity in a project, teachers should be cautious in giving subjective comments on novelty and appropriateness of the design. Subjective comments on novelty and appropriateness as reported in the news stories should be avoided. As teachers are adults who have a richer life experience and knowledge, it is very difficult for the majority of students, most of them teenagers, to create ideas that exceed teachers' knowledge. If assessment is done subjectively, probably everyone will be de-motivated from working on creative ideas. This implies that teachers should assess students' P-creativity objectively (see Boden, 2004). P-creativity is also the major concern in education with respect to the H-creativity. Assessing P-creativity does not involve competition with others, and is more important in fostering creativity, as competition may be detrimental to creativity (Howard-Jones, 2002).

Novelty should be assessed with respect to the individual. However, appropriateness should be assessed in a broader sense, which implies that is widely accepted by other people. In order to implant the idea of objective appropriateness in students' learning, teachers can form a team with other staff or involve more students in assessing design ideas. By inviting more people to assess the appropriateness of ideas, students in subsequent projects should be able to address different needs of different people or groups, and hence optimise their design ideas.

5.3.2. The ability of association

Also, students have to learn that in order to be more creative, they must be able to associate the design problem with other knowledge. The more remote the knowledge is, the more likely it is that others will not be able to link the idea with its origin, so that the idea is considered to be more creative (Howard-Jones, 2002). Creative ideas are not originated from nothing, but they have their origins in something that other people did not or cannot think of. Teachers have to encourage students to pay attention to their surroundings and absorb different kinds of knowledge whenever possible.

5.3.3. The Role of Teachers

As mentioned earlier, students may perceive creativity wrongly from reading newspapers and bring what they learned from news stories to the classroom. D&T teachers should be aware of the discrepancies between the beneficial creativity and the creativity that Hong Kong people use in the newspapers. They have to understand that the creativity that design educators are calling for is the beneficial creativity which is able to do goods for human beings. They should also teach the concept of beneficial creativity to their students so that students could have a better concept towards the topic of creativity. Otherwise, students may not understand creativity correctly and thus create something which is not creative. Teachers have the responsibility to direct students to cultivate the beneficial creativity instead of others.

Besides, teachers are encouraged to identify students whose creativity has become dampened. More assistance and guidance might be needed to rebuild their creativity, as support from teachers is important in classroom (Pianta and Hamre, 2009). Teachers also can assign group project for students so that students whose creativity is suppressed can feel more secure in taking risks (Austin, 2009). However, teachers should go beyond conventional beliefs about education, as these traditional beliefs might be detrimental to creative thinking.

In cultivating students' creativity, there is always a doubt whether a fixed route or a non-creative way of teaching is successful in teaching for 'creativity'. Teachers are not computers that are only able to follow steps and procedures thoughtlessly. They have professional judgment when they deal with certain situations or students. They should be aware of their implicit theories (Dow, 2004) in relation to their professional knowledge and creativity skills when teaching for creativity, so that creativity can be successfully developed among students in different learning environments and settings.

5.4. CONCLUDING REMARKS

This section reveals how society understands creativity by analysing perspectives found in popular newspapers. The benefits of creativity research are not yet widely enjoyed by either society or design education. This is clear from the newspaper clippings, in that discrepancies can be identified between the literature and the concepts perceived by journalists. Some of these concepts might not be conducive to the cultivation of creativity in design education classrooms. The section offers some suggestions for design education in order to optimise the situation and fill the gap between research and the real world.

The world is calling for creative solutions to solve new and complicated problems. However, it seems that society is satisfied with a vague and ambiguous definition of creativity. This acceptance of ambiguous 'creativity' does not contribute to training more creative elites in solving problems. On the contrary, this will only, to a certain extent, hinder the development of creativity at a societal level. Consequently, it is important for design education, which is believed to be the best educational section in cultivating creativity, to induce appropriate concepts and knowledge in the context of creativity. Design education in schools should be the pioneer in training and preparing students to solve problems creatively in the world.

There is no firm route to the cultivation of creativity. However, teachers should pay attention to issues such as the objectivity in assessing the novelty and appropriateness of students' design ideas and the emphasis on the use of existing knowledge in idea creation. Nonetheless, teachers are professionals who are able to judge how to teach creativity in different learning and teaching environments. Given adequate time, and purposeful arrangement and effort, creativity should be successfully fostered in design education classrooms now and in the near future. At present, the question is: How does the current design education in Hong Kong perceive creativity?

Chapter 6

A Review of Creativity in Hong Kong Design Education

It is advantageous to embed creativity in secondary school education (Siu, 2002a). Among all subjects in the curriculum, D&T is probably the very best subject for fostering and cultivating students' creativity, as the subject offers creative activities that enable students to realise their ideas in the context of real world (Eggleston, 2000b; Spendlove, 2005). Creativity can be developed initially in the D&T classroom (Rutland & Barlex, 2008) because the design process in D&T relies on the development of novel, useful and appropriate ideas (Dow, 2004; Feng & Siu, 2009; Siu, 2002a). This chapter reviews how Hong Kong design education perceives creativity from the perspective of curriculum, public examinations, and students' artefacts. Before going further into the discussion, the chapter also discusses issue of creativity in design education of Hong Kong based on a historical perspective.

6.1.   A SHIFT OF HONG KONG DESIGN EDUCATION

The development of design education in Hong Kong over the past century reflects wider social and economic changes. The level of the technological facilities and technological knowledge involved in design education has advanced or declined in accordance with the growth of industry, technology and education in Hong Kong (Siu & Wong, 2011). Based on the progression of design education outlined in

Section 1.4.1, Figure 6.1 depicts the factors associated with such education in an industrial economy.
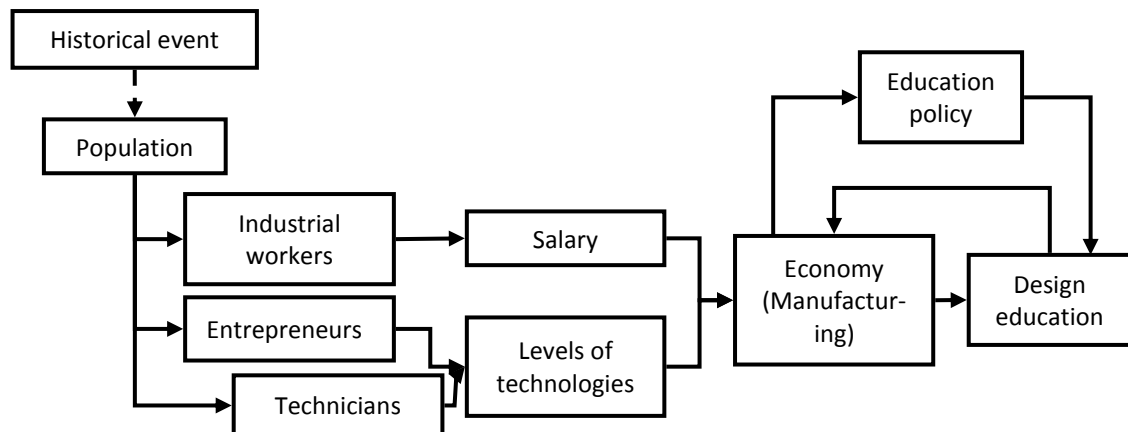
Figure 6.1. Relationship between design education and other factors in the industrial economy of Hong Kong before the 1980s (Siu & Wong, 2011)

Figure 6.1 shows that, in the history of Hong Kong, a historical event may affect the population, even though the relationship between the event and the population may not be absolute if other historical events are considered. However, some of the events mentioned in the historical review did directly boost the population of Hong Kong (e.g., it increased by 20.5% between 1949 and 1950 [Nyaw, 1997]). As a result, the numbers of workers, entrepreneurs and technicians increased, and the changes in the populations of these social groups indirectly led to workers' salaries remaining at a low rate (e.g., HK$4.35 per day in 1953 [Nyaw, 1997]) and the level of industrial technologies rising. In addition, per capita GDP increased from HK$1575 to HK$2800 between 1947 and 1953 (Nyaw, 1997). These factors undoubtedly contributed to the development of the manufacturing industry at that time and, hence, accelerated the development of design education. The workforce educated in design was demanded by and, at the same time, a benefit to the economy. Furthermore, the rapid growth of the industrial economy interfered with educational policy making, which, in turn, affected the position of design education in society. The relationship between design education and the economy became more secure prior to the economic restructuring of the mid-1980s.

Figure 6.2 shows that a number of the factors that affected the manufacturing industry ceased to be relevant to the development of design education after the 1980s.

The service sector took the place of manufacturing as the dominant industry in Hong Kong. The relationship between design education and the economy changed, in that the economy now demands problem solvers, not skilled workers. In accordance with the economic changes, the aim of design education changed from specific industry skills training to training in problem-solving skills. The nature of the workforce produced by design education is now very different from that in the past. Design education is still influenced by the technologies used in society and industry, and by the educational policies based on the economic development of Hong Kong, but it is unknown to what extent technology will affect a non-industrial economy. Nevertheless, it is clear that design education had redefined its role in the society since the 1980s. Moreover, the correlations among the factors depicted in Figure 6.2 appear to reflect the current state of Hong Kong society.
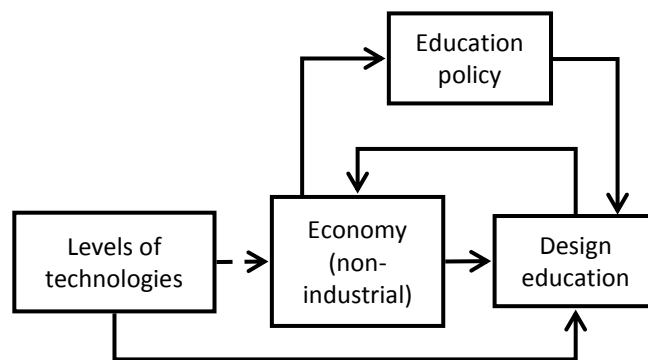
Figure 6.2. Relationship between society and design education in the non-industrial economy of Hong Kong from the 1980s to the present (Siu & Wong, 2011)

The two models depicting the factors relating to the development of design education are based on the case of Hong Kong. The generalisability of these models greatly depends on the historical, economical and cultural similarities between the locale in which the model is applied and Hong Kong (Siu & Wong, 2011).

The foregoing analysis based on the history of design education in Chapter 1 suggests that design education had developed naturally in line with industrial, social, technological, and educational developments. In the past few decades, the design syllabus had been reviewed several times for different historical reasons. Now, D&T is regarded as a subject that enables students to learn about materials, tools,

machinery, the design process, and the manufacturing and fabrication processes of a variety of products through a number of problem-solving activities.

This review of the development of design education in Hong Kong makes it apparent that it has developed alongside the growth of industry and changes in the government policy. However, design education appears to be beginning to detach itself from its relationship with industrial development, due to the economic restructuring of Hong Kong. It is believed that as design education is no longer limited to operational knowledge and the acquisition of skills, greater attention needs to be paid to the broader sense of technology, that is, to the history of technological development, the impact of technology on society, human civilisation and the environment, the ethical issues related to technology, and more importantly the problem-solving skills (Siu & Wong, 2011). In this regards, the emphasis of creativity becomes crucial. The current design curriculum in Hong Kong also emphasises the cultivation of creativity and innovation. However, it is uncertain if creativity is valued in the implemented curriculum. The next sections in this chapter discuss how design education perceives creativity in practice from the perspective of design projects in Hong Kong.

6.2.   DESIGN PROJECTS IN DESIGN EDUCATION

Students need to finish several tasks, such as identify a problem, research on relevant materials, suggest possible solutions to the problems, realise the chosen solution, make the artefacts and evaluate it in a project. Project work is inevitably one of the essential features in design education and curriculum. It can be argued that in design education, project work is assumed to be the major assignment that students need to work on. Drain (2010) and Mioduser and Betzer (2007) also believed that project-based learning is also recommended as one of the promising pedagogical approach for teaching technology and design.

Unlike the project-based learning in other subjects or at university level that students need to take the initiative to develop and identify a question or a problem, in the design classes at the secondary school level teachers are supposed to provide a

project title with a design brief for students. The design brief describes explicitly what kind of product or artefact that students have to make in a given period of time. This practice seems nearly natural and indubitable in the design classes – teachers and students would probably accept it without any questions. The silent consent on doing a project in design classes between teachers and students is not without any basis. As a matter of fact, the historical background and development of design education is one of the major reasons of the silent consent.

Because of the history of design education, unsurprisingly, the majority of the activities were to produce craft work in solving a real life problem. Activities now in design education, which are very similar to the antecedent, always have a real life purpose, for example, designing and making a device or an object to solve a problem. The teaching and learning style was very similar to the apprenticeship that the industry was practising. The act of making an object to solve a problem had naturally developed to the projects practice in current design education.

In recent years project work in design education has been developing some new directions that it is significantly differentiated from the traditional project work in the past. For example, distinct from the design-and-make projects, there are some educators who advocate design-without-make project (Barlex & Trebell, 2008). Also, the orientation of the nature of the projects which the teacher chooses for students varies. Teachers choose a large variety of design areas in design projects for students. Some teachers would ask students to work on projects regarding interior design, architecture, robotics, control systems, product design, etc. The emphasis of the design projects are also shifting from the product to the process. Portfolio has an increasing importance in the assessment of the design project in design education at the secondary school level. Some of the shifts also apply to the situation of Hong Kong D&T.

6.2.1. Projects in Hong Kong D&T Public Examinations

This section primarily focuses on the D&T projects in the Hong Kong Certificate of Education Examination (HKCEE) over the past five years. The HKCEE are the

public examinations after 5-year of schooling in Hong Kong. It is considered as decisive examinations which determine their future education and the eligibility in studying university preparatory course. However, in the year 2012, the HKCEE is replaced by Hong Kong Diploma of Secondary Education (HKDSE) Examination due to the educational reform in Hong Kong started in 2009.

As D&T in Hong Kong has two different syllabi, each year the Hong Kong Examinations and Assessment Authority prepares two different examinations for those who study the D&T syllabus while the other set is prepared for those who study the D&T alternative syllabus. Two sets of project titles for two syllabi are also set for the students to choose each year. Students have to attempt one of the projects.

6.2.1.1.   D&T Syllabus

The examination of the D&T syllabus consists of three papers. Paper 3 is Project Work, which carries one third of the subject mark. The paper examines students' abilities in solving a specific design problem. Students are expected to spend about 30 to 35 hours for practical work in the project. In the project, students are expected to investigate and analyse a given design problem, write a list of specifications, research and collect data which are related to the problem, develop a range of initial ideas and possible solutions, realise the final solution, evaluate the solution and also the artefact, and present their communication skills along the process (Hong Kong Examinations and Assessment Authority, 2010b).

Besides, in order to illustrate the development of the chosen project, students are required to submit a design folder with the artefact. The design process illustrated in the design folder and the communication and presentation of the project carry 38% and 17% of the project mark respectively. The realisation of the end product (the artefact) carries 45% of the project mark (Hong Kong Examinations and Assessment Authority, 2010a). Table 6.1 below shows the project titles and their popularities in the examination of D&T syllabus from 2005 to 2009.

Table 6.1. Project titles and their popularities in HKCEE of D&T syllabus from 2005 to 2009 (Hong Kong Examinations and Assessment Authority, 2005a, 2006a, 2007a, 2008a, 2009a)

Year	Project Title	Popularity
2005	1. A lawn swing that can swing forwards and backwards	15%
	2. A scaled-done model of a barbecue site to be located near a hill side	44%
	3. A toy that produces sound and makes moving actions when travelling down a slope	11%
	4. A set of traffic signs with a stand which fits every sign	27%
	5. A scaled-down model of an automatic covering system to prevent clothes from getting wet when it rains	3%
2006	1. A model of a water-mill system for a green house	5%
	2. A unit which swings/rocks for a baby aged 1-2	13%
	3. A welcoming device to detect customers at the entrance of a shop	13%
	4. A toy that can move and float in water	29%
	5. A model of a ferry pier to illustrate the use of plants to keep the environment green	40%
2007	1. A 3D universal calendar and stationery holder for a study room	51%
	2. A model of a sculpture park	33%
	3. A device for the visually impaired to detect the level of water inside an aquarium	7%
	4. A lion dancing robot to celebrate the Lunar New Year	1%
	5. A model of a traffic city to illustrate the system of traffic control	8%
2008	1. An interactive display item for Science Museum	12%
	2. A model for a selected historical building/landmark	7%
	3. An adjustable chair and table for children aged 3-8	11%
	4. A set of three pieces of decorative body jewellery	26%
	5. An electronic coin-box for children	44%
2009	1. A model of a puppy garden	43%

2.	A rotating frame for 12 photos	38%
3.	A miniature display model (e.g. HK tea bistro, Chinese tea house, congee and noodle shop, Chinese herbal shop, pawn shop, etc.)	8%
4.	A beach chair for children aged 4-8	11%
5.	A sheet-metal toy for teenagers	0%

Each year from 2005 to 2009, five projects were given to students to choose in attempting the examination. The popularity of the projects varies in each year. It is noted that every year the most popular project attracted more than 40% of students to opt and the least popular project attracted only 0 to 7 % of students. In 2009, the project of 'a sheet-metal toy for teenagers' even had 0% of attempts. Apparently there are some projects which are very popular among the students, and some of them are avoided in the examination. The least popular projects (an automatic covering system in 2005, a water-mill system in 2006, a dancing robot in 2007, a sheet-metal toy in 2009) are associated with higher techniques of technology or more difficult craft skills, except the one in 2008 (a model of historical building/landmark). It is understandable as students tend to attempt projects which have a lower risk. However, it does not imply that projects are heavily technology-inclined. On the contrary, most projects incorporate both the element of technology and design, as projects are under a higher level of examination of D&T in which the two elements should be balanced.

Projects can be categorised into five different areas as shown in Table 6.2. They are special needs, public space, products, system, and others. The more popular projects often fall into the category of public space and products. The categories of less popular projects vary.

Table 6.2. Projects (with simplified titles) in different categories in D&T syllabus (most popular projects are shaded)

Year	Special needs	Public Space	Products	System	Others
2005		Barbecue site	Toy with sound and actions	Covering system for clothes	Traffic signs
		A lawn			
2006	A unit for a baby aged 1-2	Ferry pier	Toy that can move and float in water	Water-mill system	Welcoming device
2007	Device for visually impaired	Sculpture park	Calendar and stationery holder	Traffic city	Robot
2008	Adjustable chair and table for children	Historical landmark	Decorative body jewellery		Interactive display item
			Electronic coin-box		
2009	Beach chair for children aged 4-8	Puppy garden	Sheet-metal toy		Miniature display model
			Rotating frame		

In general, most of the topics of these projects in D&T syllabus are in realistic settings. The project descriptions are very specific, in that they usually referred directly to an existing item or system in the real world. It is very clear to the students what kind of outcome is required in the examination.

6.2.1.2.   D&T Alternative Syllabus

The examination of D&T alternative syllabus established since 2003, and it has a similar arrangement to the D&T syllabus. However, instead of 3 papers, it only has two papers. Paper 2 is Project work, which carries 30 % of the subject mark. The requirement and the mark allocation of the project work is the same as the

examination of D&T syllabus. Table 6.3 below shows the project titles and their popularities in the examination of D&T alternative syllabus since 2003.

Table 6.3. Project titles and their popularities in HKCEE of D&T alternative syllabus in from 2005 to 2009 (originally in Chinese) (Hong Kong Examinations and Assessment Authority, 2005b, 2006b, 2007b, 2008b, 2009b)

Year	Project Title	Popularity
2005	1. A park with fitness facilities	49%
	2. A set of wind chimes/windmills	17%
	3. A pick-up device	34%
2006	1. A sound toy	12%
	2. A model of recycling old batteries	36%
	3. A device for carrying beverages	52%
2007	1. A floating toy	39%
	2. A score display device for table tennis matches	11%
	3. A model of stage design	50%
2008	1. A set of mould for making a photo frame	12%
	2. An instrument for testing mechanical properties of materials	4%
	3. A conceptual model of the redevelopment of a community	84%
2009	1. A home for pet turtle	51%
	2. A teaching tool for teaching technology education	6%
	3. A model of a stadium	43%

Different from the D&T syllabus, in the D&T alternative syllabus, only three projects each year were given to students for attempting the examination. The most popular project attracted about 50% of students. The popularity among projects in each year was quite similar, except in 2008 that more than 80% of students were attracted by the project 'a conceptual model of the redevelopment of a community'. Projects can be categorised into three different areas as shown in Table 6.4. They are product, space, and others. The more popular projects are the category of products and space.

Table 6.4. Projects (with simplified titles) in different categories in D&T alternative syllabus (most popular projects are shaded)

Year	Product	Space	Others
2005	Pick-up device	Park with fitness facilities	Wind chimes/windmills
2006	Sound toy Device for carrying beverages		Model for recycling old batteries
2007	Floating toy	Stage design model	Score display
2008	Instrument for testing materials	Model of a community	A set of mould
2009	Home for pet turtle	Stadium model	Teaching tool

Similar to the projects in D&T syllabus, the projects in D&T alternative syllabus are in realistic setting, and the project descriptions are specific. However, in general, projects in D&T alternative syllabus require lower craft skills and technological knowledge in compared with the projects in D&T syllabus. Nevertheless, the syllabus is still relatively new, and both syllabi are replaced by DAT syllabus in the new Hong Kong Diploma of Secondary Education (HKDSE) Examination in 2012.

6.2.2. Projects on the Government Website

In an effort to examine the current situation of creativity in D&T, exemplar projects and coursework presented on the website of the Education Bureau of Hong Kong were also examined. Forty-six projects and coursework assignments are available for teachers' reference online (Education Bureau, 2007a). All assignments online were designed by D&T teachers in Hong Kong, and all artefacts corresponding to each assignment were completed by students. The researcher examined the teachers' design briefs and exemplar artefacts completed by the students. The following subsections review the projects, and assess the creativity of the artefacts collectively using the pentagon model of the domain features mentioned earlier.

6.2.2.1.   The projects

Unlike the projects appeared in the public examination, projects on the government website could be divided into three categories in terms of the level of technology and design elements involved, as most of them are meant for the junior secondary school level for the purpose of skills training and knowledge acquisition (Wong & Siu, 2012). The three categories are design-oriented, technology-oriented, and un-oriented. The oriented categories refer to those projects in which design or technology is the main focus of learning, while the un-oriented category refers to those which focus on both technology and design, in most cases applying technology to designing an artefact. Two sub-groups of design-oriented projects were identified as design-oriented with realization, and design-oriented without realization. Among all 46 projects, the sub-group 'design-oriented without realization' refers to CAD (computer-aided drawing) projects. Figure 6.3 shows the distribution of the projects into different categories and sub-groups, and Table 6.5 shows the project titles under different categories.
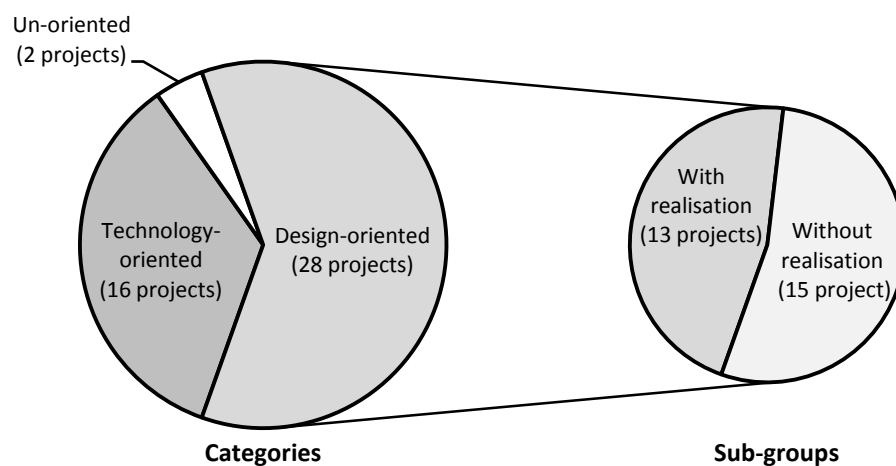
Figure 6.3. Distribution of projects into different categories and sub-groups (Wong & Siu, 2012)

Table 6.5. Example of projects under different categories (not all 46 projects) (Wong & Siu, 2012)

Categories	Projects
Design-oriented projects with realization	Designing and Making: • a stationery stand • a bird house • a menu stand • a notice board • a clock • a key chain • a lamp • a thematic food kiosk
Design-oriented projects without realization	Using CAD to design: • a tray • modern military facilities • interior design • a fishing booth • a clock face • an adhesive tape holder • Chinese architecture • a space shuttle
Technology-oriented projects	Designing and Making: • a bullet car • an environmental-friendly water rocket • a remote-controlled ore collector powered by water pressure • a computer-controlled car • a water-powered plane
Un-oriented projects	• applying pneumatics theory and using its apparatus to design and make a game booth • applying the mechanics of a solar powered flipping device to design • building a scenario that uses Chinese idioms

Similar to the projects in the public examination, most of the topics and the design briefs of these projects are in realistic settings, and the project descriptions are very specific, for example designing *a notice board*, using CAD to design *a clock face*, designing and making a *bullet car*, etc. By examining the products made by the students, it is clear that most of the projects, especially the technology oriented projects, focus on functionality instead of originality.

Three Highlighted Projects

Three projects out of 46 were highlighted for their distinct characteristics. Two fall into the 'un-oriented' category mentioned above: the design and construction of a game booth, and the design and production of a scenario that demonstrates a Chinese idiom. The third project, which falls into the 'design-oriented with realisation' category, is to design and make a daily utensil using a commonly found material in Hong Kong named 'red-white-blue'. [3] These three projects possess several characteristics that contrast with the others below.

1. They are introduced under a theme
2. The nature of the projects is supportive of variations
3. The design briefs of the projects direct students to designing and making an indefinite item
4. Students have the freedom to choose exactly what they are going to design and make
5. They have strong connection with students' daily life
6. They do not primarily focus on the acquisition of knowledge and skills, but rather on the aesthetic quality of the final product

In these three projects, it is apparent that students have their choice in selecting the nature and the design of the artefact under a theme. For example, in the project of designing a daily utensil by 'red-white-blue' in Hong Kong, examples of student designs included a purse, a ball-pen and a bandage. The projects also demonstrate active linkages with students' daily lives, in that they are familiar themes that can be

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[3] The material 'red-white-blue' is a kind of nylon-made sailcloth with red, white and blue colour strips.

easily inspired by the project brief. Note that these three projects are not designed for students to learn any technological knowledge or skills, but instead are summative projects that enable students to apply what they have learned in previous D&T sessions or in other subjects such as Chinese (i.e. the Chinese idioms project).

6.2.2.2.   The artefacts

The artefacts were examined, and the five aspects of the pentagon model of the domain features of the artefacts (suggested by Rutland, 2009) were commented accordingly. The following is a general description of the artefacts that fall into the five aspects of the model.

Concept/Idea: The ideas generated by the students in each project vary. However, the majority of the designs are neither new nor original with respect to the business market. It might be possible that such designs are only novel in relation to students' own personal experiences. Most artefacts are considered feasible and useful.

Aesthetic: Students' artefacts have limited variations and are very similar to existing items available on the market. For most of the technology-oriented artefacts, such as the water rocket, the only variation appears to be the decoration of the product.

Technical: Some technology-oriented artefacts mainly focus on technological knowledge. It is obvious that some of these artefacts are copies of existing systems or products. Nevertheless, these artefacts were designed by students, even though the outcome may be considered repetitive.

Constructional: Students are required to be involved in hands-on activities in realising a product. There is no doubt that students have to use a variety of tools and equipment such as a laser engraving machine, saw, drill, etc. to finish the projects. For the CAD project, students are only required to use 3D rendering software to realise their ideas and products.

Marketing: Most of the artefacts, especially those with realization, are designed for personal use. However, the marketing value of students' artefacts in some projects, such as the water rocket, space shuttle design, modern military facilities, etc., is unknown. It is unclear who the design is aimed at and where it might be sold.

By transforming the pentagon model into a radar chart, it is easier to study the level of creativity of the artefacts in general and in the highlighted projects in the domain features of the three-feature model of creativity. A relative score is given to each type of creativity in the pentagon model for students' artefacts of the projects in general and of the highlighted projects in particular for the ease of comparison. Figure 6.4 below compares the performance of the students' work in general with the highlighted project.
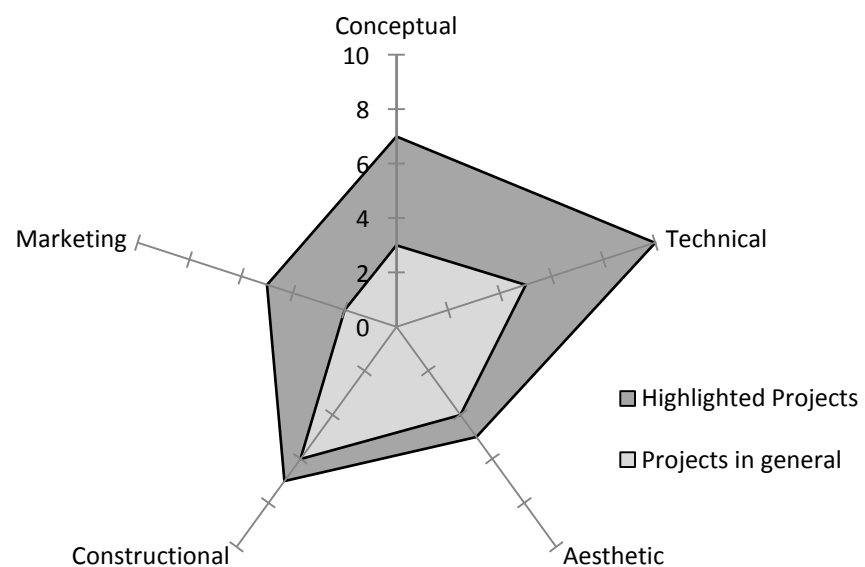
Figure 6.4. Creativity of the artefacts of highlighted projects and projects in general (Wong & Siu, 2012)

The shapes of the two radar charts above are almost homologous. In contrast to the aesthetic aspect, both technical and constructional aspects score relatively higher than the others.

6.2.3. Discussions

Most topics and briefs of the projects in Section 6.2.1 and 6.2.2 limit students' creativity by not encouraging them to generate and develop new ideas. Most of the projects are closed and do not encourage students to investigate in a context. Besides, it can be seen from the exemplar projects that most students' artefacts were not creative. Creativity of students is limited by the project brief to a certain extent. The following further describe some issues of the projects.

6.2.3.1.　The emphasis of the projects

By looking at the artefacts made by the students on the government website, the key issue in some projects is the functionality of the finished product, rather than its aesthetic quality. The pentagon model analysis is lucid enough to show that more emphasis has been placed on technical and constructional creativity in most artefacts. The marketing value of some finished products is also dubious. This unbalanced emphasis hinders the cultivation of creativity in the classroom. This is similar to studies of D&T in the UK, which Rutland (2009) claimed lacks balance between understanding knowledge, developing skills and providing students with the opportunity to work in a heuristic way by making their own decisions. If part of the project is too technical that students have to follow step-by-step under teacher's instruction, students who are more talented in design might get bored easily and thus this might hinder students' creativity (Atkinson, 2009; 2011).

Projects under public examinations have a more balanced emphasis compared with the projects in the government website. However, it is unknown if students also consider the aesthetic creativity while approaching the projects. Nevertheless, if students choose a project which involves more technology elements, most teachers would focus more on the technical value and the functionality of the artefacts, as a functional product could guarantee a pass in the subject.

6.2.3.2.　The design brief

In project-based learning, even though students are guided under the supervision of the teacher and it is a teacher-facilitated approach to learning (Bell, 2010), students are self-driven and also the active agent in the learning process (Mioduser & Betzer, 2007). The design briefs of the projects of public examination and the government website limit students' role of being an active agent and thus their creativity. They fail to stimulate students and capture their imaginations. The brief hampers the creativity of students from the very beginning. For example, in the project of designing a stationery stand, once students perceive the topic 'stationery stand', the appearance of a standard stationery stand would probably appear in their minds. This limits the students' thoughts and dampens the development of creativity. As such, the finished products do not show many variations and most of them are quite similar to a usual form of stationary stand as seen in the collection of students' artefacts.

The design brief of the three highlighted projects on the government website is slightly different from the other projects. The project brief is similar to a thematic approach. What has been done in the highlighted projects is comparable to Art and Design project work mentioned by Rutland and Barlex (2008), who suggested that D&T teachers can learn from art and design teachers to introduce projects with themes, encourage more conceptual design with greater aesthetic awareness, and avoid prescribed functionality of the finished product. The project brief and the product of the highlighted projects have characteristics that correspond to those of art and design projects. Projects with these characteristics enable teachers and students to enhance teaching for creativity, and to learn how to be creative (Rutland & Barlex, 2008). However, while the three projects discussed above shed some light onto D&T teaching in Hong Kong, they provide only a small sample.

Besides, these highlighted projects are similar to the thematic approach in Singapore public examination. In the year of 2009, the project theme for D&T (ordinary level examination) is 'Tidiness' and that for D&T (normal-academic level examination) is 'Movement' (Ministry of Education, 2009a, 2009b). Students thus define their own scenario and design problem according to the theme, and design and make a solution.

6.2.3.3.   Linkage to social and cultural background

On the government website, most projects seldom link with the students' social and cultural backgrounds, and seem to be irrelevant to their lives. For example, in the project of drawing and designing a fishing booth, most students living in Hong Kong, a high-density city, are unlikely to have much experience of fishing (see Education Bureau, 2007a). This kind of project might not be stimulating and interesting enough, and students might lose their intrinsic motivation once they perceive the project content. It would be difficult for creativity to appear in the process of learning, because intrinsic motivation of is one of the important factors in fostering creativity (Dow, 2004; Sternberg & Lubart, 1999). The connection between the project and its social relevance to students might be regarded as the social/environmental features of the three-feature model (Rutland & Barlex, 2008).

On the other hand, the projects in the public examination have a linkage to the social and cultural background. For example, in the D&T examination of 2009, the project 'miniature display model' is closely associated with the cultural and historical aspect of Hong Kong. Project of this kind cannot be seen in the examination of earlier years, and it can be argued that the project 'miniature display model' might indicate a change of the development of D&T. Besides, the three highlighted projects are strongly linked to students' daily life, and students have freedom of choice in the decision making process. These characteristics trigger students' intrinsic motivation, which the expert teachers interviewed by Rutland and Barlex said fosters creativity in design. It can be concluded that the three projects are more pertinent to promoting creativity, and they provide the potential for students to be creative.

6.3.   CONCLUDING REMARKS

Being the school subject of design education in the Hong Kong secondary school level, D&T should be the best platform in cultivating students' creativity through design projects. The design process involved in D&T should provide an opportunity for students to extend their creative ability.

Hong Kong has its unique cultural and historical background of design education, and the development of D&T syllabus implies that design education appears to detach itself from its relationship with industrial development. A shift of teaching operational knowledge and skills to learning positive attitudes towards technology and the society, and problem-solving skills is observed. Focus should be put on creativity and innovation in design education.

However, it seems that creativity is not fostered in its fullness, based on the investigation on the projects in Hong Kong D&T public examinations and on the government website. The analysis of the pentagon model reveals that most projects have an unbalanced emphasis. Also, projects have closed design briefs and seldom link to a cultural and social context. These issues indicate the possible detriments of creativity in Hong Kong D&T at present. Fortunately, some projects on the government website are still capable of encouraging students' creativity; however, they are just the minority.

Chapter 7
Findings of the Empirical Study

The previous chapters review much regarding creativity in design education and Hong Kong society through newspapers, design projects and artefacts. However, the review might not be able to provide a full picture of creativity in design education of Hong Kong. Therefore, interviews were conducted to collect more data in understanding the 4P's, especially the person and the process of creativity in design education and the roles of creativity. As previously noted in Chapter 4, two officers from the Curriculum Development Department of Education Bureau and the Assessment Development Department of Hong Kong Examination and Assessment Authority, six teachers, and seven students from six different schools were interviewed. The interviews were recorded and transcribed. Data were then coded into different categories. This chapter presents the findings related to the study.

7.1.   FINDINGS

Among the 21 coding categories, ten are related to the objectives of the study. In order to have a clear presentation, these ten coding categories are presented in three different sections. The topics of these sections do not imply the coding method in the study.

It is noted that all interviews conducted in Hong Kong are in Cantonese. All the Cantonese quotes of the interviewees are translated into English in discussing the research findings for presentation.

The findings and the figures here do not show the frequencies each interviewee responded in each coding category, as the quantity that each interviewee commented on a particular coding category is not the major concern in this research. Besides, sometimes interviewees might express same ideas in different ways while talking different topic of interests. In these circumstances, the quantity might be less important. However, presenting the number of interviewees responded in each category might be helpful in determining the reliability of the data. The quality and the contents of the interviewees' responses in the interviews should be the major concern. This applies to all the bar charts in this chapter.

7.1.1. Perception towards the Definition and 4P's

Interviewees' perception on the definition and the 4P's of creativity are one of the main concerns in the study. Figure 7.1 below shows the number of interviewees responded in the definition and the 4P's of creativity.
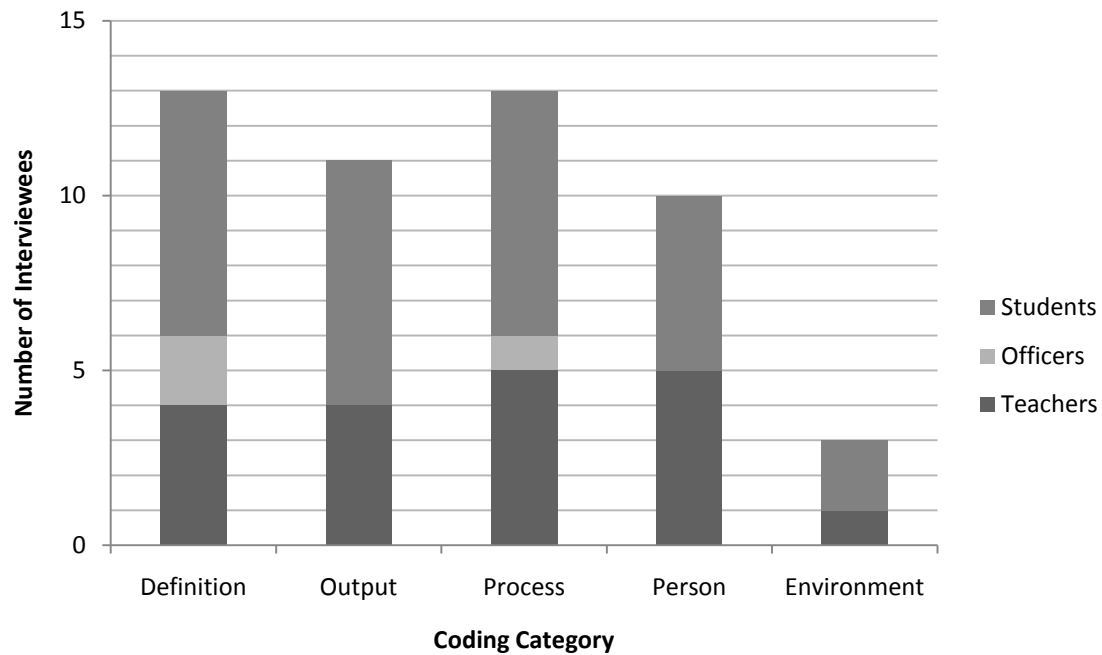
Figure 7.1. Number of interviewees responded to the definition and the 4P's of creativity

It is noted that investigating the perceptions of the definition of creativity is one of the objectives in the study. Interviewees were then asked to comment on what creativity is. However, instead of giving a definition to creativity, some interviewees described what a creative output is or what is essential in the 4P's to explain the definition of creativity. Subsequently, those responses regarding the characteristics of the 4P's were included in the sub-sections of the 4P's. Responses which could not be categorised in the subsections of the 4P's were put into the subsection of 'Definition'. Nevertheless, it does not imply that the findings and discussion of the subsection of 'Definition' are totally detached from the content of 4P's. More precisely, the responses in the sections of definition and 4P's collectively indicate what creativity is.

The following sub-sections show the responses of the teachers, students, and officers in each category in detail.

7.1.1.1.   Definition (Perspectives other than the 4P's)

Responses which were made from perspectives other than the 4P's are presented in this sub-section. These responses are useful in understanding interviewees' perception on creativity, as they are the beliefs that the interviewees hold. They also include some implicit theories of the interviewees, and these suggest how the interviewees deal with creativity in D&T classrooms.

Teachers

Even though teachers are experienced with creative activities, it seemed that they did not have a structured belief towards creativity upon the interviews. Most teachers constructed their own theories right in the conversation.

Teacher A believed that creativity is not related to any habitual activities, and it is appeared to be significant to others:

> "Creativity is something different from the routines. It has its distinctive features."

Teacher E also stated that creativity is not something routine:

> "... (To be creative) you have to make a breakthrough from what you have seen, and you need to think of something that you are able to do. I think (you need to) meet the needs, solve the problem by not using an usual way to finish the task. I always think that copying others' design can only be regarded as re-design, but not a creative design..."

He mentioned the relationship between creativity and routines and also highlighted the relationship between creativity and the capability of finishing or realising the idea or output. In his opinion, it could be argued that if the output is impossible to be accomplished or realised, it might not be regarded as creative. Teacher F also gave his opinions on how people emphasise accomplishment and success when talking about creativity. He recalled one of the most creative products that he had ever seen and commented on how people see creativity. He said that:

> "... actually he applies some ideas to another context, and he succeeded, then people would agree it is creativity. That means if he succeeds, it is creativity; if he doesn't succeed, it is not creativity."

However, in his opinion, he did not agree with this idea. He believed that even some ideas are yet to be noticed and recognised, they still could be regarded as being creative. He commented that:

> "...there is very little creativity which can be applied into real life. Actually there are a lot of creativity; however, some of them are too tiny. Perhaps the creative idea is over in laughing. When the creative idea cannot be applied in the real life, or people are not positive on what the creative idea can do, it is difficult (to notice the creativity) ... but if you ask if it is a kind of creativity, I think it is."

Besides, creativity should have no boundaries. If there is a boundary, a person needs to change the boundary so that it fits to his needs in generating creative output. As Teacher A stated that:

> "It is very often that we operate in a thinking boundary. It may be because of our characteristics, or the knowledge we ever made contact with; however, creativity is to think away from the thinking boundary."

Also Teacher F also commented that:

> "Creativity should not have a boundary. If there is a boundary, you have to change the boundary from a square to an irregular shape."

However, it does not mean that creativity disassociates with constraints. Teacher D mentioned that design is a kind of compromise, and creativity also exists in different ways of compromise. The way of seeking balance among considerations and factors is also a kind of creativity:

"... I believe, in the reality it involves many considerations and factors. And this is a kind of balance ... in technology many designs are a kind of compromise. Your idea, something very special, is the outcome of what you compromised with some factors and requirements. There are many methods to conform to the requirements, and these are also creativity."

Creativity not only exists in compromising with considerations and factors. It also exists in other ways. Teacher D furthered his comments on different kinds of creativity and suggested that creativity has different forms under different levels of constraints:

"Creativity has many forms. If creating new ideas in a less constrained situation, thinking without boundary, then it is a kind of creativity ... (if) the person combines or deals with different constraints and considerations together in a creative way, it is another kind of creativity."

He extended his comments on how constraints associate with creativity in a spectrum of task with various levels of constraints:

"... (However) I don't think there should have two distinctive kinds of creativity. It is a spectrum. This end has no constraints at all, and the other end has many constraints ... in this spectrum there are many different tasks, and the level of creativity concerned is also different."

Other than the opinion regarding routines, boundaries, and constraints, one of the teachers, Teacher F, suggested that modification (which is supposed to be not new) is also creativity. He said that:

"If (someone) modifies a product, it is creativity. (If) a product appears in the market and people design other accessories to fit the product, it is creativity."

Other than modification, arrangement or re-arrangement, i.e. how things are being arranged or rearranged, is also creativity. As Teacher D believed that:

> "How the parts are being arranged is also a kind of creativity. A clever person can arrange 10 different parts in a very compact way using minimum space, but some people might need a large table."

On top of these responses, Teacher F gave another viewpoint towards creativity. Instead of stating what creativity is or what creativity is related to, he suggested that the factor time-space determines creativity:

> "... (People might think) Picasso might have some (mental) problems, as his drawings were what he thought and what he saw. However, why do people appreciate him after so many years? It is because the space-time is wrongly assigned (to Picasso)."

Officers

Officers approached the definition of creativity from different perspectives, and some of their comments were more sophisticated than the teachers'. One of the officers commented that creativity has different definitions in different time, different place, and for different people. He agreed that creativity has to be novel, and the novelty is the reason why creativity has various definitions. It is quite similar to what Teacher F commented about the factor determining creativity. However, the comment made by the officer was more complete and objective. The officer stated that:

> "... First of all you need to have (something) old, it is relative. Then you will have the new. The meaning of novelty is different in different space-time, for different person with different backgrounds. Therefore, in this case, creativity also has different definitions."

Different from the teachers, he not only addressed creativity in thinking, but also in operation and process:

> "What is creativity? Maybe you are being creative in the process. For example, in the past I use paper and pen to compose songs, now I use computer to help me. Then this process is already new, and this can also be regarded as creativity."

The other officer had another comment which was totally different from others. He believed that creativity depends on how a person effectively makes use of available resources. The same definition applies in the creativity in general and in D&T. He commented that:

> "What is creativity? I think (creativity exists when) the person makes use of the resources he has on his hands. Thinking without boundaries and doing whatever he wants is not the kind of creativity I believe in. For example, I need to reach a particular destination but I only have 2 dollars. How I can use the 2 dollars effectively to reach the destination is the kind of creativity I believe in."

This response is related to the comments made by Teacher D about constraints. However, the officer not only focused on the existence of constraints (for example, the 2 dollars in the officer's response), but also how a person should manipulate the resources so that the output is creative.

Students

Most of the responses from students were simpler than those from teachers and officers. Except Student Ab, he defined creativity from several different perspectives. He thought that creativity is curiosity from a children's perspective. In terms of attitude, he thought that creativity is also a kind of bravery. Creativity is also to think out of the box. When he was asked to give a universal definition of creativity, he

responded that everyone defines creativity differently, and the definition is quite subjective.

Student Fb2 approached creativity differently by suggesting what creativity belongs to. He commented that creativity could be a product and also a kind of thinking method.

On the other hand, Student Ag gave a simple definition to creativity:

> "Creativity is something that you cannot normally think of, it is something not normal or not in a common sense."

Other students generally believed that creativity is to create something which should not exist or to creative from null entity. As Student Eb2 commented that:

> "(When) you create something which should not exist, then I would think that is creative."

Comments made by Students Eb1 and Fb1 were similar to that made by Student Eb2. However, both of them extended the comments that creating from null entity is just one kind of creativity. There is another kind of creativity which should be of concern as well. As Student Eb1 stated that:

> "I think that the highest level of creativity is to create something in which no one knows, no one has ever investigated ... However, modification is creativity too, though it has a lower level. Or using a new method in carrying out an experiement to cut the cost should also be a kind of creativity."

Student Fb1 also believed that:

> "I think there are two kinds of creativity. One is modification, that is to modify an existing item so that it becomes a new item. The other one is to create from null entity. Creating from null entity might

actually mean combining many items to create something which has never been seen before."

It is found from the responses of Students Eb1 and Fb1 that modification is also a kind of creativity. This is similar to what Teacher F commented on modification. However, this kind of creativity might be of lower level.

7.1.1.2. Output

How teachers and students perceived creative output might affect their judgment on what creativity is. Their perception of creative output is also important for investigation in this study. Thus, responses regarding what a creative output consists of are reported in this section. Teachers and students were asked what kind of products, ideas, or what they had done or received in classroom or competition were creative, and they were then asked to describe them. They were also asked to comment on the features of a creative output in general. In this section, officers gave no related responses.

<u>Teachers</u>

Teachers' responses were more general in describing all creative output as a whole. Many of them had described creative products that they had ever seen, and they were able to give a conclusive comment of what creative output should be.

Most of the teachers thought that a creative output should be new and had no predecessors. Teacher B believed that:

> "Creativity, in my opinion, is to do something which have not been done or tried by others ... Therefore, creativity should have no predecessors. If there is predecessor, what you are doing is just to

> modify. You have done the modification, and whether the modification is creativity is another topic to discuss."

Teacher F also believed that:

> "Any stuff which is totally new is creativity. That means no one has thought of that before."

Teacher D also gave similar comments on the novelty feature of creative outputs. However, other than novelty, he pointed out that the output should have special intentions which are personalised:

> "Uniqueness, novelty, never seen before. Having very special intentions, very special, very personalised intentions to deal with the problem. New combination, that means new combination methods, this is also related to novelty."

However, novelty is not a must in creativity. Teacher C expressed that there are not many new items in the world, and what we had is combination. A combination may not be considered as new but it is still considered as creative:

> "It (the product) needs not to be very novel. I don't think novelty is needed. Actually, nowadays many things are not new, but a kind of combination. How many things in this world are new? I believe there are not many ... in the past mobile phone was designed for communication, in the past children played Gameboy, NDS, PSP, etc. Combining all stuff, and they become the Apps in iPhone."

Teacher D seemed to agree that in order to be creative the combination needs not be new but skilful. Besides, this comment echoes with the previous comment he had made on personalisation. He believed that:

> "It is not necessary for creativity to be something stunning. Sometimes you have to know to appreciate how she (the student) deals with some

problems ... A good product is to put few functions or parts together in a very skilful way, in a way from a special perspective, in a special combination method with personal characters."

In addition to the discussion of novelty and combination, according to the responses of Teacher C, a creative output should be functional but not just functional in the way it ought to be. Sometimes an extra meaningful and useful function might be needed so that the output could be considered as creative:

> "...other than the functions (of the product), it (creativity) is (something) whether you can give me more other feelings ... for example, the Tape Holder Project. That student combined a tape holder and a gun together, and is this creativity? If requesting him to be creative, then the product should have a second function after combining a holder and a gun."

He further commented that:

> "Other than its functions, if the product has an additional appropriate function, and at the same time this function is not unnecessary, then I would think it is creativity."

On the other hand, Teacher D suggested another requirement in creative output. He again used the arrangement example to explicate his thought on elegancy:

> "My another requirement to the students is elegance, that is neat. Just like what I said, 10 parts, you can arrange them in a very compact or neat way, or even simplify any 1 or 2 parts, change a particular design of the parts and make it to be another design. These are also a kind of creative performance."

Students

Students made relatively more comments on the characteristics of a creative output compared with the responses in the definition of creativity. Their comments in this section varied a lot, and some of them were fairly interesting.

The response given by Student Ab on the topic of creative output echoes with his comment made on the definition of creativity. Similar to his thought that creativity has no particular definition, creative output have no common features:

> "There are no (common) features ... if there is a feature, then it is supposed that all creative outputs would have that particular feature. However, it is not absolutely true. The features of creative outputs are different. A creative output is not limited by a particular characteristic. Everyone defines creativity in a different way. Therefore, there is no standardised formula to describe the features of creative outputs."

However, when he was forced to give a few distinctive features of creative outputs, he believed that if there are some features, they would be the features of going beyond the common sense, the rational and logical way. As he commented that:

> "If you need me to state what the features of a creative output are, I would say it is out of common sense. Or if you have used a way which exceeded the rational and logical way to obtain a result, the result would be creative."

The idea of uncommon features was also mentioned by Student Ag. Besides, she pointed out that a creative idea should be something novel, which echoes with the comments of the teachers. She stated that:

> "Something that ordinary people would not think of. When you heard of a creative idea, you would feel fresh, very special. If there is a creative output that the audience have heard of before, then the output is not creative already. The main points are outstanding, very special, and not ordinary."

Student Fb1 had similar comment on novelty:

> "Something is creative when it has no predecessors, or which is not popular and you popularise it."

Other than the simple novelty, Student Cb suggested that the novelty should be with respect to the creator. He thought that:

> "When the creator generates the output by himself but not copying, the output is creative ... The creator should not have created the same thing or known it before."

Novelty was not the only feature that students mentioned. Another feature in which number of students mentioned was combination in a creative output. When Student Ag was asked why she thought the idea they used in the competition is creative, she responded that it was because they had combined all items that could be found in the environment they designed. She said that:

> "What others used is just a machine, a real complicated machine, but for us, we used all items in a toilet and embedded these items to our (toilet bowl) machine."

Similarly, when Student Fb2 was asked which part is the most creative in the product they have designed, he replied that the combination that they have made in the product is the most creative. He responded that:

> "... we combine many functions together ... we mix them together, together with some ideas about renewable energy, we make something which is quite creative."

Besides, when Student Cb was asked what kind of stuff is creative, he responded that mobile phones are creative nowadays:

> "... people in the past might not think it is possible to put camera into mobile phone, but nowadays every mobile phone has the camera and video function. Then I think it is creative."

When Student Eb2 was asked the same question, he gave similar responses. He commented that:

> "... iPhone is creative. It combines all functions into a phone, so that it is convenient for us to use..."

The comments of students on combination are parallel to that of teachers, even though none of the students related combination with novelty.

In addition, some students gave interesting comments which were different from novelty and combination. When Student Eb1 was asked what product is creative, he commented that iPhone is creative because of its touch screen. The use of touch screen has brought numbers of improvements to the design of the phone:

> "In the past there were buttons and the buttons occupied about 3/5 of the phone ... However, this phone (iPhone) uses touch screen keyboard, and the display is then larger. The phone now becomes lighter, and the battery can last for longer. All these are creative."

Student Fb1 focused not just on the improvement of a particular product but on the benefit of all. He thought that products which improve the living standard of human beings are considered as creative:

> "... it can change the living standard in a large extent, for example, the invention of airplane, smartphones like iPhone, or something invented in the future that we can use brain waves to control physical objects. If these items can change the living standard and comforts in a large extent, they are creative outputs."

Student Fb2 gave another point of view that a creative product should provide inspiration to others. He suggested that:

> " I think a creative product would give a fresh feeling to others. Also, it is designed for practical use ... it helps people to live more comfortably. I think a new product should generate new thoughts. It inspires others to think of some new ideas..."

On the other hand, Student Ab mentioned the emotional impact that a creative output could give. When Student Ab was asked which part is the most creative part in the competition they participated, he responded that the surprise that they gave the judges is one of the most creative parts:

> "... (You) need to make the judges to look at you with quite different eyes. Or you need to lead the judges to think "wow can you finish such difficult tasks?". If you can do it eventually, the surprise you give the judges is creativity."

7.1.1.3.   Process

Teachers and students were asked if there is a creative thinking process which leads people to be creative, or a creative output is generated by a random method. Even though the same question does not appear in the interview guide of the officers, one of the officers also gave comments on the creative thinking process.

<u>Teachers</u>

Some teachers suggested that design process is the process of being creative. However, others suggested that design process is different from creative thinking process. Some of them believed that creative output is generated in an illumination or by an accident.

When Teacher A was asked if there is a creative thinking process which is similar to design process, he argued that design process does not guarantee a creative output and a creative output is generated in an illumination. He commented that:

> "This method (design process) is effective, it can help us generate some solutions. However, whether the solution is creativity, it is another discussion. It is because it might be an effective solution, but it might not be a creative solution ... Actually sometimes creative solution is generated in an illumination. We do not know why, a flash, and then the solution is there."

He also commented that:

> "As a whole, (if) the solution is not created by a normal thinking method, then usually I would accept it is a creative solution..."

Similar to Teacher A, when Teacher B was asked if there are several steps in generating creative output, he commented that the steps are just referring to the design process but not creative thinking process. He also believed the illumination in generating creative output:

> "If there are step 1 step 2 step 3, these are just design stages. Creative people seldom follow steps to create a product. A creative person would create the solution in a flash, which is not like the traditional method. Therefore, I think it is not a must to have stages."

However, while responding to the question of how a person could generate creative output, Teacher D commented that the process is actually a design process in D&T, and different people might have different outcomes after going through the process. Whether the person could generate creative outputs depends on the backgrounds and the abilities of the person:

> "... indeed the design methods help you rearrange your experience ... everyone knows how to apply the methods ... some people are more

special that he has some special abilities to make sense of an idea.
You may combine something in a way, others may combine in other
ways and transform the item."

Teacher F believed that there is a thinking method that helps students to be creative.
However, when he was asked what kind of thinking method it is, he replied the
thinking method is the design process indeed. He replied that:

"The thinking method is that you have to understand the whole
design process, that is the question of the problem solving. You have
to know what the problem is, or what you want to have. Then you
have to research what have been existed, how to be functional. After
that you can think if there are any new or creative methods, or how to
borrow others' ideas."

On the other hand, Teacher E gave another perspective towards creative thinking
process. When asking how students generated creative ideas to solve problems, he
highlighted the importance of problem identification. As he commented that:

"... if you really understand where the problem is and really aim at
solving the problem, but at the same time not limited by many things
that you have seen before, then you will be able to be creative."

Besides, Teacher E also had an idea that creative output is not generated in a rational
way. As he said that:

"... In the process, creativity is sometimes happened by an accident."

Officers

One of the officers also commented on the process of generating creative output
while he talked about the definition of creativity. He mentioned that in order to have
a creative output, a process is essential. And the process includes investigation and

application to another context. However, he did not explain explicitly whether the process he mentioned is a kind of design process.

> "Creativity is not to create from nothing to something ... it is not something like I suddenly have an idea when I sit here, but it is like I have gone through a process, and in this process I investigated the methods of how others dealt with the problem, and applied the methods to an indirect context. In the past people might finish the task in this way, now the method can be applied in another way."

Students

When Student Ab was asked if people can obtain a creative output through a random method, he responded that he achieves creativity by random. Being random is creative. As he commented that:

> "For me, I get the creative idea in a random way. If you have steps, your thought will be rigid ... When you start to think what idea to be used, being random is a good creativity."

He further commented that there are methods leading to creativity. However, the creativity that is led by methods or formula and the creativity that appears in an illumination with free thinking are different. He also suggested a problem of using a method to achieve creativity. He said that:

> "... the whole matter is equivalent to the invention competition we have participated. To invent something you have to be creative. However, if you base on what is insufficient, or you collect some information to generate a creative idea, in this way the whole matter will be formularised. You have creativity, but the creativity you obtained from a formularised way is very realistic but not achievable ... The way of collecting information to generate some creative ideas and the way of having an illumination suddenly are two different things."

He further pinpointed the limitation of collecting information at the very beginning of the idea generation. He said that:

> "If you collect the information first, you will be limited by the information or the nature of the information in generating ideas ... for example, after you generate a creative idea in an unprepared situation, then you would start to think of the possible way to realise it. I think in this way, even though you might not be able to realise the idea to make a tangible item, the creative idea would have potentials if you research on them in the future."

Student Eb1 also suggested that creativity should not have procedures. However, in idea generation sometimes the procedure of evaluation exists. He commented that:

> "I think that creativity should not have procedures. However, after you create a creative product, you need to have procedures to review its weaknesses and to see what is needed to be modified so that you can optimise the product."

Students Ag, Cb, and Eb2 had similar opinions. They thought that a process or a method for creativity does not exist. When Student Ag was asked if there is a process which leads people to be creative, she commented that:

> "There is no way to follow to achieve the kind of creativity in my mind."

Student Cb commented that it is very random to achieve creativity, and Student Eb2 also thought that there should not have any method for creativity:

> "If there is a method to limit a person to be creative, then it is not creativity ... Creativity is unlimited."

Comments made by Student Fb2 were different from those made by other students, as he believed that there are some methods to achieve creativity. He also gave an example of how to be creative in a rational way. However, he did not deny the possibility of being creative randomly:

> "I believe that creativity can be achieved through some routine methods ... when we cannot generate creative ideas, our teacher would ask us to copy. He does not mean to encourage us to copy, but he wants us to find the suitable elements to add to our own design in the process of copying, so that our design can be more creative and more special. There are also some methods, some routine methods for generating creative idea, for example, eliminating some parts of a product ... Of course, creativity can be achieved through random methods, for example Beethoven can compose a master piece in a random and sudden way."

Student Fb1 had another perspective towards the creative thinking process. He thought that creativity is not obtained by a routine method but by many routines. He commented that:

> "I think it is not based on a routine to be creative ... I think that people is based on more than one routine but not just one routine to be creative. It is because very often a single method may not be appropriate to solve a problem. When you use other similar methods in other aspects and apply them to solve the problem, the new stuff you get will be creative."

7.1.1.4. Person

Teachers and students were asked to describe the character of the creative persons that they had met before. Sometimes they were also asked to suggest the general characteristics that a creative person has. Officers in this section gave no related

responses, and questions related to the topic of creative person are not included in the interview guide.

<u>Teachers</u>

When Teacher C recalled the most creative student he had ever taught, he commented that the student was quiet, loved to think, asked actively when he had questions, and was able to think deeply.

Teacher D had another opinion that some creative students do not behave well but they are clever. He recalled a creative student and said that:

> "She is clever, but she is too talkative, making too many noises and trying to talk to others in lessons ... she was the vice-head prefect of the school, but she nearly got fired by the teachers, as she skipped duty very often and she did not manage her team members properly. However, you can see what she did is very creative."

However, he also commented that some of the creative students behave quite well. He said that:

> "The doctor (the student) is very quiet and he speaks logically. When he was studying at Secondary 6 and 7, he talks like a professor..."

Teacher E generally believed that creative students are calm and persistent:

> "Character... they are relatively calmer, very focused. They are about the same; they can spend a long period of time for stuff. I believe they usually have this kind of characteristic that they are persistent..."

He added that:

> "... they won't give up. They have perseverance to solve a problem so
> that they can create. Otherwise, they will only follow what they have
> seen ... However, if you have the perseverance, you may come across
> with something that you cannot think of..."

He also believed that if students do not have this kind of characteristic, it is difficult
to cultivate their creativity:

> "I think it is difficult. I believe if a student is creative, he himself must
> have some characteristics. The characteristic is perseverance ... if he
> doesn't have the characteristics, then he is not that kind of person to be
> creative."

Teacher A suggested that creative students tend to not accept teachers' suggestions:

> "It is inevitable I think. For example I feel that my suggestions to them
> are to the point, but they don't accept them."

Teacher F had similar comments as Teacher A that creative people never follow
regulations. This might be comparable with the opinion given by Teacher E that
some creative students do not behave well in class. Teacher F said that:

> "Creative people never follow regulations, because there is no
> creativity in a boundary."

He also thought that creative persons are considered as abnormal by others. He said
that:

> "Other people view us as abnormal, different from them. It is simple.
> Those who are similar to them are normal; those who are different are
> abnormal. We always have the leaping thinking, we always go very
> fast. When we think it is correct we will work on it, because you
> would think if I don't work on something right I will never succeed..."

Students

Students' comments were quite different from the teachers'. Besides, students tended to share their feelings when they got along with their creative classmates.

Student Ab recalled that one of his creative classmates is humorous. He said that:

> "One of my classmates, he makes jokes very often. After he finishes the joke, it takes some times for us to understand the joke..."

Also, the creative classmate would try his best to express himself and have good presentation skills. Student Ab added that:

> "... Sometimes when he wants to express something, he will exaggerate it. He won't use the usual way to tell you, like sending you an SMS. He needs to call you, or he needs to express it in front of you using different body gestures."

However, at the same time the creative classmate is not very talkative. As Student Ab said:

> "...Sometimes you might think he is cool, or he is not so talkative. However, when you get familiar with him, he can make you laugh when he speaks."

Similarly, student Ag thought that creative classmates could think and speak in a fast way and they have good presentation skills. They also dare to challenge teachers in front of the whole class:

> "They know how to express themselves ... I think they can speak and think in a very fast way. They are noisy in lessons. However, they are not chit-chatting with other students, they argue with teachers. They can challenge teacher in a sudden when the teacher is talking."

Student Fb2 thought that creative persons are different from others, he said that:

> "First of all, he has a specialty. He gave us a feeling which is different from others. For example he is able to think of some elements that others cannot think of in design."

When he recalled one of his creative classmates, he commented that the classmate is a perfectionist:

> "When I work with him, I can feel that he is a perfectionist. He is very persistent in the detail..."

Student Fb1 had a similar comment towards creative persons on the perfectionism:

> "Usually a creative person has different points of views towards a matter. He would have a lot of comments that we called them picky comments. However these comments are constructive..."

Student Eb2, on the other hand, commented that sometimes creativity might not be realistic and he thought that it is essential to evaluate the ideas the creative person generated. He suggested that:

> "... there are some realistic kind of creativity but there are also some unrealistic ones. When we are together, we need to remind him which one works and which one doesn't work..."

7.1.1.5. Environment

One teacher and two students gave comments on how environment is related to creativity. Even though no questions in the interview guide directly address the topic of environment, it do not mean that the topic of environment is not covered in the interviews. Teachers and officers in the interviews reflected on how Hong Kong or

D&T is considered as an environment in cultivating creativity. In order to maintain the consistency of the data presented in the section 7.3.1, data which reflect the current situation are presented in the coding categories 'Issues in D&T'. In this section, only general comments on environment and creativity are presented.

Teachers

Teacher A commented that creativity is related to the environment. He said that:

> "...With an environmental factor, his ability might not be unleashed only. It might also have an explosive result..."

However, he did not further elaborate what kind of environment would unleash the creative ability with explosive results.

Students

Both Fb1 and Fb2 believed that an environment is essential in cultivating creativity. Fb1 commented that creativity is demanded by the environment. He said that:

> "Most of the time the environment leads us to understand the need, and the environment would hone you. You would feel that there is a need of breakthrough, a need of change, and a need of creativity ... Creativity is, to a certain extent, forced by the environment..."

His classmate Student Fb2 also commented that the environment has an influence to creativity. He used the example of Thomas Edison to explain his idea:

> "...there should be some knowledge and an environment to cultivate the thinking so that creativity can be generated. For example, Thomas Edison, why he could invent light bulb, it is because he was affected by the environment that the world was using gas light. Therefore I

think there should be an environment to influence him so that creativity can be cultivated."

7.1.2. Other Related Coding Categories

This section presents other interviews findings regarding the roles of creativity and the research objectives. The coding categories included in this section are Learning to be Creative, Assessment, Teacher-student Interaction, and Emotion. In this section, the data only describe the perceptions or the usual practice of the interviewees in a particular topic.

Figure 7.2 below shows the number of interviewees responded in these coding categories.
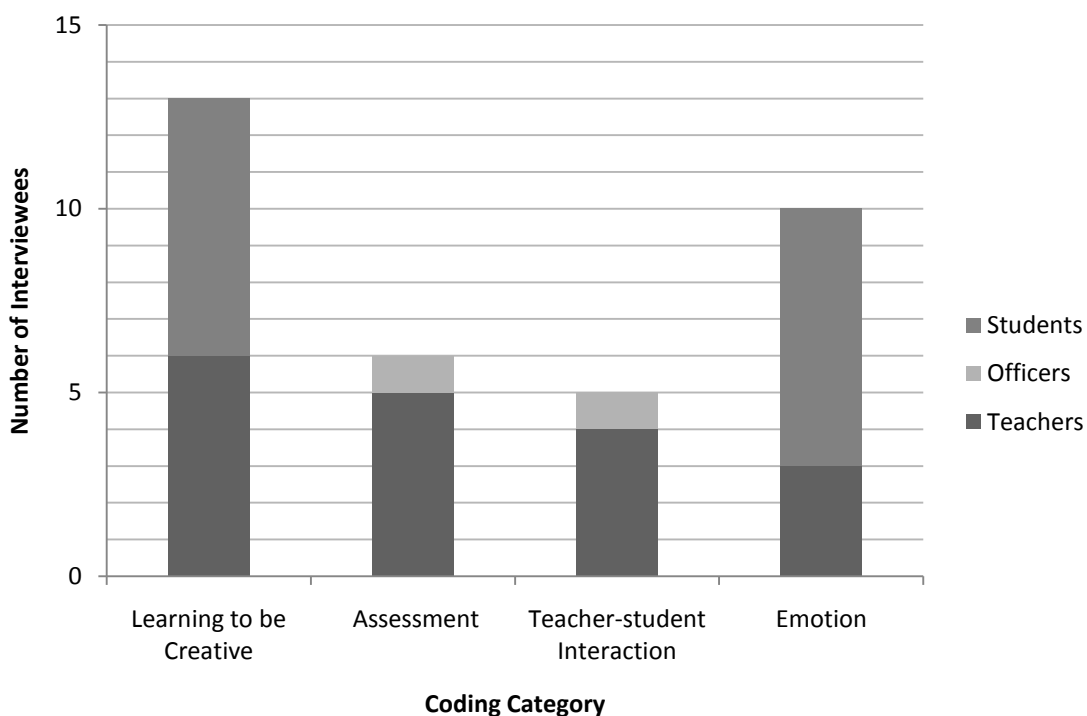
Figure 7.2. Number of interviewees responded to the coding categories related to the roles of creativity

7.1.2.1.   Learning to be Creative

The perception of whether creativity can be learned might affect the effectiveness of how teachers promote creativity in classroom and how students develop their creative ability (Dow, 2004). This topic might also help in understanding creativity and identifying the roles of creativity in current design education. Consequently, teachers and students were asked to comment if creativity is an innate or a cultivated talent. Almost all interviewees believed that creativity is both. Officers made no related responses, and the question regarding this topic is also not included in the interview guide of the officers.

Teachers

When Teacher A was asked if creativity is inborn or cultivated, he replied that it should be 70% innate and 30% cultivated. However, when he was asked if a person who was not born to be creative can be trained to be creative, he replied that training would not do much for him:

> "If he is not a creative individual when he was born, the 30% of the trained creativity might not have a significant effect on him."

Teacher B commented that in order to be creative, a person needs to have both inborn and cultivated ability. He used the computer as an example to explain his idea:

> "Both are needed, they are complementary. The student himself should have a characteristic, he loves to explore ... For example, a computer, the student could be a fast-speed computer, however, no matter how fast the computer can perform, it needs software, so that it can be used. If you do not have appropriate software, what could the computer do? Therefore, you need to give him (the student) software after he was born ..."

Teacher E commented that creativity is inborn, as this is the personality. If a person does not have this personality, it is difficult to cultivate his creativity.

Teacher C had a different comment with Teachers A, B, and E. He believed that training and learning are more important than the inborn ability that the student has. He also believed that even a student who was not born to be creative could be trained to be creative:

> "I think that the training and learning are important. Even you were born to be creative, you do not know how to express, or you do not know how to finish the task, it is useless. I believe that the acquired skill is more important than the inborn ability."

Teacher D also believed that creativity could be trained. He did not deny that creativity, to a certain extent, is inborn. However, he believed that education could cultivate a person so that he could acquire the inborn ability. He commented that:

> "... I think these can be trained. Training doesn't mean to train like a genius, but those who do not have this kind of creative ability can be trained up to acquire the skill gradually."

Teacher F, similar to Teacher C and D, thought that creativity could be cultivated through training. However, in his opinion, it is not guaranteed that the outcome is successful. He commented that:

> "... if creativity can't be taught, we won't teach D&T. Therefore, I would insist creativity can be taught. However, whether a successful designer or creator is trained depends on the opportunities that the person has."

He also stated that the cultivation of creativity is not for elderly or people with lots of experiences:

> "However, teaching elderly to be creative is difficult. After a person gained many experiences, it is difficult to ask him to relive his experiences and the tradition, and start to be creative."

<u>Students</u>

The comments made by students were similar to those made by the teachers that creativity could be cultivated and learned. Moreover, some of them also stated that all individuals possess creativity, and thus creativity is inborn. Student Eb2 commented that:

> "It is the personal will to train up and stimulate the potential. If a person is willing to simulate the potential, his creativity can be very extraordinary."

Student Eb1 also agreed with Student Eb2 that everyone should possess creativity, and some may be willing to use it but some may not. Student Ab also had the same belief. He commented that:

> "Everyone has creativity when they were born ... creativity is inborn, but how you make use of it, how you bury, or how you develop it after you were born is important."

Student Ag also commented that:

> "Creativity can be inborn, but it is not impossible to cultivate it afterwards."

Students Cb, Fb1 and Fb2 also believed that creativity is both inborn and acquired.

Another comment made by Student Ab was quite similar to the comment made by Teacher F. He believed that creativity is being buried when a person is getting old. However, he did not explicate the cause of this.

7.1.2.2.   Assessment

Assessment also has a great influence on creativity in practice. As reported by one of the officers, students sometimes finish an assignment based on the assessment criteria given by the teacher. In the examination-oriented environment of Hong Kong, it is not difficult to understand that students are limited by examinations. Consequently, assessment may also be another topic which is worthy to discuss in the roles of creativity.

Teachers were asked if they would consider creativity as one of the assessment criteria. There were no responses from students as this topic is not included in the interview guide for them. Officers gave numbers of responses in this topic; however, some of the responses were describing the current issues in the assessment system of D&T. Consequently, only part of the responses of officers is included in this section, and all other responses are depicted in the Section 7.3.3 Issues in D&T.

Teachers

Most teachers had considered creativity in their assessment, and they were also asked how they assessed creativity. Some teachers were also asked how they would give marks if the artefact is creative but not functional.

Teacher E stated that creativity is counted in the assessment, and creativity is one of the criteria in the composite mark of design.

Teacher A responded that at Secondary 1 to 3, around 30-50% of the assignment marks are accounted for creativity. In addition, he also addressed the difficulty in assessing creativity:

> "... it is not easy for you to judge whether an output is creative or just
> an fallacy in a very short time..."

When teachers were asked how they would give marks for a non-functional but creative artefacts, they had different approaches and comments. The approach of

Teacher B in assessing students' artefacts is to divide the total marks into two parts: design and function. Creativity is counted in the mark of design, and the mark for design and the mark for function are mutually exclusive. He commented that:

> "In our assignments, we have marks for design and function … If his artefact functions very well but its design is not very creative, the marks for creativity would not be high. Some students might be very creative, but his skill is not so good, so that the artefact does not function very well. The marks will show the differences under different situations."

Teacher C had a different point of view. He believed that if the artefact is not functional, it is not creative at the same time. An artefact with no functions is not creative. The function is also another factor in assessing creativity. He commented that:

> "Usually I have a high standard. In addition to creativity, the artefact students made must be functional. No matter how creative it is, being not functional is not accepted … It is a product design. For a product, it must be functional. If it is not functional, it is useless, no matter how your design is. It is my bottom line. Another thing is if it is not functional, I don't think it is creative from any perspectives."

On the other hand, Teacher D stated that he had different approaches for different types of assignment. In the assignment which focuses on the idea generation, the quality of the finished artefact is not counted in the assessment. He stated that:

> "For those assignments, we won't consider if the work piece is sawed nicely, because the emphasis is on the idea. How many percent you would allocate for creativity is a question to be considered. However, it is not absolute of course. Sometimes you need to develop a skill among students, then you need to have portion of marks for skills. Sometimes you only want the students to play with ideas."

Officers

One of the officers gave a suggestion on the appropriate standard used by teachers in assessing students' creativity. He mentioned that even though a student creates something which is not new in the market, it is new for him as he has never used or applied the method to solve the problems before. In this regard, using a world standard to assess students' creativity is not appropriate. He commented that:

> "But for him (the student), it is new. Therefore, in the learning process, it is creativity and also a kind of training. However, the end product might not be creative in terms of the functionality in the social context. If we use the standard of the world, he might not be creative…"

He believed that in assessing students' creativity, the assessment should be with respect to the creator but not other parties.

Besides, he also suggested that the weighting in assessment would affect students' creativity.

> "In the assessment scheme, creativity is not the only assessing criteria. For example, some assignments are technically inclined. How does technology weigh in the assessment? Therefore, the weighting might be important for the students..."

7.1.2.3. Teacher-student Interaction

When students are generating creative outputs, teacher often plays an important role, as most of the work done by students should be endorsed by the teachers in an East Asian classroom. The relationship between teachers and students thus become an essential topic which might govern creativity among students in classroom. In this section, responses regarding how teachers interact with students in the creative thinking process were reported. The responses can be divided into two different

categories. One describes how the teachers affect the creativity of students. The other describes how the teachers guide students to unleash creativity in project or competition. Students gave no responses towards this topic.

<u>Teachers</u>

Teacher A suggested that the interaction between teacher and students is essential in unleashing students' creativity. He said that:

> "... In what extent the student can unleash his creativity depends on the interaction between us. Sometimes he can give me something, and I believe that sometimes I also can give him something. It is just like sending gifts to each other, and this builds up a kind of partnership."

Teacher D had a similar comment. Teacher-student interaction is essential. The information needed for creativity might be recalled through the interaction. He commented that:

> "Actually it depends on the interaction between teachers and students. In the interaction, how the background and knowledge is reminded might have an effect (on the generation of creative output)."

Teacher F on the other hand pointed out that in order to cultivate creativity among students, teacher should be creative beforehand:

> "The teacher should be creative before a creative student can be cultivated. The teacher needs to be inclusive enough so that there is a safe area for students to do something which is in between safe and unsafe..."

Besides, teacher should not reject students' idea quickly. He added that:

"When we work for creative education in the future, we need to stop for a while and let students express them. Do not ban their ideas too fast ... actually everything that the student can think of should work. The problem is in what extent it works in teacher's point of view...."

When teachers were asked about the experience of how they guide students to unleash creativity in project or competition, some of the teachers showed that they have some practice when interacting with students.

Teacher A suggested that he tends to be an observer and gives advices to them from time to them. Similar to Teacher F, he also mentioned not to reject ideas too quickly:

"Brainstorming. We sit together, let them think freely. At the beginning I wait for them to think individually. Sometimes they have many ideas ... but as a whole I am an observer, they will lead me to think, and at some moments I will tell them if they can succeed in their knowledge. However, I won't ban their ideas completely, they really have a chance to succeed. I will give advices to them only. As a whole I would let them do whatever they want... "

Teacher D, based on his experience, suggested that too many descriptions on a project might stifle students' creativity:

"I can see that sometimes I talk too much, give too many descriptions (on the project) to them. Therefore, sometimes I feel that, in the other way round, if I have fewer descriptions to them, I can give them more space for creativity..."

Besides, he thought that giving adequate resources and advices at an appropriate timing are important. He added that:

"I think first of all you need to provide the students with adequate resources. Then the responsibility is on them. The responsibility for us in contributing to creativity is not to hinder them. When they feel

frustrated, or when they have difficulties, give 1 or 2 hints and let them think, and then they will be okay..."

Teacher E believed that problem identification is important. Teacher needs to let students understand where the problem is. When he was asked what if students understand the problem but they still could not be creative, he replied that support is very important in this case. He said that:

"I must give support to them. We are important, so I stay here (in the workshop) longer than they do ... I need to introduce to them and let them see. I ask them to read from computer ... I give the fundamental things to them to see..."

He also suggested that teacher needs to give chances for students to try on their creative ideas:

"We would let students try. If you have nothing for them to try, they cannot unleash (creativity). If there are no competitions, they would just sit here. However, if you have some channels for them to work, there are many rooms for them to create and unleash creativity."

Officers

One of the officers responded that while teacher is interacting with students, the teacher needs to be open-minded. Otherwise, creativity would be stifled. He commented that:

"What the teacher should aim at is the open-mindedness. No one can acquire all the knowledge and skills in the world. If the teacher still uses the old practice, that is when the teacher does not know that kind of knowledge, students are not allowed to work on that, then this will limit the development of the students...."

Subsequently, the role of the teacher is a facilitator instead of a knowledge transferor. He suggested that:

> "...the role of the teacher is to create a learning environment which is conducive to creativity. He should be a facilitator, but not a knowledge transferor... he is not the main source of all resources..."

7.1.2.4.   Emotion

As mentioned in the Chapter 3, emotion is closely related to design and creativity. Emotion might affect students' creativity in design activities. This section reports how the interviewed teachers described students' emotions during the design process or creative thinking process. Besides, students also described how their emotions changed when facing different situations and how they would treat the emotions. Officers had no responses regarding this topic.

<u>Teachers</u>

When teachers were asked about the emotions of their students, only some teachers were capable of addressing them. Besides, only few of these teachers could recognise students' negative emotions. Teachers also suggested some methods in handling students' emotions.

When asked if students had any negative emotions during the process of being creative, Teacher A commented that both teachers and students would have such feelings. He was aware that students experienced great emotional changes when they work in groups. Sometimes they argued with each other and some asked why his/her own idea was not appreciated by the other group members. He also noticed that:

"... Students at this age could not escape from their emotions easily. Their negative emotions would accumulate to such an extent that they could explode."

When he was asked how he dealt with such situation, he commented that telling students what is right and what is wrong is ineffective. On the contrary, he preferred to let them express themselves. He commented that:

"I prefer to let the student speak out the problems. After he has finished, I would then ask him to exchange his role with others' and let him think if he were his classmate, what he would do..."

Besides, he also expressed the view that sometimes he had to act as a cushion that absorbs students' emotions. He must act calmly and be a role model for students:

"... Sometimes when they are unhappy with their classmates, I would absorb their emotions. Then others will see even the coach (teacher) can absorb it, they will accept what their classmates has done in an easier way."

Similarly, Teacher B noticed that sometimes students quarrelled with one another during group projects. When asked how he managed this situation, he responded that he would ask them to calm down first:

"I would wait for them and ask them to take a walk outside and calm down. Everyone has emotions, and the most important issue was how they compromise, get used to each other, and how they change themselves..."

On the other hand, Teacher D did not think that students had unhappy moments. Most of the time his students were happy. He commented that:

"They always say they are unhappy. However, I think that if they are unhappy they can't make such artefacts. They would say very tough,

not enough time. Even though they said all these, I think they can enjoy the experience, and actually they are happy with it."

When he was asked if students had unhappy time in the classrooms, he replied that:

"Sometimes. But their expectation to lessons is a happy one. At most they might sit aside and not to work ... if they can invest into the lesson and they are willing to stay here, they are happy basically."

Students

Students also reported that they had unhappy or desperate time in the process of preparing competition or finishing D&T projects.

Student Ag commented that the process is tough and sometimes they also had quarrels with each others. However, she stated that there is no specific way to solve the quarrels. What they would do is to switch the focus to other things and stop quarrelling for a moment.

When they were upset and facing many difficulties, Student Ag said that their teacher would help them and then they would get happy again:

"... our teacher might generate something very creative suddenly, or he would say let's go to have dinner together tonight..."

Student Eb1 also had quarrels with classmates sometimes. He said that:

"Of course sometimes we would have quarrels. It is because the creativity of each person is different. That means he might think that a certain idea is better, but at the same time I would think another idea is better ... actually we always have quarrels in the D&T group..."

When discussing the topic of failure, Student Ab admitted that there were times of inadequacy. However, he would treat the failure as an experience. He expressed that:

> "... I treat failure as an experience. The what-so-called failure would bring you more afterwards. For example you would know you need to modify, or it doesn't work like this ... We would see failure as an enlightenment, but not treat it as a frustration. You fail for once then you are over, there is no such thing."

Student Eb2 said that when facing failure, he would also get desperate, and he would ask for advice from his seniors. He also has a good way to redirect his emotions positively. He said that:

> "When I have a creative idea, but its effectiveness is not significant, I would also be desperate. However, I would choose a sense of balance that I would treat it as a good start."

Similarly, Student Eb1 commented that when facing failure, he would get desperate at first. However, when he succeeded, he would be excited because he believed he would get praised.

Fb1 expressed that he enjoyed the progress of finishing his DSE project. However, it is the unhappiest moment when the deadline is near. He said that:

> "You are running out of time. At the beginning it was fun, however, it becomes a painful homework. You have to do it continuously to get it done".

Few students did not mention negative emotions. Student Fb2 expressed that he enjoyed the progress because what he was doing is his strength. Besides, Student Cb commented that the process of preparing competition is an unforgettable experience:

"It is unforgettable. We sometimes work on the robots late at night. We are together. People who have never participated in this kind of competition would not have this experience..."

7.1.3. Issues in D&T

'Issues in D&T' is one of the coding categories in the study. The coding category includes opinions from teachers, students, and officers regarding the current issues in D&T. This section presents opinions in relation to the roles of creativity. These opinions describe the situation of D&T in 5 different aspects. They are Environment, Teachers, Students, Implementation, and Assessment. Figure 7.3 below shows the number of interviewees who responded in these aspects.
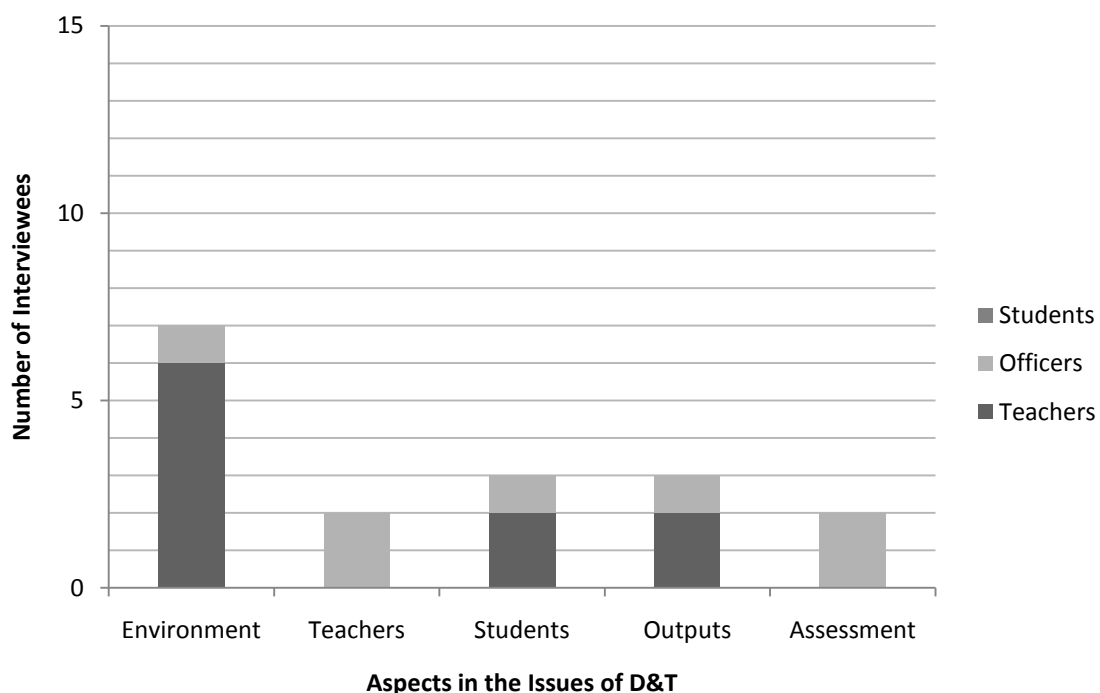
Figure 7.3. Number of interviewees responded to aspects in the coding category 'Issues in D&T'

Teachers and officers were the only respondents in this section. Students made no responses. It might due to the fact that students might not be aware of issues in the current educational policy. It can also be assumed that they might not know how D&T is implemented in other schools. Consequently, they might not have comments

on the current issues in D&T. Besides, only officers commented on the aspects of 'Teachers' and 'Assessment'. Officers might have a wider scope in commenting on the issues of D&T compared with teachers in schools, as they have made contact with many D&T teachers and participated in the public examination assessment. The lack of responses from teachers in these two aspects is still tolerable.

7.1.3.1. Environment

Section 7.3.1 reports opinions regarding the perceptions towards environments for fostering creativity. In that section, only students gave their opinions. Most teachers and officers tended to talk about the current environment of the cultivation of creativity in D&T instead of talking about the perceptions. Their comments are reported in this section.

Their comments can be further divided into 3 different sub-aspects: Education in Hong Kong, School Culture, and Learning Environment. Teachers and officers primarily focused on the issues that D&T teachers are facing in creativity cultivation in Hong Kong and in their schools, and how teachers cultivate creativity in classroom or other learning settings in practice.

Education in Hong Kong

One teacher and one officer commented that it is difficult to foster creativity in Hong Kong education nowadays. Teacher C commented that:

> "I believe according to the educational system now, it is difficult to train up a creative student. Comparing with other foreign countries, we have too many limitations."

The conformity of current education in Hong Kong limits the development of students, and creativity might be stifled since the students were young. One of the officers said that:

"It kills creativity since childhood. I don't know if other places are the same. The education in Hong Kong has no creativity when a child starts going to school. Why? You can understand from these examples. Chinese or Hong Kong people emphasise the training of conformity. Therefore, when you go to kindergarten, except those international schools, you have to learn to obey instructions, queue, not to move. Then you learn to write. How many pages you have to write every night is fixed. You must write in the grids, size must be the same. When you draw a sun, the sun must be a circle with some arrows round it. If you don't draw in this way, you are wrong."

He further commented that:

"Houses top must be a steeple. But if you ask the students, no one lives in this kind of houses. Then why the student has to draw a steeple house with a window in a 田 shape?[4] I found that creativity has been killed when they were young..."

Schools Culture

The school culture also affects creativity cultivation. As D&T is not the only school subject, supports from the principal and colleagues are also very important. If other school members do not value creativity, it is not easy for D&T to excel well in fostering creativity. Subsequently, teachers were asked if their colleagues or principal supported them in creativity competition or creative creation in D&T.

When Teacher B was asked if his colleagues were supportive to what they have done in competition, he replied that his colleagues were not very supportive but they appreciate their outcomes. He also mentioned a problem that he faced currently in

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[4] '田' is a Chinese character which means 'field'. The interviewee used the character to describe a shape in a drawing. Therefore, the Chinese character '田' is remained and is not translated into English.

front of his colleagues. Some of his colleagues argued why D&T, as a non-academic subject, could spend so much:

> "... The 100 thousand dollars is for all the students in the school. If you can represent Hong Kong to participate a competition like music competition, recitation competition, track and field competition, the school would support the students. However, the problem is, there are local competitions in other subjects ... but they could never join the international competitions. Therefore, the 100 thousand dollars is always spent by D&T. Other teachers also have some thoughts or comments on this ... some colleagues would think that why D&T spent so much, it is not a major subject, and university does not emphasise D&T, so then why D&T could spend so much."

This situation was not shared by other teachers in the interviews. Teacher A believed that the principal and colleagues were supportive to them:

> "The school provides many resources in this area and also encourages the students to participate in the creative competitions. They also agree that there is a mentoring effect when the students participate in this kind of competition ... As a whole it (the competition) provides a fundamental environment for students to try ... In this aspect, our school is supportive that creativity is an important element in education."

Teacher D also thought that the principal was supportive to D&T, and the knowledge of D&T of the principal also helped:

> "Our principal supports D&T ... I think he understands D&T, as he was very familiar with the D&T teacher in the school he worked before."

Teacher E commented that achievements and recognitions would be an important factor in gaining supports from school:

"It is possible for us to induce the school to support us ... After we gain the recognition, they will see this stuff can contribute to the school..."

Teacher C also commented that achievement is important; however, he also pointed out that D&T is also the first subject to be considered if the principal wants to cut budget:

"If the importance of the school subject is still there, the school would not cut it entirely. Sometimes you have to compete ... for example, we post all the competition posters on the board, compete so that more students can go out to enrich their experiences, and through the competitions we won some championships. First, we have done something. Second, we have some achievements to show ... but of course, if school wants to cut (budget), the first idea would be cutting D&T, because D&T spent a lot of money."

Teacher F, on the other hand, suggested a possible answer to the question why some principals do not support D&T in school:

"As I can see D&T is a fundamental life skill in a highly materialised society, it is a kind of common sense. However, others do not think so. The reasons why principals do not think so is that they think D&T workshop is so large and it is a waste ... The principal has never studied D&T and he doesn't know what can be learned in D&T ... He might think that even though he hadn't studied D&T before, he can still work as the principal now, so why do people have to study D&T?..."

Learning Environment

Even though the environment of Hong Kong and school culture are important in the creativity cultivation, the learning environment is also essential as it is the setting where students generate creative ideas. The learning environment is not limited to classrooms, but includes anywhere that students can learn through interacting with their teachers. In this aspect, teachers were asked to respond specifically how they would react if students propose ideas which are creative but unachievable.

Teacher A would give freedom to students and let them try the idea out to see if that works only if there were no safety problems. Safety was his major concern:

> "If there are no safety problems, I would let him do it ... I let them try freely, including time, materials, and something that they need me to provide continuously such as knowledge, I would help and let them continue to work for that."

Teacher C would not stop students from thinking. However, he would also let them understand that there is something that they could not achieve because of various constraints. He replied that:

> "I need to bring them back. It is like design. I cannot stop them from thinking and being free of the boundaries; however, after thinking you have to choose what can be done in practice. If you ask him not to think in this way, it doesn't work. This is one of the taboos in design."

He also expressed that teacher needs to let students speak out before telling them what problems they might encounter if they finish the work in a certain way. He also commented that it does not matter if students fail when they try things out:

> "... sometimes you need to let them fail. But what I can do is to give them resources that I can provide. It is okay to let them fail, if it is good for the students in a long run."

Teacher D has a similar approach of guiding students. However, he commented that teachers might need a lot of effort and time for guidance, and sometimes he may not able to do that:

> "I would guide him (the student). This is the biggest problem now. You need to give him hints but not the solution. However, very often I am very tired and give him the solution ... sometimes when I have more time ... I will give him hints ... and in this way students usually can create something interesting."

Similar to Teacher A, Teacher E commented that if the idea is dangerous, he would not let students do it. Otherwise, he would allow students to try. He would also tell the students what would not work and give instructions to them for modification. However, he also expressed that sometimes it varied from situation to situation if the resources are limited.

7.1.3.2. Teachers

The quality of the teachers also affects creativity cultivation. Officers in this section commented that there are several issues concerning teachers. From their experiences, it can be seen that these issues hinder the development of creativity education in D&T.

One of the officers commented that teachers are unwilling to change. When he attended a seminar some time ago, he found that teachers have not changed. However, whether creativity can be fostered depends on the teachers:

> "It is the factor of people ... Recently I went to a seminar, I see that the attitude of the teachers has no change..."

He believed that it is because of the training and the backgrounds of the teachers:

"...Because of the training or the backgrounds of the teachers, even though some students have some very good ideas, they cannot support the students."

He also supported his idea by stating that teachers could have full control in the classroom, they could teach whatever they wanted:

"… you change the name, we teach the same. The classroom is the kingdom of the teacher. It is up to the teacher how to teacher as he likes…"

The other officer also commented that the teacher is one of the factors and they themselves lack creativity so that projects also lack creativity. It might be because of their traditional training:

"The training of the teachers is relatively inflexible. The inflexibility is one of the severe problems ... the teacher should possess creativity … how do they effectively use the teaching materials in class? It is the creativity of teachers. However, the problem is, now most of the D&T teachers are traditional, or rigid, they would think that the best is to give them a set of materials and they can follow the set and teach … they don't even think, they are like craftsmen, craftsmen of teaching ..."

He further added that teachers do not like assignments which could result a large variation, as this would increase their workload:

"… If you need teachers to teach in a way that he have to ask students to draw an object freely using AutoCad, then the teachers start to get unhappy. That means they have to teach individually. When every student draws different objects, the workload of teacher will increase …"

Similar to the other officer, he believed that teacher is the major factor in fostering creativity among students:

> "… If the teacher himself is willing to devote, he can teach students to be very creative … actually it depends on the teacher. I think that it's the willingness…"

7.1.3.3. Students

Teachers are not the only group of people who are encountering issues in cultivating creativity. Students also have some issues to be concerned. Even though some students might be creative, a large proportion of the students in Hong Kong do not understand creativity, they do not have the ability to be creative, or they even do not want to be creative. When one of the officers was asked to comment on how Hong Kong students understand creativity, he said that:

> "I think they have no understanding on creativity. I think they even do not know why they need to go to school ... They do not know D&T is related to creativity, and they do not know what they are learning. They just think D&T is fun ... They do not emphasise creativity and they may even think it is troublesome. The best is to tell him what to do directly."

Coherent with the comments made in the aspect of Environment, he again commented that students lost creativity since childhood, and scoring marks in examination becomes the most important:

> "... however for our students, they have lost the creativity when they were young, they don't dare to do anything, they never think of doing that, or the best is you tell them what to do directly so that they can score marks, or tell them what is correct."

He also pointed out that students in Hong Kong are rather reluctant to express themselves:

> "If you look at the society, Hong Kong students are passive relatively. I think it is one of the influences to creativity. Being passive means you don't dare to think, let's not talk about doing first, doing is another matter, not dare to think, it is a problem already. Daring not to think means the student never thought things can be done in a certain way, or they even haven't thought of how it can be done in a better way…"

Besides, some students even do not have the ability to express themselves:

> "… they even don't dare to express. If you ask him to express himself, they don't know how to express. They cannot express what they have in their minds …"

Teachers, instead of commenting on the general problems of students in Hong Kong, they shared students' current problems when they promote creativity. Teacher F commented that there are problems in cultivating creativity among low ability students, because it is a must for them to understand the fundamental knowledge before creating; however, it is not easy for lower academic ability students:

> "… you need to have a concrete fundamental knowledge base. You need to know what the market has … and this is one of the problems when we promote technology education among lower academic ability students."

In Teacher D's opinion, students need to understand the fundamental knowledge and manipulate them. However, students could not transfer what is learned to other contexts, and this hinders the development of creativity among students:

> "A problem that all students in Hong Kong or Hong Kong education are facing is whether they can transfer their knowledge. Now what students learn is not transferable. The knowledge learned in Physics cannot be applied in D&T, but actually sometimes you will use it …

> Whether they can exceed the subject boundary is a general problem of
> Hong Kong students."

7.1.3.4.   Outputs (Artefacts)

Some teachers pointed out that the quality of students' artefacts diverges when they encourage students' creativity in D&T. When Teacher D was asked how he could unleash students' creativity, he said he would give fewer descriptions and instructions for students to think freely. However, there is a side effect that sometimes students might submit a very simple design and some of them might feel frustrated. He said that:

> "Yes. There are some very simple designs. It is because we told them
> the minimum requirements..."

However, at the same time Teacher D thought that it is very individualised that for practical subjects such as D&T, the student might only be able to do a certain kind of work at that moment. He also believed that the basic requirements he gave to students could trigger students' thinking. He expressed that giving appropriate support is not easy, especially when the project involves difficult technology contents:

> "The difficulty is how many supports are appropriate so that their
> development and creativity wouldn't be limited ... especially when the
> project is related to more complicated technology, like robots ... the
> more complicated the outcome of a project is, the more time you need
> to input…"

Teacher A also had a similar comment on the diverse quality of students' artefacts.

> "… Some students are not willing to think … the difference is large.
> That means those who are willing to think are push and he will make
> some creative stuff, and they will get better and better. Those who are

more passive, easy to give up, not willing to overcome difficulties will get worse. The diversity is large, and it is different with the assignments in which more instructions are given…"

He believed that there is a cost for creativity:

"It (D&T) is an environment which encourages students to act creatively. Sometimes we need to pay the cost, or it is the cost of this subject ... this subject gives a chance for him (the student) to hide, but there is no such chance to hide in other subjects ... he must finish the assignment, he must think hard in other subjects, and in this aspect he is okay. But when he comes to D&T, he hides as he can."

When he was asked how he could solve the issue, he said he could show them how active other classmates are so to motivate them. However, he could not think of any instant methods to solve the issue.

The comment made by one of the officers also noticed this potential problem. He stated that it is not guaranteed that promoting creativity would grant teachers and students a success, which is very much unlike the traditional craftwork:

"Creativity not necessarily generates a good outcome. However, the training that we had always has a good one…"

7.1.3.5. Assessment

Officers pointed out that while promoting creativity, the issues of assessment in D&T is getting problematic. Some policies of assessment in public examination had changed so that students could have more rooms to unleash their creativity. However, this in turn generated some other issues. One of the officers stated that starting from the year 2014, no project topics will be offered to students in the DAT school-based assignment of DSE. There are no themes to guide teachers and students in choosing

a topic, and students can have the freedom to choose any topics to work on. He commented that teachers and students would feel very difficult in this situation.

> "If the students are really very creative, 20 students in a class, then the teacher have to guide 20 independent projects. And how should the teacher assess students' projects?"

> "It is not possible for a comparison. Comparing them through which perspectives? The assessment falls back to the pervious form. That means to assess information collection. It is retrogression, falling back to the time when we had a very objective standard to assess students. Is it fair to the students? Some might have better presentation skills, and some might write better. These students might then get higher marks, but this doesn't mean that they are creative..."

In addition to the difficulty in assessing students, he further added that there is a potential problem if teachers are not enthusiastic towards creativity:

> "If the teacher is lazy, he would not let students choose their own topics. The teacher would choose the topics for the students, and he might choose the same topic for 5 years or 10 years. In this way, the problem is solved by problem solving. And he doesn't need to bother. All the information is there, students can use them each year. After the first cohort has finished the project, the second cohort has references and the students can do even better ... in this way, the problems of the teachers and students are all solved. You want to encourage creativity, but eventually, creativity is gone after the problem is solved."

He also gave a real example of a D&T teacher in school of Hong Kong. He recalled that the D&T teacher indeed chose a topic for all the students, and all the students work on the same project in the public examination. However, the officer also understood that this might be one of the ways to deal with students with lower academic ability, as at least these students are willing to finish the project. It might not be practical to ask this kind of students to design and to think.

This is not the issue on the topic of assessment. Some teachers had their own requirements on projects and artefacts that limit creativity of students. This limitation was reflected on the marks given by the teachers that an artefact which is creative but not presented in real would not score high marks. As the other officers commented that:

> "Some teachers only accept a tangible artefact as the outcome of an assignment. The artefact must be functional and workable … If you do a simulation, or make a paper model, the teacher would think that is not adequate ... he would deduct your marks. Even though you are very creative, sorry, your marks will not be high …"

7.2.   CONCLUDING REMARKS

Six teachers, seven students and two officers were involved in the interviews. The chapter presents their perceptions towards the definition, the 4P's of creativity, and other coding categories which are related to the roles of creativity and the objectives of the study.

It is noted that there are more summarised views from teachers and students than from officers in the first two sections (including categories of definition, output, process, person, environment, learning to be creative, assessment, teacher-student interaction, and emotion) because there are more questions for teachers and students than for officers, and some questions cannot be found in the interview guides of officers. In the last sections 'Issues in D&T', there are more summarised views from officers than from teachers and students, as officers have a wider scope in commenting on the issues of D&T compared with teachers in schools. The findings of the empirical study are summarised in the followings.

Definition

Teachers believed that:

- Creativity is different from the routines.
- Even some ideas are yet to be noticed and recognised, they still can be regarded to be creative.
- It is out of boundaries.
- It has different forms in different ways of compromising various constraints.
- It only appears in an appropriate space-time.
- Modification and arrangement is also a kind of creativity.

Officers believed that:

- The definition of creativity varies in different time, space and for different person.
- Creativity is not limited in thinking but also the operational process.
- Creativity is not to think without boundaries, but to manipulate resources in certain restrictions.

Students believed that:

- Creativity is curiosity from a children's perspective.
- It is a kind of bravery.
- It is thinking out of the box.
- Creativity can be subjective and might not have a universal definition.
- It is a product and also a kind of thinking method.
- It is something not normal.
- Creativity associates with the creation of output from null entity.
- Modification is a kind of creativity but at a lower level.

Output

Some teachers believed that:

- A creative output should be new and has not predecessors.
- Creative output should have special and personalised features.

- An additional meaningful and useful function and elegancy are also the characteristics of a creative product.

However, some teachers believed that:

- A creative output needs not to be new, as many combinations are not new but creative.

Students believed that:

- Creative outputs have no common features.
- They are out of common sense and not in the rational and logical way.
- Outputs which have no predecessors are creative.
- Creative outputs are new with respect to the creator.
- Outputs which are created by some kinds of combinations are creative.
- Creative outputs should give improvements to a product and the living standard
- They have the ability of inspiring others and creating emotional impacts.

Process

Teachers believed that:

- Design process might not guarantee a creative output.
- A creative thinking process might not have stages.
- Creative output is generated in an illumination or even by a sudden.
- Creative thinking process is different from design process.
- Problem identification is also one of the concerns in the creative thinking process.

However, some teachers believed that:

- Creative thinking process is equivalent to design process. Whether a creative output can be generated depends on the person.

Officers believed that:

- The creative thinking process should include investigation and application of the idea to another context.

Students believed that:

- Creativity cannot be achieved through a routine way.
- Collecting information before idea generation might induce some limitations in thinking.
- Creativity should have no procedures, but the procedure of evaluation is needed after idea generation.
- Creativity is achieved by many routines methods.

However, some students believed that:
- It is still possible to follow a method or a rational way to be creative.
- The creativity obtained randomly and in a rational way might be different.

Person

Teachers believed that:
- Creative persons are calm and persistent. It is not easy to cultivate creativity if these characteristics are missing.
- Some of the creative students do not behave well in class but they are clever.
- Some of them tend not to follow regulations or teachers' instructions.
- Sometimes creative persons are considered as abnormal.

However, some teachers believed that:
- Some of the creative students might behave quite well.

Students believed that:

- Creative persons are humorous.

- They might not be talkative.

- They have good presentation skills.

- They are brave enough to challenge teachers in class.

- They might be perfectionists and they are special among others.

- When working with creative persons, it is essential to remind them to evaluate their creative ideas.

Environment

Teacher believed that:

- Creativity is related to the environment.

Students believed that:

- Creativity is demanded by environment.

- Environment has an influence to creativity.

Learning to be Creative

Teachers believed that:

- Creativity is both an innate and a learned ability.

- Training for creativity is necessary in creativity cultivation.

- The training must be based on some inborn characteristics, abilities, or personalities so that the training is effective and successful.

- Creativity can be cultivated to a certain level even though a person was not born to be creative.

- It is not guaranteed that the training will grant you a successful outcome.

- The cultivation of creativity is not for experienced people.

However, some teachers believed that:

- Creativity is inborn, as this is the personality.

Students believed that:

- Creativity is both an innate and a learned ability.
- Everyone possesses creativity.
- It is up to the personal will whether he wants to be trained.
- The ability of creativity might decrease along with age.

Assessment

Teachers believed that:

- It is difficult to assess creativity.
- Functionability is one of the governing factors of creativity and thus creativity and functionability should be assessed together.

In practice:

- Some teachers would assess creativity separately or incorporate the marks for creativity into the marks for design.
- Teachers would assign 30-50% of the assignment marks for creativity at Secondary 1 to 3.
- Functionability and creativity are assessed separately.
- Some teachers would select different approaches to fulfil different purposes of different assignments.

Officers believed that:

- The assessment of students' creativity should be with respect to the individual but not other parties.
- Different weighting of assessment criteria would affect students' creativity.

Teachers-students Interaction

Teachers believed that:

- The interaction between teacher and students is important.

- It might help recall essential information needed through the interaction.

- Teachers should be creative as well in creativity cultivation among students.

- Teachers should not reject students' idea quickly and let students think freely.

- Sometimes teachers might give hints, advices or supports to them in an appropriate time in the process of idea generation.

- Teachers should not give too many instructions to students.

- It is important for teachers to give chances to students in unleashing their creativity.

Officers believed that:

- Teachers need to be open-minded.

- The role of the teacher is a facilitator instead of a knowledge transferor

Emotion

For teachers, it is found that:

- Only some teachers were capable of addressing students' emotions, and only few of these teachers could recognise students' negative emotions.

- Some teachers can see that students have unhappy moments in the design process, and they might use some strategies to deal with students' emotions.

- Some teachers think that students are quite happy most of the time.

For students, it is found that:

- Students sometimes might have unhappy times when facing failures or deadlines.

- Their teacher would help them and then they would get happy again.

- Some of them can face the difficult times wisely by their own methods.

- Some of them treat failure positively.

- They might have some quarrels with their classmates.

However, it is also found that:

- Some are very positive towards the entire design process or creative thinking process.
- Few students did not mention negative emotions.

Issues in D&T

The environment issues in D&T includes the followings:

- Regarding education in Hong Kong, it is found that:
  - It was difficult to foster creativity in Hong Kong education nowadays.
  - The conformity of current education in Hong Kong limits the development of students, and creativity might be stifled since the students were young.

- Regarding school culture,
  - Some principals and colleagues of teachers were supportive, but some were not.
  - Colleagues might be jealous of D&T because of the huge amount of money spent in D&T.
  - Achievements and recognitions would be an important factor in gaining supports from school.
  - D&T is the first subject to be considered if the principal wanted to cut budget

- Regarding learning environment,
  - Safety is the major concern, and teachers would let student try if it is not dangerous.
  - Teachers would also let students understand the limitations, but students can think freely.
  - It does not matter if students fail when they try things out.
  - Teachers might need to put a lot of effort and spend a lot of time for guidance.

   ○ Sometimes teachers might not be able to guide students but to give the solution to them directly.

   ○ If the resources are limited, teachers might not let student try as much as they want.

For issues regarding teachers, it is found that:

- Teachers are unwilling to change because of their training and the backgrounds.
- Teachers lack creativity so that projects also lack creativity.
- Teachers did not like assignments which could result in large variations, as this would increase their workload.

For issues regarding students, it is found that:

- A large proportion of the students in Hong Kong do not understand creativity.
- They do not have the ability to create, or they even do not want to be creative.
- Students lost creativity since childhood, and scoring marks in examination becomes the most important for them.
- Students in Hong Kong were rather passive to express their ideas.
- It is not easy to cultivate creativity among lower academic ability students because they do not have the ability to acquire the necessary knowledge.
- The knowledge students learned are not transferable, and this hinders the development of creativity among students.

For issues regarding the outputs done by students, it is found that:

- The quality of students' artefacts diverges when promoting creativity.
- Sometimes students might submit a very simple design.
- There is a cost for creativity, and it is not guaranteed that all outputs are creative, and some students are left as they 'hide' in D&T when teachers give them freedom.
- Giving appropriate supports is not easy, especially when the project involves difficult technology contents.

For assessment issues in practice, it is found that:

- Teachers and students feel very difficult in guiding, assessing, and working on projects when no topics or theme is provided.

- Some teachers even assign all the students the same topic to save troubles.

- However, this is also a method to get lower academic ability students engaged in the projects.

- An artefact which is creative but not tangible would not score high marks.

It is believed that similar findings would be arrived at if more creative teachers or students or officers were interviewed, as some of the responses given by the interviewees have been overlapping. The data given by the creative teachers and students and the officers in this study should be adequate to describe their perceptions on creativity. There should be no other extreme comments if more creative teachers or students or officers were interviewed.

Chapter 8

Analysis and Discussion of the Empirical Study

The findings of the empirical study presented in Chapter 7 were analysed and discussed with supporting literatures in this chapter. In order to have a systematic analysis and discussion, all data were discussed in 5 different sections: output, process, person, environment, and definition. However, these sections are not identical to the sections in Chapter 7. They were extended in a way that not only the corresponding coding categories were included, other coding categories related to these topics were also discussed, as the major focus of the discussions here is not on each coding category, but what the coding categories collectively implies. Besides, the roles of creativity were also discussed in this chapter. They roles were summarised from the discussion of the 5 sections. The chapter also highlights related issues, applicability and application of the roles.

8.1. OUTPUT[5]

Responses from teachers and students are comparable to the literatures that a creative output possesses novelty and appropriateness (see Atkinson, 2000; Hoard et al., 2008; Howard-Jones, 2002; Mayer, 1999; Sternberg & Lubart, 1999). Their responses are also coherent with their perception to the definition and the process of creativity that

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[5] The section analyses and discusses findings from Sections 7.1.1.2. Output and 7.1.3.4. Output (Artefacts).

creative output should be out of common sense and it cannot be achieved by a logical way. Some of them also suggested that emotion is involved in creative outputs. This echoes with the literatures regarding emotions in Chapter 3 (see Averill et al., 2001; Bass et al., 2008; De Dreu et al., 2008; Filipowicz, 2006; Perry, 1989; Russ & Schafer, 2006; Sung & Choi, 2009; Van Kleef et al., 2010). Interviewees not only emphasised novelty and appropriateness but also some ideas which are not covered in the literature reviews. Besides, even though interviewees had positive viewpoints towards creative outputs, they had highlighted the issues of the output in current design education.

8.1.1. Towards an Educational Perspective

8.1.1.1. Appropriateness

Appropriateness might be simply related to the ability of the output in solving a problem in the discussion of its assessment (see Howard et al., 2008). However, if we consider appropriateness as the output's value as suggested by Averill et al. (2001), the issue becomes more complicated because values are not differentiated by high or low levels, but by different natures, purposes, and outcomes. Teachers and students interviewed also addressed appropriateness in these two perspectives.

One of the values suggested by one student (Student Fb1) is that a creative product should improve to the product itself or our living standard. A product is valuable if it can lead to improvements. In addition to improvements, one teacher (Teacher D) mentioned that a creative product should be elegant. That means the product not only needs to be appropriate in solving the problem but also be able to induce a feeling of elegancy to its users. It has values in a way that it gives users the joy of using it. For example, a device for shelling shrimps is now invented. A huge and noisy machine to shell shrimp is not considered creative. However, a small and user-friendly utensil which shell shrimps just by a simple touch may be creative.

Besides, the teacher also thought that a creative product should have special intentions which were personalised. He suggested that the appropriateness involves

interaction with users. The creative product should give a kind of feelings to the users that the product is not only appropriate for solving the problem but also appropriate for them to use.

The above discussion might refer to as the valuable appropriateness suggested by Averill et al. (2001). Valuable appropriateness refers to the appropriateness that focuses on the values of the creative output, but not its ability of solving the problem. As for the ability of solving a problem, it can be regarded as the functional appropriateness. In this thought, functional appropriateness may be the basic requirement of valuable appropriateness and also the fundamental of a creative product. Figure 8.1 below clearly shows the hierarchical relationship of the valuable appropriateness and the functional appropriateness.
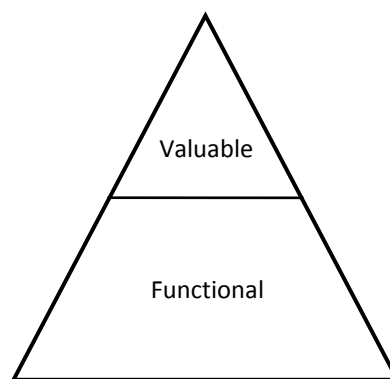
Figure 8.1. Appropriateness hierarchical triangle

In the discussion of functional appropriateness, another teacher (Teacher C) believed that in order to be creative, a product should be functional and possess more meaningful and useful functions in combination. He gave an example of a tape holder to illustrate this idea. He would not think a gun-like tape holder is creative if its appearance was just for fun but without other meanings or purposes. This implies that combined functions which do not solve related problems are not creative.

The above discussions suggest that both valuable and functional appropriateness in a creative product are not as simple as it appears. Sometimes problems are linked together, and appropriateness has to be achieved in different dimensions. The

interaction between a function and another function, the functions and the product, and the product and its users should be appropriate as a whole. However, if this standard of creative product is used in design education, creativity would be very rare among students because secondary school students might not be able to achieve it.
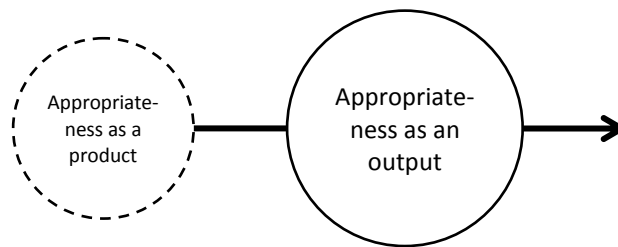
Figure 8.2. Shift of appropriateness

From a macro perspective, appropriateness should be regarded as the appropriateness of the product up to the standard mentioned above. However, as it is difficult for the secondary schools students to achieve the standard, and it is undesirable to discourage creativity among them, the appropriateness in educational context is best to be considered as the appropriateness of an idea or an output in a product. That means teachers should not apply their macro definition and standard of creative products on their students in classrooms. However, to what extent teachers should apply the standard in educational context greatly depends on their perceptions on creativity. Teachers have to be conscious of their requirements and perceptions of creativity.

8.1.1.2.   Novelty

Teachers and students generally believe that creative output should be new and have no predecessors. In spite of this, there is a conflict that some teachers believe novelty is not a necessity of creativity, as the combination of functions in a creative product might not be new. Students also mentioned that combination is a kind of creativity, but they did not relate combination with novelty directly. These comments might

imply that teachers overlook the novelty hidden in combination. Sometimes the act of combination or what are being combined might not be new, but the result of the combination might be new. However, it is more appropriate to judge whether the combination of functions is both new and creative case by case, as it greatly depends on the outcomes of the combination.

According to the literature, the creative output should be novel (see Averill et al., 2001; Bass et al., 2008; De Dreu et al., 2008; Filipowicz, 2006; Perry, 1989; Russ & Schafer, 2006; Sung & Choi, 2009; Van Kleef et al., 2010). However, at the same time we also understand that creativity can be categorised in two kinds: historical and individual, suggested by Boden (2004). It is also clear that the P-creativity should be more important in educational context (Howard et al., 2008), as education is interested in educating individual to reach his/her full potential. The contribution the person can make to the world is less important comparatively, as long as the person excels in his best. Despite the importance of the P-creativity in the literature, only one student interviewee (Student Cb) mentioned that the novelty of a creative output should be with respect to the creator. It can be argued that other teacher and officer interviewees were not aware of the P-creativity.

Novelty is with respect to the history, the culture, or to the second or third parties from a macro perspective. However, in educational perspective, it should be with respect to the creator himself. Otherwise, it is difficult to promote creativity, as students are unlikely to achieve the H-creativity. For example, sometimes students might have created some ideas in which they have not created before. If teachers compare their ideas with other products in the market, in the history, or in their own knowledge, students might then be discouraged in working on creative products because they would understand that their products would never be better than those in the market, and it is very unlikely for them to be more knowledgeable than the teacher. If the teacher can recognise students' achievement in P-creativity and encourage him accordingly, students may be more willing to work on his own creative ideas. In this case, creativity is promoted. Consequently, the novelty with respect to the creator (student) should be emphasised. Figure 8.2 below shows the necessary shift of novelty in design education.
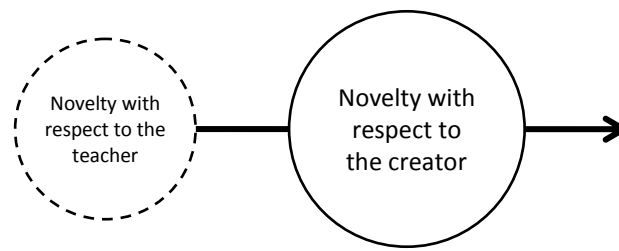
Figure 8.3. Shift of novelty

Nevertheless, it does not mean that teachers should stop at the requirement of P-creativity in the long-run. Teachers should, according to the level of the students, guide students to try their best. Also, focusing on P-creativity does not mean to limit the vision of students. Teachers also have to facilitate students in understanding the creativity of the world by learning different knowledge. In this way, students' creativity would be encouraged, and at the same time, they would not be ignorant about what is happening in the world. The prior knowledge they need for creativity can also be reinforced.

Furthermore, in the discussion of the functions' combination, the main focus should be placed on how teachers value novelty with respect to the students. If a student has never done any similar combinations before, he is creative when he combines different functions together. Again, the development of students' creative ability should not stop at combination, and teachers should encourage students to achieve more in being creative.

8.1.2. Resulting from Creativity

Novelty and appropriateness are not the only points for discussion on creative output. There also some discussions which are not covered by the literature yet. Some students concerned the by-product creative output can give. These by-products are not considered as the valuable appropriateness because they are not intentionally designed by the creator or designer. However, they cannot be neglected, as they are

some characteristics of a creative output or product which are identified by the interviewees.

One student (Student Fb2) believed that a creative product should inspire people. That means when a person comes across a creative product, the creative product will inspire him in thinking of other creative ideas. However, it can be argued that the inspiration comes because of the person's personalities, characteristics or abilities related to creativity. If it is the case, an idea in a less creative product might also inspire the person to generate creative outputs. The person can be inspired regardless of the products' creativity. It is questionable whether the product provides the person with inspiration or the person finds it.

If the inspiration comes because of the creative characteristics of the product, that means the creativity in the creative product is not limited in the product itself, but is transferred and then benefits to other potential creators. This is surely more favourable in educational context because the person is not the factor of the inspiration here. That means students can be inspired when coming across creative products. However, if the inspiration comes because of the person, the focal point will be on the creative person, and this will be discussed in Section 8.3.

Teacher interviewees also have different approaches on these two thoughts. Some teachers might introduce some creative products to their students to inspire them. However, some teachers might believe that giving students a creative product might limit students' thinking, and the best way of stimulating creativity is to give fewer instructions. Nevertheless, the inspirational characteristic of creative products cannot be neglected that it is beneficial to some students in design education.

In addition to the inspiration drawn from creative products, another student (Student Ab) believed that a creative product or idea should have emotional impact on others. In other words, when a person comes across a creative product or idea, he/she will experience an emotion. In the literature review, it is discussed that emotion, design, and creativity are related with each other (see Figure 3.9). The direct relationship between emotion and creativity emphasises the favourable kinds of emotions to creativity and the affect processes that lead to creativity in design (e.g. Filipowicz,

2006; Russ & Schafer, 2006), but not the emotional impact that is aroused after encountering a creative output. Also, it seems that there is not much research focused on the topic of the creative output and emotional impact. It might be due to the fact that the relationship between the two might not have explicit contributions to the creativity cultivation. However, it might be helpful in defining what a creative output constitutes or what creativity involves.

8.1.3. Issues of Output in Practice

Sections 8.1.1 and 8.1.2 discuss the perceptions of teachers and students towards creative outputs and the implication to design education. It is believed that if teachers can view creative outputs from education perspective, creativity can be promoted more effectively in the classroom. However, teachers encounter some issues in receiving artefacts from students, and the educational perspective mentioned in the previous sections might not help solving them. These issues are influential to the cultivation of creativity.

Teachers who believed that giving less or basic descriptions and instructions to students might help unleash students' creativity encountered a problem in general. They commented that sometimes they would receive extremely simple designs. The diversity of the artefacts' quality is extreme. Some students are able to create creative products but some students can only submit simple designs which only meet the minimum requirement. Those who are more motivated in the classroom can learn a lot in the process, but those who are more passive will only get worse in learning. Teacher also found it not easy to give appropriate supports to the passive students.

It is understandable that when students are motivated, they will put more effort and time in finishing the project, suggested by the motivational creativity of Amabile (1983; 1996). They will get more successful experiences after series of activities. However, those who are not willing to contribute more in the projects just want to finish the job as soon as possible. They will not do more than getting a pass. As the minimum requirement is already given by the teacher, they understand that if they can meet the minimum requirement, they will get a pass. In this circumstance, their

artefacts will be very simple, and they cannot learn or even try to be creative in the design process. As the instructions and requirements given by the teacher are the bottom line, teacher can push the students to make a better artefact by setting more requirements on the quality. However, even though the artefacts submitted by the passive students improved, the students are still not willing to contribute more on thinking and creating newer or better ideas. Creativity is still not promoted among this kind of students. The only advantage of having more requirements is that products' qualities will be better on average, and it is more favourable in presenting the overall achievement of students to the principal and colleagues.

There is a possibility that giving more instructions might limit creativity of other creative students. Teachers have to choose between the average qualities of products or creativity. It seems unavoidable if the teacher chooses to give only basic instructions and gives more freedoms for students to be creative, he/she might lose some students in cultivating creativity. One of the teachers interviewed also commented that it is the cost of creativity in design education. If the teachers want to promote creativity, they are bound to have some students who are not catered for in the classroom. Figure 8.4 below shows the results and problems of giving different amount of instructions to students.
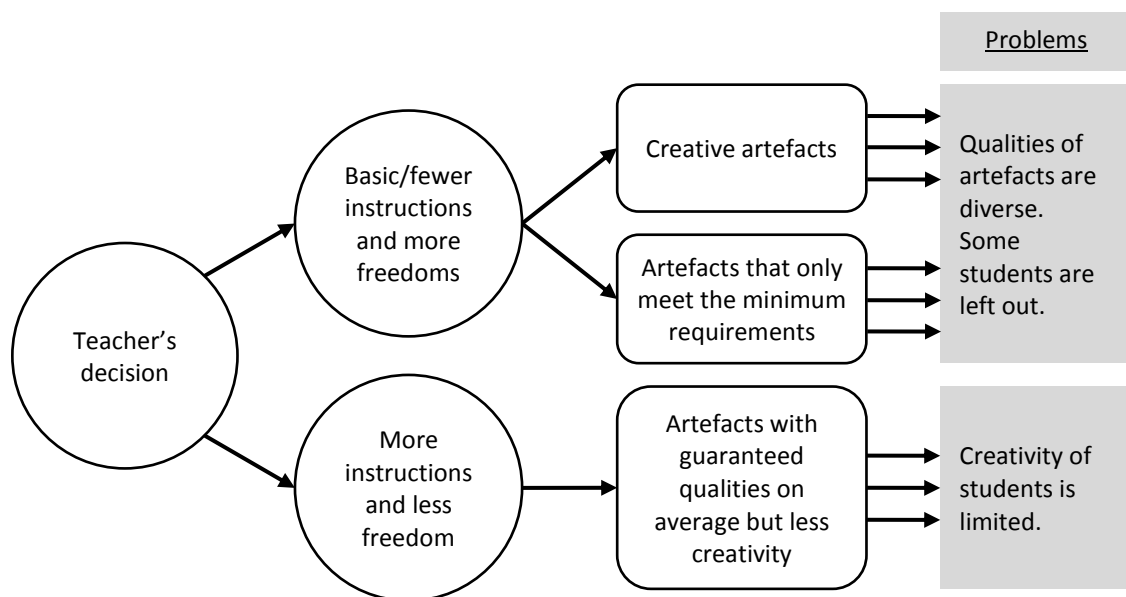
Figure 8.4. Results and problems of different approaches in design projects

The results presented in Figure 8.4 are surely not desirable in design education, as no matter which approach is applied in the classroom, some students are not benefited. Nevertheless, the approach of giving basic or fewer instructions and more freedoms to students is becoming more popular among D&T teachers. It might be due to the fact that giving more instructions and less freedom is similar to the teaching method of traditional craftsmanship training in 1980s. One of the officers also suggested that the traditional training we had in craft-based D&T always had a good outcome, but the situation is not the same in creativity and design education nowadays because the outcome of being creative might not be good sometimes.

The issue discussed above leads the discussion to the inclusiveness of all students in cultivating creativity, as it concerns whether creativity of all students can be promoted. If creativity cannot be promoted among all students in class, and the effectiveness is not signification for those who are not motivated, it can be argued if such creativity education should be made available to some students only. It might not be necessary to spend resources on all students, as some of the students would be left out. Subsequently, whether creativity education is a kind of gifted education or education for all is of question. However, if we consider design education as a platform for students to be creative, every student should have the rights to perform on this platform. Students should have equal opportunities on this issue. Furthermore, as stated in the introduction, there is a need for all students to tackle problems requiring creativity in various disciplines. If it is true that creativity can be acquired and learned, creativity education should be offered to all students.

In these circumstances, teachers might have to cater individual needs of students attentively. Teacher could give basic or fewer instructions to the whole class. Students who are more creative might then be able to unleash their creativity, realise their ideas and create their products. However, when the teacher observes that there are some students who are more passive and less creative in the design process, he might need to give more instructions to them. The question is to what extent the teacher should give the instructions and how often the teacher should guide the passive students. One of the teachers (Teacher D) also reflected that giving appropriate guidance and instructions is not easy. Teachers have to spend a lot of

time and put a lot of effort on students. The challenge is considerable, as teachers at present encounter different issues from the East Asian context, historical factor, and special situation of D&T in Hong Kong. Teachers have to understand students so as to guide them in an appropriate way. However, this concerns teacher-student interaction and relationship in the design process, and this is discussed in the next section.

8.2. PROCESS[6]

Teacher and student interviewees sometimes regarded 'the process' as creative design process instead of creative thinking process. They did not have a very clear differentiation among creative thinking process, creative design process, and design process. As Howard et al. (2008) suggested that design process is comparable to creative thinking process, and creative design process is a kind of design process, it is unsurprising that they had the ambiguity.

Teachers and students have diverse comments on the creative thinking process. Some of their comments are similar to the literature. Some of them are quite interesting that they give insights to what creative thinking process is.

8.2.1. Towards an Educational Perspective

Even though creative thinking process and design process are comparable, they are two different thinking processes. According to the literatures, they are combined to form the creative design process in different ways (see Gero & Kannengiesser, 2004; Howard et al., 2008). They are similar but not equivalent to each other. However, some teachers mixed up the two processes and also the creative design process. They believed that design process is indeed the process which leads people to creativity. Different people would produce different outcomes in the design process, because people have different backgrounds and abilities to deal with available knowledge and

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[6] The section analyses and discusses findings from Sections 7.1.1.3. Process, 7.1.2.3. Teacher-student interaction and 7.1.2.4. Emotion.

resources. In spite of the confusion on the perception of the two processes, their comments on the reasons why some people can generate creative output contribute more than those comments made by people who can distinguish the two processes. Teachers who can distinguish creative thinking process from design process believed that creativity is achieved through illumination. Although the idea of illumination also exists in the literature (see Wallas, 1926), this does not help students be creative (Guilford, 1987). Figure 8.5 below presents the perception of teachers towards the processes and the way of achieving creativity.
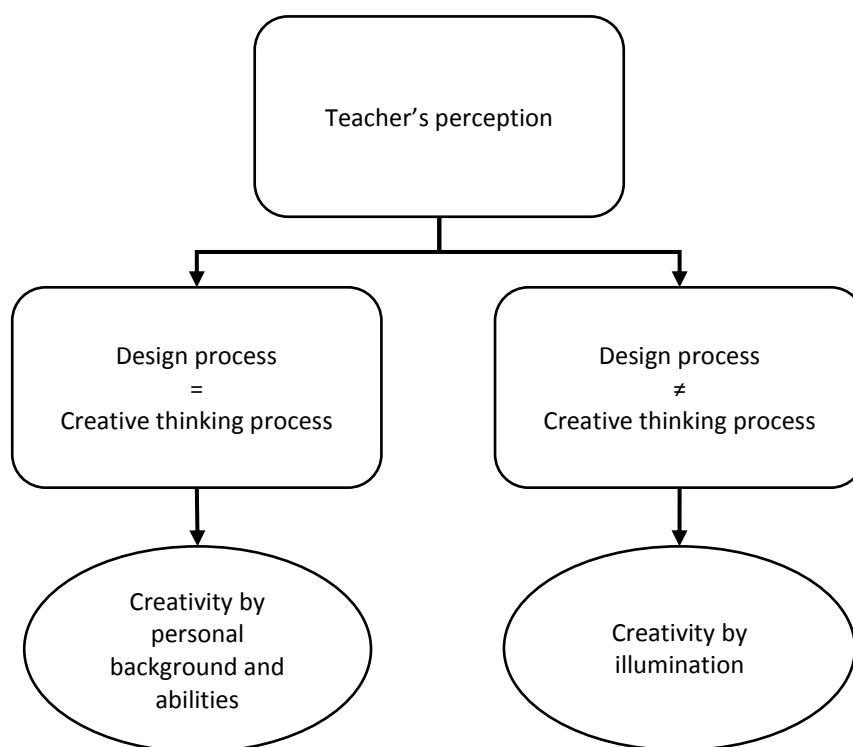
Figure 8.5. Perceptions of teachers towards design process and creative thinking process

If creativity can be achieved through personal backgrounds and abilities, it is surely more educable. Even though we cannot change the background of students, we can develop students' abilities and broaden other experiences to equip students to be creative. However, if creativity is achieved through illumination, the method to guide students to be creative would be in question. It is problematic in teaching students to experience illumination. Subsequently, instead of teaching students to be creative through illumination, it is more appropriate to teach students to achieve creativity by

some methods, even though sometimes illumination works in generating creative ideas. Figure 8.6 below shows the shift in teaching students to be creative.
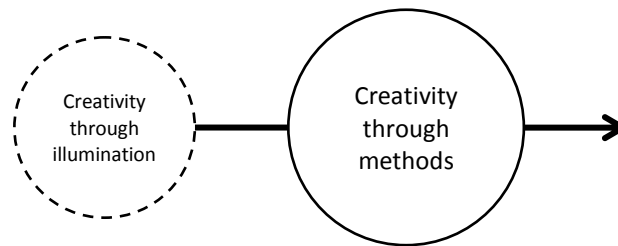
Figure 8.6. Shift of teaching students to achieve creativity

However, it does not imply that teachers should consider design process equivalent to creative thinking process. Rather, they have to understand the differences between them so that they can assist and guide students as suggested in the Section 3.1.4. Achieving creativity through illumination should not be neglected, as it is also one of the ways to generate creative ideas. Whenever students generate ideas through illumination, teachers also have to appreciate the work done by students.

There are many methods to foster and achieve creativity. Some of them are easy to put into practice and does not need many resources. For example, it would be a good idea to teach basic technological knowledge by finishing small tasks and let students experience the process of creativity by finishing projects under themes, as it is understood that knowledge is important in being creative (Howard-Jones, 2002). Some of them provide a systematic way in thinking so that creative idea is generated. For example, TRIZ is a structured approach to innovation. There are increasing numbers of international companies such as Samsung, Motorola and Xerox adopted TRIZ for product development (Pelt & Hey, 2011). TRIZ is a Russian acronym which stands for 'Theory of Inventive Problem Solving' (Orloff, 2003). In TRIZ, an inventive problem is reformulated to a general problem. A general solution of the general problem is then proposed by using the TRIZ tools. The general solution is then translated to the solution of the inventive problem. Yang and Chen (2011) suggested that using this method can avoid heavy time consumption in using trial-and-error method.

TRIZ is not the only method to approach creativity and innovation. One of the student interviewees (Student Fb2) suggested that his teacher asked them to copy when they lack of creativity. Copying may help generating creative ideas. Another student interviewee (Student Fb1) made an interesting comment that creativity is not achieved though a routine but many routines. In other words, creativity is the combination of many routines. Combining different usual ideas or outputs might generate a creative output. These two are also considered as a method to achieve creativity. As a matter of fact, copying and combining are indeed the suggested methods in the 12 tips of creativity suggested by a famous scholar in creativity in Taiwan Chen Lung-An (2006). Copying ideas also includes transplantation and application of the ideas into other contexts.

Education Bureau (2003) also suggested some learning and teaching resources for teachers to facilitate the cultivation of creativity in the gifted education of Hong Kong. The method of the 12 tips of creativity of Chen (2006) is also documented in the teaching resources. Other methods suggested by Educational Bureau (2003) are:

- brainstorming,
- modified brainstorming,
- discussion in twos or threes,
- Philips 66 techniques,
- mind mapping,
- the 9 squares,
- reversal thinking,
- synectics,
- attribute listing technique,
- hope bulleting technique,
- advantage listing technique,
- weakness listing technique,
- Osborn's checklist method,
- SCAMPER,
- 5W2H evaluation,
- directory listing, and

- creative problem solving.

Teachers can use these methods to cultivate creativity. However, it seems that D&T teachers are not aware of these resources in Education Bureau, as these resources are located in the section of gifted education. Even though these resources are open to all the teachers, these resources are not made known to them. Hong Kong education might perceive creativity as a kind of special education for gifted. Section 8.4 will discuss more about the environment of Hong Kong education in cultivating creativity.

Interviewees suggested two pathways of achieving creativity. One is through illumination, and the other one is through some certain methods. One student interviewee (Student Ab) suggested that the creativity achieved through these two ways is different. He believed that the creativity obtained by some rational methods is often not achievable in practice. It is unlikely to realise this kind of creative ideas. He believed that creativity obtained by rational methods is more inclined to technology, and this might be the reason why he thought that the creative idea is unachievable. His comments highlighted the difficulties that students would encounter in dealing with technological kind of creativity. Students might avoid being creative in this regard. Teachers have to pay adequate attention and provide more guidance to students when the project requires comprehensive knowledge of technology.

8.2.2. Before and After Idea Generation

In addition to the comments made on idea generation, teachers, officer and students also had different comments on the stages before and after idea generation in creative design process. Some of them are quite interesting and worthy for discussion.

One of the students (Student Eb1) believed that there are no procedures in being creative. The only possible procedure is evaluation after the idea is generated. It is necessary to evaluate ideas after generation to see if the idea is workable. His idea

corresponds to the concept of converging thinking and divergent thinking in the literature (see Baer, 2003; Eris, 2003; Isaken et al., 2001; Roberto, 2000). He, being a student, understood that idea generation and evaluation are two different consecutive stages which could not be separated and performed at the same time. He is also the only student who had mentioned such concept. In asking how teachers guide students in thinking creatively, two teachers (Teachers A & F) suggested that teacher should not reject students' idea quickly. This act of delaying evaluation hints that some teachers also have similar ideas of idea generation and evaluation. Nevertheless, whether other interviewees were aware of the relationship of these two stages is unknown. If teachers are not aware of the appropriate creative thinking process, creativity will be limited.

In addition to the stage after idea generation, some teachers and students gave comments on the stage before idea generation. The stage before idea generation should be analysis as suggested in Section 2.3.2. One of the students (Student Ab) commented that the information collection performed at the stage of analysis limits creativity because thinking would be formularised after collecting information. The comment he made is rather injudicious, as information collection helps understanding the problem through different perspectives (Roozenburg & Eekels, 1995). The person should acquire necessary knowledge for generating ideas in information collection. Instead of limiting creativity, information collection should extend the knowledge associated with the problem. As Howard-Jones (2002) suggested, when more information is associated with the problem, it is more likely that a person can generate more combinations through illumination. Whether the thinking would be formularised is based on the manipulation of knowledge. Sometimes information collection also helps inspire people to apply knowledge into different context.

One of the officers also agreed that creative thinking process includes investigation and application of an idea in other contexts. The knowledge acquired in investigation helps applying ideas in other contexts effectively. However, if students have the perception that information collection might limit creativity, they might only collect the minimal information to solve problems. This might limit the knowledge acquisition and the association that he can make with the problem, even though it is

possible for him to connect the problem with other acquired knowledge. Teachers have to be aware of this situation, and guide students to collect information related to the unsolved problems.

Students should collect two types of information in the design process. One is knowledge related to the problem. The other is the knowledge of the existing solution in tackling the problem, if the problem is not totally new. Sometimes it might be possible to ask students to suggest solutions before gathering information on existing solutions. In this way, students might feel more comfortable in generating their own ideas and then evaluate the ideas by comparing them with the existing solutions. Teachers and students might then modify and improve the suggested solutions to optimise the outcomes. Other new ideas might also be inspired while learning from the existing solutions.

Understanding problem in the stage of analysis and information collection is important. It is also agreed by one of the teachers who commented that problem identification is important in the creative thinking process. As mentioned by Siu (2007), problem finding is important that creative solutions would not exist if no one is going to discover problems. However, it is not guaranteed that good problem identification would lead to a creative solution. Therefore, good supports from teachers are important, suggested by one of the teachers (Teacher E) when replying on what more is needed to lead students to generate creative solutions. The comment of the teacher highlights the importance of teacher-student interaction in the creative thinking process and creative design process that being a facilitator, teacher plays an important role to guide students to think creatively.

8.2.3. Facilitating the Creative Design Process

8.2.3.1. Emotional Support

As mentioned in the Section 3.2, it is important for teachers to give emotional support to students in their creative thinking process. Teachers, being the facilitators,

should understand students' emotion, especially negative ones, so to give appropriate guidance to them in creative thinking process.

During the interview, one of the teachers (Teacher A) addressed some problems that arose when students work in groups, which is often the case in Hong Kong, where group projects are common in the context of creativity in D&T in Hong Kong. Because interactions with peers might induce and affect different emotions among adolescents, as mentioned by the teacher, it can be argued that peers become one of the essential elements that affect creativity in group design activities. The emotional problems among the group members might be detrimental to the generation of creative ideas. The observations and assumptions here might clarify the knowledge in the existing literature that the effect of emotions on creativity is not only intrapersonal, but also interpersonal. The emotions concerned might include those existing within and outside the design activities. Yet, further investigation is needed to verify this concept by investigating the possible effect of students' emotional status on group creativity in design activities.

Moreover, the teacher mentioned that teachers have to act as a cushion to absorb students' emotions. This explicitly highlights the importance of the maturity of teachers' attitude towards emotional problems. Teachers' emotional literacy or the emotional intelligence (Haddon et al., 2005) is essential in handling students' emotional problems. Their role as a role model is crucial for students to develop their emotional ability.

Teacher interviewees suggested some methods to handle students with negative emotions. They handled the emotional problems of students based on their experience and believed that the methods they used are useful on their students. Students at the secondary school level sometimes have emotional conflicts (Slavin, 2009), and it is important for teachers to handle this problem in design process. The methods used by the teacher interviewees are just a few of many. Specific methods may be needed in various situations when handling different types of students. This again highlights the importance of the emotional ability of the teachers. Such ability can only be developed through real-life experience by interacting with different

kinds of people. The maturity of the teachers thus becomes another important factor that governs the development of students' creativity under their supervision.

Some teacher interviewees might not be aware of students' emotional change and negative emotions. However, it does not mean that their students did not have emotional problems. Students whose teachers did not mention students' emotional problems expressed that sometimes they also had unhappy time in the process of creativity. It might imply that their teachers sometimes were not aware of their emotions, and this might be detrimental to students' creativity as suggested in the Section 3.2.

It is clear that teachers have a role to play in guiding students in emotional issues based on students' responses. One of the students (Student Ag) suggested that when they were upset, teacher could excite them by using particular methods. Even though some students did not mention how teachers helped them in emotional perspective, it is believed that supports from teachers are important, as Pianta and Hamre (2009) pointed out that teachers who can give appropriate emotional support to students are more likely to create effective classrooms. The effectiveness of cultivating creativity in classroom might also relate to teachers' ability in supporting students emotionally.

Students who did not seek help from teachers had their own methods to solve their emotional issues. For example, one student (Student Ab) would treat failure as an experience, and another student would treat unsatisfied situation as a good start. They might be more mature in handling emotions. Teachers' role seems not significant in these cases; however, the majority of students still need emotional supports from teachers.

8.2.3.2. Teacher-student Interaction

Interaction between teacher and students is essential in unleashing students' creativity. One teacher interviewee (Teacher A) suggested that if the interaction is good, creativity could be unleashed. It is like sending gifts to each other. Another teacher interviewee (Teacher D) also suggested that through the interaction, teachers

and students might be able to recall knowledge needed for solving problems creatively. These comments pinpoint the importance of the teacher-student interaction in unleashing students' creativity

One of the teachers (Teacher E) suggested that it is important to give students chances to realise their creativity though different competitions. Without competitions, students can only finish the design projects assigned by their teacher. Students might not have chances to participate in large-scaled activities which require larger space or large amount of resources. For example, in a robotic competition in Hong Kong, students have to design an underwater robot to rescue a shipwreck. The whole task is performed in a water tank of 2.4m x 2.4m x 0.6m. Most schools might not have space to store a water tank like this, as part of D&T workshops in most schools have been renovated to be classrooms and meeting rooms. However, a competition held by some organisations might be able to provide such space and facilities for students in trying out their new designs or artefacts. Students might be able to broaden their horizons and learn more knowledge to be creative through competitions.

Amabile (1983, 1986) noted that if competition exists among co-workers, creativity is unlikely to exist. However, the competitions mentioned here often require students to form a group and compete with other groups in other schools. Thus, there is no competition among students in a group, and this kind of competition does not affect creativity.

However, only very few students in a school can participate in competitions. Teacher would only choose those who are more motivated and willing to devote to participate in competitions. In addition to guiding students in competitions, teachers also have to devise design projects for students in D&T classes. Although creative competitions might be conducive to students' creativity, teachers also need to put considerate amount of efforts in guiding students in design projects. Teachers cannot spend all the time and efforts on the competitions. Consequently, this might become a problem encountered by teachers that they might not have enough time to take care of both. It is nearly undoubted that if a teacher is enthusiastic in cultivating students' creativity, he has inadequate time to finish all the tasks in current educational settings.

Teacher-student interaction is not limited to the contribution of teachers. Students also have to do their job in the interaction. According to the responses of the teachers interviewed, knowledge and ideas are exchanged in teacher-student interaction. At the first glance, the exchange might mean to form an equal partnership that teacher and student work hand by hand in finishing a design project or solving a problem. However, in this way students might be too dependent on the teachers and thus break the equal partnership after a certain period of time. This is not desirable in educating students to be creative. Students have to solve the problems by their own creativity with supports from teachers.

As suggested by one of the officers, teacher should act as a facilitator in guiding students, and teacher should not act as a knowledge transferor. Teachers should provide necessary resources and guidance in creative thinking process. Students should be responsible for larger proportion of creative thinking. However, it is not always easy for students to perform creative thinking. Sometimes teacher needs to initiate the creative thinking process and lead the students to the right track. In this sense, teacher's creativity might be important.

One of the teachers (Teacher F) also commented that in order to cultivate creativity among students, teacher have to be creative beforehand. When teacher is creative, students would feel more freedom in generating creative ideas. Teachers can also inspire students when students are lost. Creative teachers are also more flexible in organising creative activities and handling students' problems. However, whether teachers in Hong Kong possess creativity is questionable, and the issue of teachers' (and also students') creativity in Hong Kong is discussed in the next section.

8.3. PERSON[7]

Teachers and students have diverse opinions on the characteristics of creative people. Some of these creative personalities are comparable to those in literature. Besides,

[7] The section analyses and discusses findings from Sections 7.1.1.4. Person, 7.1.3.2. Teachers, 7.1.3.3. Students and 7.1.2.1. Learning to be creative.

almost all interviewees believed that creativity is both an innate and a learned ability. This perception is important, as it affects how effective teachers can promote creativity in classroom (Dow, 2004). Some of these comments are linked to the personality of creative person, and their perception on the characteristics of creative person might explain their standpoints on the nature of creative ability. This also raises the issue whether teachers now in Hong Kong are able to promote creativity among students.

8.3.1. Comparing with the Literatures

Teacher and student interviewees have two different sets of comments on the characteristics of creative person. Teachers primarily commented on the intelligence, discipline, endurance, and conformity of creative person. On the other hand, students primarily commented on the presentation skills, information processing speed, conformity and the request on quality. Teachers tend to focus on the intrinsic characteristics over a period of time, and students tend to focus on instant behaviours. It might be due to the fact that teachers understand a person by his personality and characteristics, while students by the person's visible behaviour. Students are more straightforward in this sense.

Some comments made by teacher and student interviewees are comparable to those in literature. For example, the characteristic of 'committing obsessively to their work' suggested by Gardner (1993) corresponds with the comment of perseverance and persistence suggested by Teacher E. The characteristics of 'willingness to display results' suggested by Cropley (2001) corresponds with the comment of presentation skills suggested by Students Ab and Ag. Table 8.1 presents the similar perspectives held by the interviewees and researchers.

Table 8.1. Comparison between the characteristics of creative person suggested by researchers and interviewees

Characteristics suggested by Researchers	Characteristics suggested by Interviewees
Committing obsessively to their work (e.g. Gardner, 1993)	Perseverance and persistence (Teacher E)
Less agreeable (e.g. Batey & Furnham, 2006)	Not accepting teachers' suggestion or follow regulation (Teachers A & F)
Less socialised (e.g. Batey & Furnham, 2006)	Not talkative (Teacher D & Student Ab)
Desire to go beyond the conventional (e.g. Cropley, 2001)	Abnormal (Teacher F)
Willingness to consult other people (but not simply to carry out orders) (e.g. Cropley, 2001)*	Willing to ask actively (Teacher C)
Willingness to display results (e.g. Cropley, 2001)*	Good presentation skills (Students Ab & Ag)

*Note: The last two characteristics suggested by Cropley (2001) in this table may seem to be contradictory to the personalities suggested by Batey and Furrnham (2006); however, the two characteristics refer to the motivational properties of a creative person, and they are different from the personalities which describe a person under a general situation. Therefore, the contradiction does not exist.

As shown in Table 8.1, it seems that the characteristics suggested by interviewees correspond to the literatures. However, some other characteristics suggested by interviewees cannot be found in the corresponding literature. For example, one student (Student Ag) suggested that the creative person she ever met could think and speak in a fast way. Some other student interviewees found that creative persons are perfectionist (mentioned by Student Fb2) and at the same time humorous (mentioned by Student A). Further verifications are needed to prove their relationship with creativity.

Besides, some characteristics suggested by the interviewees reflect the creativity issues in the East Asian educational belief of Hong Kong. For example, some teacher and student interviewees focus on the discipline of creative students. They reported

that creative persons did not behave well, or they challenged teachers. These behaviours are inconsistent with the Confucian collectivistic culture that teachers are authoritarian in classroom (Cheng, 2004), and this might be the reason why teacher and student interviewees can easily spot these behaviours.

Interviewees' comments are not limited to their perceptions on the characteristic of creative person. One student (Eb2) gave an interesting comment that when working with creative classmate, he needs to evaluate their ideas for them. There is a hidden assumption in the study that creative people perform creative thinking process including evaluation to create creative outputs. However, his comment challenges the assumption. Creative people or students might not be able to perform the entire creative thinking process. However, there is a possibility that the student interviewee's evaluation might come too fast in the viewpoint of that creative classmate. It might also be possible that the creative classmate had not finished the process of idea generation.

This issue put a question concerns group creativity: is there more creativity when more people are grouped together? This issue is critical in D&T, as students often form groups to work on projects, due to the time and resources constraints. In group projects, students learn how to co-operate with other group-mates. However, inspiring by the situation above, having more people involved in creative thinking process sometimes might violate the thinking of creative individuals. For example, if several creative students are grouped together, they might have different opinions towards the same issue and might argue with each other. If a creative student is grouped with less creative students, the creativity might be stifled as in the situation mentioned above. Consequently, how teachers cultivate students' creativity in groups is also an important issue to concern.

Sawyer (2012) claimed that groups can be more creative than individuals, as "the group's creativity is more than a simple sum of the individual members' creativity" (p. 246). Tagger (2002) also suggested that groups are more creative when the behaviours of team creativity-relevant processes exist in the group. Without the creativity-relevant processes, creativity of creative persons in the group would be neutralised. These processes includes "team citizenship, performance management,

effective communication, involving others, providing feedback, reaction to conflict, addresses conflict, and averts conflict" (p. 321).

Sawyer (2012) summarised if group members share different backgrounds, the group is more creative when the group has to find a new problem. However, this does not favour the situation when the group has to solve a known problem. When solving a known problem, it is the best for the group members to share similar knowledge and expertise. Subsequently, teachers sometimes need to assign students into different groups purposefully if promoting creativity is the main purpose in a design project. Teachers also have to guide students in team creativity-relevant processes so that losses in creativity can be avoided.

The section discusses much on the perceptions of teachers and students towards the characteristics of creative persons. However, whether they have put these perceptions into learning and teaching is critical, as it might affect the effectiveness of creativity cultivation (Dow, 2004).

8.3.2. Towards an Educational Perspective

One of the teachers (Teacher E) commented that creative students are calm and persevere. If students do not have these characteristics, it is difficult to cultivate their creativity. His comment concerns the belief about whether a person can learn to be creative. According to the implicit theories, if the teacher believes that it is possible to teach creativity, creativity can be cultivated among students. On the contrary, if the teacher believes that creativity cannot be taught, it is unlikely for him to teach creativity in classroom (Dow, 2004). Similarly, if the teacher believes that only those who possess certain personalities or abilities are able to be creative, it is unlikely for him to teach creativity among students without those personalities or abilities.

In fact, some teachers believed that innate ability of a person has a role to play in creativity. Even though they also believed that creativity could be learned, they believed that the inborn ability is the prerequisite of learning creativity. That means

if the person does not have certain abilities, it is difficult to cultivate his creativity. This perception might again affect the cultivation of creativity among students.

Teaching students to acquire the innate ability of creative person might be a resolution. These abilities are inborn, but it does not mean that they cannot be cultivated after series of activities or training. In the literature and the interviews with teachers, it is clear that the abilities or characteristics required in the creative thinking process are associated with perseverance, flexibility (De Dreu et al., 2008), motivation (Amabile, 1983, 1986), and divergent and convergent thinking (Baer, 2003; Eris, 2003; Isaken et al., 2001; Roberto, 2000). Teachers might train up students to acquire these abilities or characteristics so that creativity can be cultivated.

However, it might take some more time to train up students, as they not only need to learn the knowledge needed but also to acquire the abilities to be creative. It is more appropriate for teachers to identify, teach and guide them to acquire missing abilities or characteristics. However, whether a student is willing to be perseverant or motivated enough to learn creativity greatly depends on the subject of creativity concerned. It is unlikely for a person to be perseverant in doing anything. It is also unlikely for a person to get interested and motivated intrinsically in any activities. Students might only show motivation and perseverance in certain interesting areas appeared to them. Subsequently, what is more important is how teachers guide students to cultivate the necessary abilities and characteristics in the area which attracts the students.

In other words, students have to learn skills or cultivate characteristics which are required in the creative thinking process. Figure 8.7 above shows the shift of the perceptions of the prerequisite of creativity.
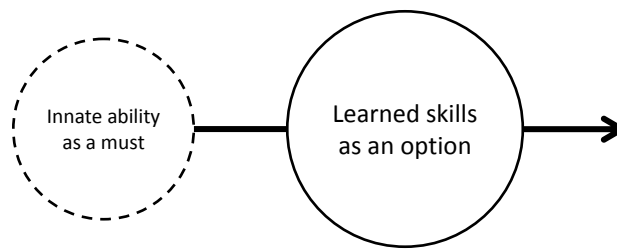
Figure 8.7. Shift of perceptions of creativity as an innate ability

Similar to teachers, students believed that creativity is an inborn ability. However, they had a different perspective. They believed that all people possess creativity when they are born. That means if creativity are associated with any abilities or characteristics, a person should have possessed the necessities. It is the person's will whether he wants to train up and stimulate the potential. This is a very positive opinion, as it addresses creativity as a potential, and all people possess it. It is not against the idea that abilities or some methods are needed in achieving creativity. Creativity can probably be cultivated among students under this perception. Teachers will find it easier to guide and train students to stimulate the creativity potential.

If students think that there are no methods to learn creativity, it is very difficult for them to acquire the skills. Self-efficacy is important. If the student believes he is able to achieve something, he is more likely to make the achievements (Slavin, 2009). Teachers have to be aware of students with this perception. If both teachers and students think that creativity cannot be learned, they will not be able to foster in classroom.

In addition to the abilities or characteristics needed in cultivating creativity, teachers and students also mentioned the kind of persons whose creativity cannot be cultivated. They believed that it is not possible for elderly to learn creativity. One of the teachers (Teacher F) attributed this to the inflexibility of elderly and the limitation of their mindset. Their experiences and achievements do not allow them to take risk, given that performing creative thinking process does not always generate creative outcomes. Similarly, from their comments it can be argued that students who have already achieved a considerable amount of good results might not want to

be creative. For example, a student has obtained a very good result near the end of the term year. He understands that if he performs well enough in the last assignment, he will be able to get an A for the subject. Therefore, in order to guarantee an A, he will avoid making mistakes. Besides, all teachers and classmates are expecting him to perform well until the end. He does not want to let teachers down and be laughed at by classmates. At the beginning of the term, he might be very creative. He could take risks, as he has nothing to lose. However, now he cannot bear the consequences. Instead of being creative, he might take the design approach which guarantees a good result. Because of the possibility of failure of creativity and time constraints of the assignment, he does not want to be creative.

On the other hand, students who have an average grade along the terms might want to be creative. It is because he understands that if he succeeds, he will be able to have a better result for the term. Teachers and students will praise him for sure. Even if he fails, it will not affect much, as it is unlikely that the failure will cause him to get a bad grade at the end of the term. He can bear the consequence of lower grade and also social pressure, as the expectation from teachers and students is not large. If he does not challenge, his result will remain the same. He might want to try and challenge to get a better grade.

Alternatively, students who do not have good performance over the year might not care if they can have good performance, as no matter how much effort they put in the last assignment, they will not have a good grade at the end. Therefore, it does not need to bother to be creative at all. Figure 8.8 explicates the possible outcomes of being creative and being not creative in the last assignment.
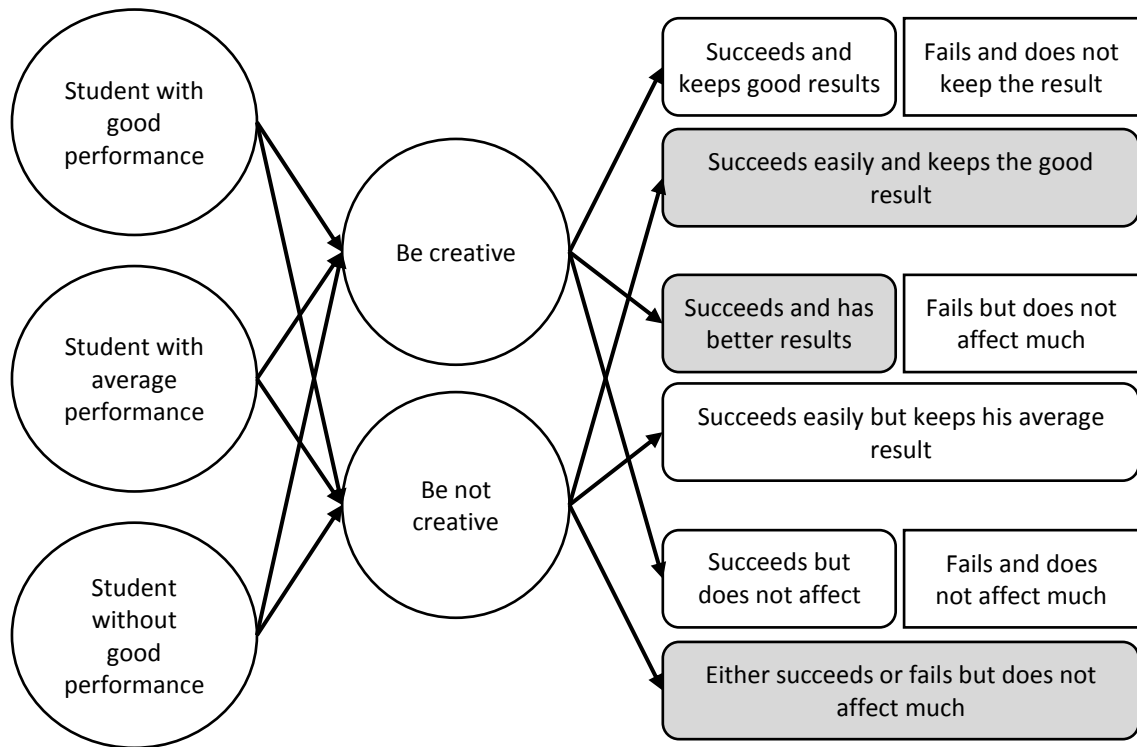
Figure 8.8. Possible outcomes of being creative and being not creative in the last assignment (preferred outcomes highlighted in grey)

The discussion above not only applies to the last assignment of the term, but also to the academic performance along years of study, as it is related to the social pressure and expectation from teachers and students. Students who have been performing very well in years of study might not want to be creative, as they have already built an image that they would not fail. It is not easy for them to let down what they have achieved and their image of success. Besides, it is not easy to persuade them to be creative, as they might feel being creative uncomfortable and insecure. If students do not have a comfortable feeling, it is less likely for them to take risks (Pianta & Hamre, 2009). The same applies to the students who do not have good performance. Their motivation has become very low because of the low achievement over years. It is also very unlikely to persuade them to work on creative projects.

However, it does not mean that all students would behave in the same way. Some students who have a good grade might also want to challenge and take risks to be creative. Nevertheless, it is necessary for teachers to be aware of this problem. Fortunately, assignments are not the only channel for students to be creative.

Students can be creative in extra-curricular activities and competitions. However, it depends on students' own will or teachers' decision if students will join these activities, as the activities are not compulsory in schools.

8.3.3. Current Hong Kong Teachers and Students

8.3.3.1. Teachers

From the above discussion, it is lucid that teachers need to take care of numbers of situations in cultivating creativity among students. One teacher (Teacher F) also mentioned that in order to cultivate creativity, teachers have to be creative beforehand. Both officer interviewees also had similar comments that teacher is an important factor. However, the abilities of teachers in taking care the situations and their capability of being creative are of question.

Officers commented that teachers lack creativity. They are unwilling to change. They viewed the classrooms as their kingdom, and the situation of 'you change the name, we teach the same' persisted in classroom. Both officers attributed the reason to the traditional training and background of teachers.

Because of the history of D&T, D&T teachers were trained to teach craft-based subjects such as woodworking and metalworking. In spite of the new curriculum of D&T, some teachers still use the old methods of craft-based subjects to teach D&T. Training are needed to change teachers' mindset in D&T. However, trainings provided by Education Bureau are not enough. The existing training workshops and courses do not make an impact to the mindset of D&T teachers. D&T teachers had no significant change, as observed by one of the officers in D&T seminars. At present, there are no courses available for training D&T teachers at the tertiary educational level. Dow (2004) suggested that training could be provided for student teachers in educational institutes, so that the teachers with traditional training are replaced by young and energetic teachers. Courses on creativity and related theories could be embedded into teacher training at the undergraduate or diploma levels. Unfortunately, D&T teacher-training programmes in Hong Kong have closed in

2006, and there are no more new D&T teachers in Hong Kong. It is rather ironic that the D&T curriculum advances along the years, while the government invests fewer and fewer resources in teacher training.

Besides, most D&T teachers in schools are experienced in teaching, and this probably exaggerates the potential detrimental impact of East Asian style classrooms on the development of creativity (see Section 2.5.2.). In addition, experienced teachers were taught in a traditional Chinese style in which teachers are authoritarian in classroom. They are unlikely to construct an environment that is conducive to promoting creativity in accordance with the implicit theories suggested by Dow (2004) that the personal experience of a teacher is crucial in constructing the environmental structure within the classroom.

Furthermore, one of the officers mentioned that teachers do not like assignments which results diversity. It is unsurprising, as not many variations exist in students' artefacts in the traditional craftwork, and the diversity violates the conformity which is emphasised in Hong Kong classroom. It also increases teachers' workload, which is not welcomed by teachers. A report of Hong Kong Economic Times (2007, May 25), reveals that Teachers in Hong Kong work up to 13.8 hours per day. They spend much of their time attending seminars and completing administrative tasks. Most D&T teachers have to teach one or two other subjects such as Mathematics, Science, or Computer Studies. Clearly, the workload is heavy enough that teachers might not be able to spare extra time to learn how to teach for creativity and to supervise students' projects after school. Even though Dow (2004) suggested that some professional training regarding creativity and implicit theories has to be available for teachers to avoid the impact of their underlying beliefs, it seems that these do not work in Hong Kong.

What would happen if curriculum and assessment policies change but teachers do not change? This can be answered by the experience of one officer interviewee. He mentioned that the D&T teacher he knew assigned the whole class to work on the same project for public examination. Even though the public examination allows student to choose whatever topics they like within the options, teachers restrict their choices to keep the variation to minimal. Creativity is limited and restricted because

of the teachers' approach. However, the officer also understood that the students concerned had lower academic abilities, and the approach adopted by the D&T teacher is one of the many ways to deal with them.

8.3.3.2.   Students

It is not easy to persuade students with low academic abilities to finish projects for examination, and it is already a big achievement if they can finish the task on time. This pinpoints the problems of cultivating creativity among students with lower academic abilities. One of the teacher interviewees (Teacher F) also commented that creativity is not easy for this kind of students, as they must understand and acquire some knowledge before they could be creative. Students with low academic performance may be less able to be creative, however, officer interviewees further commented that majority of students are also not creative.

According to their comments, Hong Kong students are encountering severe problems in cultivating creativity. They are passive in classroom and might not have the ability to express their ideas effectively. They do not understand creativity, and the creativity they ever had in childhood had lost. Scoring marks in examination became the most important task, and they would prefer their teacher telling them what they need to do direct so that they can get higher marks. All these reveal that in spite of the importance of creativity stated in the government or educational documents, it is not emphasised in the main stream education. It might be due to the fact that different stakeholders of the current education do not coordinate well enough, or the mindsets of stakeholders still have not changed to meet the shift of emphasis on creativity.

The problems encountered by students are not only related to their personalities and perceptions towards study but also to their cognitive skills. As a matter of fact, knowledge of Mathematics or Physics can be applied into D&T. However, one of the teachers (Teacher D) suggested that students are not able to transfer what is learned. Even though some knowledge is transferable, they cannot transfer and apply the knowledge into other school subjects or context. This limits their creativity in a sense

that students cannot link the associated knowledge to the unsolved problem in creative thinking process. For example, when students need to make a right-angle triangular structure by using wood sticks, some students might become frustrated in finding the length of the triangle's adjacent side with the length of and the angels between the other two sides. They are not able to use the trigonometric functions learned in Mathematics lessons. Some students might get the answer by trial-and-error method, or simply ask their teacher.

Sometimes teachers have to guide students to apply different knowledge and discuss with other subject teachers to link knowledge of different disciplines. It is important, as D&T is a subject which integrates different knowledge together (Erekson & Shumway, 2006; Gattie & Wicklein, 2007). Better cooperation among teachers of different school subjects might improve the situation. However, it is doubted if other colleagues would like to help facilitate creativity cultivation and knowledge integration.

8.4. ENVIRONMENT[8]

Issues in D&T mentioned in the discussion could be resolved through better time management and cooperation among school administrative staff, decision makers, and colleagues. However, D&T is not an academic subject in secondary school. Sometimes school teachers of other subject might overlook the importance of D&T. They might not be cooperative when D&T teachers need their cooperation, and knowledge transfer cannot be facilitated. In this situation, if D&T teachers do not try hard to facilitate an environment for creativity in classroom, it is difficult to foster creativity in school. Besides, the education system of Hong Kong also has a role to play in the cultivation of creativity. This section discusses how teachers and students understand the environment for creativity, and how the current environment, including classroom, school and the education system, are in cultivating creativity.

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[8] The section analyses and discusses findings from Sections 7.1.1.5. Environment, 7.1.3.1. Environment, 7.1.2.2. Assessment and 7.1.3.5. Assessment.

8.4.1. Environment in Practice

Both teachers and students understood that creativity is related to environment. One of the students (Student Fb1) commented that sometimes creativity is required by the environment. The environment triggers the creativity. For example, if the environment requires a person to work out something for living, the person might make the impossible become possible. If the person sees that there is a great need of inventing or improving something, he would probably try his best to be creative. Their comments echo with the hypothesis of Guilford (1977) that people with difficult life have a higher potential to be creative.

However, it is not often for students to experience a difficult life in the 21th century in Hong Kong. In view of this, teachers can design different design projects and encourage students to join different competitions. Teachers can bring students to an environment with different problems, and thus students can try to solve the problems creatively. However, as students are under the supervision of the teacher, they need to get permissions from him when they want to work on certain ideas. In this case, the permission of the teacher becomes significant.

If the idea can be realised easily, there is no point to ask for permission from the teacher. However, if the idea cannot be realised easily, students have to ask the teacher. Teacher will then gives guidance and advices to students, or sometimes they might even stop the students from working on that idea. Whether they will stop the students and how much freedom they will give is essential because if the teacher does not allow any ideas to be realised, surely creativity will not exist in classroom. If the teacher says yes too easily, he would probably lose control of the students. Subsequently, a consistent and balance approach is crucial to determine which are allowed and not allowed. The perception and standpoint of the teachers construct the environment which is either conducive or detrimental to creativity.

Some teacher interviewees commented that they would give freedom to students if what students are going to do is safe, regardless of the difficulty of the task. Safety issues are the main concern of these teachers, and being safe is their bottom-line. It can be seen that they had given maximum freedom to students in being creative. The

importance of freedom and an open and safe atmosphere is supported by Isaksen et al. (2011) that these are essential to construct a creative environment. However, one of the teachers (Teacher E) commented if the resources are limited, he would not give so much freedom, as he needs students to think carefully before using them. It is understandable if students fail to make an achievement, they will not have another chance to try again. However, this constraint might limit creativity. Amabile (1996) also stated that restricted choice or constraint control have a negative effect on intrinsic motivation and creativity. More about constraints are discussed in the next section about the definition of creativity.

One of the teachers (Teacher C) also commented that it does not matter if students failed in working. Positive attitude towards mistakes and errors are also noticed when some student interviewees talked of the emotions in doing projects and encountering failure. This kind of attitude is also one of the many characteristics of a creative environment suggested by Isaken et al. (2011). It can be concluded that teachers interviewed had put effort in constructing a creative environment for students.

Furthermore, while talking about students' emotions, one of the students (Student Fb1) commented that he felt unhappy when the deadline was close. Both Amabile (1996) and Isaken et al. (2011) mentioned that time is one of the factors of creative environment. It is detrimental to creativity if teacher gives an unrealistic deadline. Enough time for finishing the assignment is essential in cultivating an environment for creativity. Teachers need to be aware of adequacy of time given to students. However, there are many students in a class, and the ability of each of them varies. Unlike other subjects, students have different designs in solving a problem in D&T, and sometimes they might not foresee the difficulties they are going to encounter. Some of them might need more time in finishing the projects, but some might not. It is also not easy for teachers to estimate the time needed by students. In most cases, teacher set the deadline based on the consideration of the school calendar. When a student expresses that he does not have enough time to work on the project because he has a creative solution to realise, should teacher give more time to him? How should teacher handle the case so that he is fair to every student in classroom?

In most cases, D&T teacher gives students a fixed amount of materials and a certain period of time to finish a project so that all students are assessed in the same circumstances. However, because of creativity, some students might need more materials or time. This raises a question about fairness. Opening the workshop and supervising students' after school time might be one of the resolutions. Students who need more supervisions or time in working on their project might stay in the workshop after school. It inevitably increases the workload of the teachers, and students might misuse all these resources.

Time given to students is limited. Students also need to learn how to manage their time. One of the teacher interviewees (Teacher D) reported that he had designed a project which could control the time and materials used by students, and this method could be applied in any project. In the project, materials given by teachers are assigned a price. Students have to report how many materials they have used in finishing the artefact, and they need to calculate the money they spent in finishing the artefact. Also, if they need to use extra time in workshop after school, they need to pay 'booking fee' to book the workshop. Students of course need not to pay the money in real, but they have to record how much they have spent in buying materials and booking the workshop. Students are asked to give an appropriate selling price of their artefact and see if the cost is worth. Students who can sell the artefact with a higher selling price with lower cost, i.e. maximum profits, will score more marks.

This method allows students to choose how many materials and how much time to spend in the project. Students have more considerations, and at the same time have more freedom. They can choose how they invest into their artefacts. This might be one of the methods to solve the problem of fairness without limiting students' creativity. Nevertheless, any methods used require teachers to put more efforts and spend more time on students. It is not a trivial task, as teachers also have many other duties to take care of as mentioned in Section 8.3.3.1.

8.4.2. Towards an Educational Perspective

The discussion so far focuses on the teacher and student interviewees. However, as mentioned by the officers, the majority of D&T teachers in Hong Kong are not creative. It is unlikely for them to construct environment which favours creativity. Environment is a complicated category of creativity. It does not exist on its own. It is closely related to the person involved. It is the person who creates the environment. Whether the creative environment can be constructed greatly depends on the people who are in control of the rules and atmosphere.

Teacher interviewees gave freedom to their students. Sometimes they let students make their own decisions in materials usage and time management. They also let them choose their projects under a theme. On the other hand, the less creative teachers mentioned by the officers assigned all students to work for the same artefact. They downplayed the importance of the self-initiated projects and their individual wish. It is clear that the teacher interviewees allow students to have more initiative than the teachers mentioned by the officers. Teacher interviewees just set the rules and directions for students to realise the ideas.

Most of the criteria suggested by Isaksen et al. (2011) also put the emphasis on the needs of students (see Section 2.5). Subsequently, it can be argued that the environment which is conducive to creativity should not be teacher-initiated but student-initiated. Students can make their own decisions according to their own needs. The role of teachers should be changed from decision makers to facilitators in classroom (Siu, 1999). Teachers also need to support and help students when needed. In this way, students will be more self-reliant, more motivated and able to take risk (Pianta & Hamre, 2009). As intrinsic motivation and the ability of risk taking are essential for creativity (Amabile, 1983, 1986; De Dreu et al., 2008; Rutland & Barlex, 2008), it can be argued that students are able to be more creative when teachers act as facilitators and construct student-initiated a classroom. Figure 8.9 below shows the shift of initiative in creative environment.
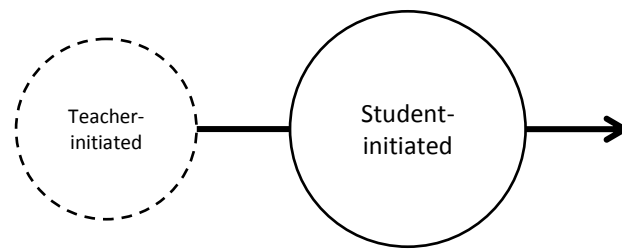
Figure 8.9. Shift of initiative in creative environment

The classroom is often not student-initiated in the context of Hong Kong classroom where conformity is emphasised, as the authoritarian role of teachers is essential in maintaining the disciplines (Ng & Smith, 2004). It is not easy to change the usual practice of teachers in Hong Kong. In dealing with the issue, teachers might learn from individualistic method of teaching. However, due to the cultural difference, it is difficult to act like western. Copying directly from western cultural practices might not be practical. An eclectic approach is to manage classroom in a limited authoritarian way without obliterating the initiative of students.

One of the officers commented that workshop or classroom is the kingdom of the teacher. However, when the classroom becomes student-initiative, the teacher might become the governor instead of the king. The teacher has to interact with the students more often to understand students' needs. Having a student-initiated classroom might use up more time of the teacher, as the need of each individual is different. If students make the decision based on their own needs, teacher will have to take care of the needs one by one. In view of the current heavy workload of teachers, it is not surprising that teachers tend to take full control of the classroom. One of the teachers (Teacher D) also commented that when he gets tired and does not have enough time, he might just tell the students what to do. It can be argued that D&T teacher alone might not be able to construct a creative environment for students. Sometimes other teachers and the principal in school also have roles to play.

8.4.3. Issues outside the Classroom

8.4.3.1.　School Culture

Even though teachers have the power to take control of the lesson, whether teachers can cultivate a creative environment not only depends on the teacher. Other teachers and the administration unit of the school should give necessary supports to the D&T teacher. Without supports from them, it is unlikely for D&T teacher to have time to cater the needs and construct the creative environment. Subsequently, the environment and atmosphere of the school should be of concern.

Some teacher interviewees reported that teachers of other subjects were supportive. However, some other teacher interviewees did not think so. One of them (Teacher B) addressed the money issue in school. When his D&T group was able to participate in international competitions, and they successfully fought for the support from the school to pay students' air ticket and accommodation, some other teachers got disappointed and questioned why school had to spend a large amount of money on D&T students for overseas trip. This is a very realistic problem encountered by the D&T teacher that some teachers might think that such a large amount of money should not be given to a technical subject like D&T or a small number of students. However, the best way for D&T to get recognised in school is to participate in this kind of competitions and make some achievements. Subsequently, D&T teachers who give chances for students to realise their creativity have to cope with the pressure from other colleagues in school meetings when financial issue is concerned. This is surely not easy for the teachers. If the teachers are not enthusiastic on creativity or the creative competitions, he might not take the risk of offending other colleagues.

The issue might be solved if students in other subjects also can spend the money for international competitions. Ironically, unlike D&T, other subjects might not have the chance, as there are not many international competitions for other subjects, or these competitions do not require students to be present on site. Even though achievements and recognitions would be an important factor in gaining supports from school as suggested by one of the teacher interviewees, D&T teachers face pressure if other teachers do not support or understand D&T.

Sometimes teachers of other subjects might look down on D&T and its value. It is not surprising that some teachers might have this perception, as most of them did not learn D&T before and could not understand the importance of association and integration of knowledge in different contexts. It is not easy to integrate other subject areas with D&T in practice. The history and the image of D&T as craftsmanship are still implanted in their mindsets, and even some school teachers still refer D&T to as 'woodwork', even a decade after the reform of Hong Kong's D&T curriculum. Integration of subject areas such as STEM education (science, technology, engineering, and mathematics) in UK and US is not easy in Hong Kong.

Besides, one of the teacher interviewees (Teacher C) commented that even though school is supportive, D&T is still the first subject in which the principal would think of when he needs to cut the school budget. It might due to the fact that D&T has the largest classroom in school (the workshop) and spend largest amount of money in a year for buying materials and consumables and maintaining machines. It is natural to think of cutting the budget of D&T while money is needed. As suggested by another teacher interviewee (Teacher D), principals who know more about D&T might help soothe the situation. If principal does not understand D&T, it is not easy for D&T to survive, as one of the teacher interviewees (Teacher F) suggested that the principal might think D&T is not necessary for a person to excel well in careers. The principal might then omit D&T in a long-run.

8.4.3.2. Education in Hong Kong

This understatement of D&T also exists among Hong Kong people and policy in general. Chapter 5 reviews the perception of creativity in Hong Kong society. Here discussion is focused on the education in Hong Kong. According to the comments given by teacher and officer interviewees, it seems that it is not easy to foster creativity in Hong Kong because we have lots of limitations. Besides, the education in Hong Kong stifles the development of students' creativity since childhood.

Furthermore, even though D&T curriculum is now emphasising problem-solving and creativity, and the craft-based image should be fading out, D&T is still categorised

as "gong ke" in the Chinese version of some government documents for secondary schools such as School Administration Guide 2011/12 (Education Bureau, 2011a, p.43). The term "gong ke" means crafts. Even though the term also means engineering, it has no such meaning in the document, provided that the subject of Home Economics is also categorised as "gong ke", and the curriculum Home Economics is far from engineering (p. 43). The term "Technology subjects" is used in the English version of the document (Education Bureau, 2011b, p.49). It seems that the Chinese term is not parallel to the English term, and the use of the Chinese term might imply the craft-based perception towards D&T.

The issue of the use of Chinese term is not limited in the categorisation of the subject. When addressing the classroom for D&T, the term "workshop" is used. While it seems fair enough in using the English term, issue comes up if we look at the Chinese term. In the government documents such as Safety Regulation in School Workshop, the Chinese term for workshop is "gong chang" (Education Bureau, 2003). However, it is found that the classroom for Home Economics and Technology and Living is named as "Technology and Living / Home Economics special rooms" instead of cooking room and needlework room in both Chinese and English version of the safety booklet (Education Bureau, 2010, p.4). By looking at the example of Home Economics, it is even clearer that the Chinese name "gong chang" reflect the perception of the government. In fact, the D&T workshop can be named as 'gong zuo shi' in Chinese. This Chinese term has the same meaning as 'workshop' but is less technical compared with 'gong chang'. It can be argued that the government does not have significant change towards the perception of craft-based D&T regardless of the change of the curriculum content.

D&T is one of the best platforms to cultivate creativity (Dow, 2004; Rutland & Barlex, 2008). However, it seems that the mindsets of policy makers have not changed to accept or understand the nature and the value of D&T. Also, it is questionable if creativity is really implanted into D&T in the government, as creativity training has been assigned to gifted education (see Education Bureau, 2003). All resources related to teaching for creativity are included in gifted education, but not in D&T in which its students are now mainly low achievers. It is ironic for

the government to emphasise creativity in D&T curriculum documents in this circumstance.

8.5.   DEFINITION[9]

The previous sections discussed the 4P's of creativity. The perceptions of interviewees towards 4P's collectively describe what creativity is. Subsequently, it seems more appropriate to discuss the definition of creativity after the 4P's, even though the interviewees' comments on the definition seem comparable to the output of creativity.

Teachers and students generally believed that creativity is unusual and out of common sense. Creativity is also related to bravery and has a 'null origin'. It is unsurprising that these data seem to be coherent to the perception of Hong Kong society presented in Chapter 5. There are some findings which have not been noticed and discussed prior to the empirical data collection stage (Stage 4). These data are interesting and worthy to discuss in detail.

8.5.1. Rearrangement and Modification as a Kind of Creativity

Some teachers and students suggested that rearrangement and modification of an existing solution is a kind of creativity. The rearrangement and modification also possess novelty and appropriateness, and some of them even give impacts to the society. They belong to creativity.

The purposes of modification and invention are different. Whether a person tends to modify or invent a new product depends on the problem identified by the person. If the person believes that parts of a product are not effective, he might want to modify those parts and optimise the product. He defines the problem on the parts of the product, but not the entire product. However, if the person thinks that the existing

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[9] The section analyses and discusses findings from Section 7.1.1.1. Definition.

246

product is not effective at all, he might want to invent a new product. In this case, he defines the problem on the overall effectiveness of the product. Sometimes modification might be more appropriate, but sometimes there is a need to have a new invention. It might not be suitable to give a general comment that modification is less creative than invention. Besides, in addition to creativity, the needs of creativity are also important.

8.5.2.   Towards an Educational Perspective

Some teachers suggested that accomplishment is a factor of creativity. From the macro perspective, it might be true that creativity should successfully solve a particular problem in practice. It is not difficult to understand, as according to the literature, one of the elements of creativity (and also creative output) is appropriateness (See Atkinson, 2000; Howard et al., 2008; Howard-Jones, 2002; Mayer, 1999; Sternberg & Lubart, 1999).

However, the standard of accomplishment and appropriateness from the macro perspective might not be applicable to students in educational context. It is because it is very often that even though students might have the ability to generate creative ideas or solutions towards a problem, it is not easy for them to realise the idea due to many uncontrollable constraints. The resources, the technology or the time available to them in lessons might not be adequate in realising the ideas in practice. If teachers focus on the accomplishment as a constituent of creativity, creativity of some students might be neglected. The issue of assessment clearly reflects this issue.

When asking teacher interviewees how they assess creativity, one teacher (Teacher C) believed that a non-functional product is not creative. That means teacher might assess creativity along with functionability, and this might affect students' willingness to choose to work on creative ideas. Figure 8.10 shows the paths of which students would choose if creativity and functionability are linked together. If the student decides to work on more creative ideas, he may have two very distinctive outcomes: he may create something which is creative and functional and score very high marks, or he may create something which is creative but not functional and

score low marks. Conversely, the student can choose to work on more conventional ideas, and he may get a moderate to high marks as the artefact he has done is likely to function.

However, it is difficult to achieve creativity. If a student has a creative idea, he might not want to put it in practice because it is very unlikely for him to succeed in a given period of them. He might want to choose to work on ideas which are more conventional because he understands that even though the idea is creative, he will not be able to score a good mark if the artefact does not perform well at the end. If a product which is not creative but functional would guarantee a good mark, there is no reason for the student to take the unnecessary risk. In this case, the student might give up his creativity, and creativity is then not promoted in the classroom. The teacher hinders creativity unconsciously.
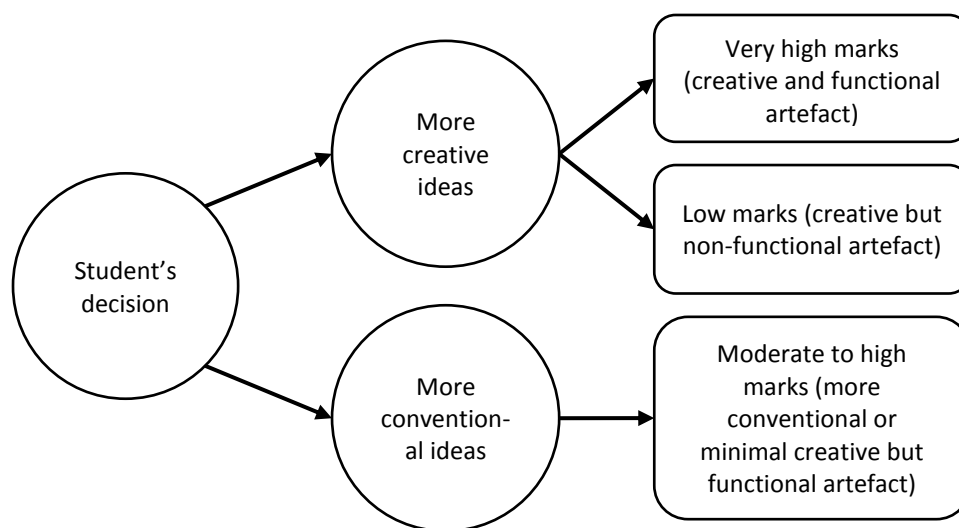
Figure 8.10. Paths of which students would choose in an assessment scheme which assesses creativity with functionability

The teacher is not wrong to define and assess creativity in a higher standard. However, if the higher standard is applied on students, students, especially those in Hong Kong, might not want to take the challenge, as it might not seem to be achievable. However, if teacher does not assess creativity in relation to functionability, it is up to students' decision whether they prefer spending time on

the creativity or the functionability of their artefacts. Creativity thus becomes a free option for students. The weighting of the assignment thus becomes important in promoting creativity in classroom.

However, it does not imply that functionability is not important. Teachers have to judge to what extent or in what circumstances innovation or creativity should be the major focus. Both should exist to give students chances to be creative and balance the need of functionability and creativity of the artefact.

One officer interviewee also addressed a similar problem that sometimes students might present their design by a computer simulation or a model but not a tangible artefact when they find that there is a limitation of resources and technology. Some teachers may not accept this kind of presentation and may not give good marks to these students because of their perceptions. Once students understand they cannot get good grades with a computer simulation or a model, they will prefer to submit a tangible artefact which is within their abilities using the limited resources and technology. They may not want to extend their thinking boundary and generate something creative, as this is not encouraged by the assessment of their teachers.

Teachers' perceptions on tangibility and functionability of artefacts limit students' creativity. Furthermore, one teacher interviewee (Teacher F) mentioned that sometimes students' creativity is hidden or neglected. This kind of creativity is often ignored by teachers and students. Being a facilitator in promoting creativity in classroom, teachers have to be aware of this situation and thus encourage or motivate students to apply his potential creative ability in different disciplines or situations. Teachers have to understand that the creativity that they often generate is the small c creativity instead of the big C creativity (see Craft, 2001). Sometimes their small c creativity might not help them create any tangible products, but this might be some tiny steps towards the cultivation of creativity and the big C creativity.
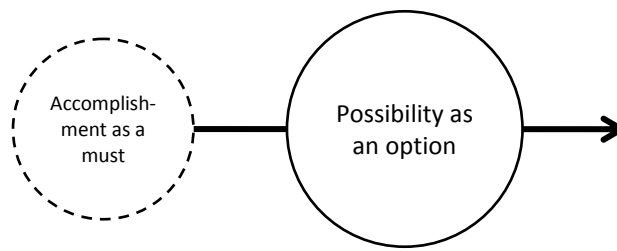
Figure 8.11. Shift of assessment

Undoubtedly, accomplishments that students achieved are important. However, students' possibility in being creative is equally important in educational perspective. Teachers should not see accomplishments as a must in assessing creativity, but notice the potential possibility of students to promote creativity. The shift of assessment is inevitable in creativity cultivation in design education (see Figure 8.11).

8.5.3. In between Boundaries and Constraints

The existence of boundaries and constraints is another interesting topic in creativity. It seems that boundaries and constraints are similar. Some teachers and students believed that creativity should have no boundary, and at the same time, creativity is associated with constraints. Are they two separate ideas? Are there any relationships between boundaries and constraints?

According to the Oxford English Dictionary (2012), boundary means "that which serves to indicate the bounds or limits of anything whether material or immaterial; also the limit itself". Constraint means "the exercise of force to determine or confine action; coercion, compulsion" (Oxford English Dictionary, 2012). From the explanation of the dictionary, boundary exists naturally and passively. It is an indication of a certain scope. In contrast, constraint exists actively and it acts as an external force limiting certain actions. The two terms are different in a way that boundary is less restricted, and constraints are more absolute. In spite of the

differences in meaning, interviewees might not be able to present a clear concept of up two concepts.

The relationship among boundaries, constraints, and creativity is illustrated in Figure 8.12. If a student does not exceed the thinking boundaries, the ideas he created are not creative or less creative. If the thinking boundaries are exceeded, his ideas might either be creative or unqualified ideas, depending on the constraints. If the ideas can meet the constraints, the ideas are considered as creative. Otherwise, the ideas are unqualified and not accepted by others. The level of refusal thus progresses from less creative or non-creative ideas to unqualified ideas. In an educational context, sometimes the constraints might not only refer to the factual requirement of an artefact, for example size and weight, or the limitation of resources and technology, but also refer to the assessment rubrics, the weighting scale of the assessment, the openness of the teacher, the acceptance of the social group, the environment and atmosphere where the creativity takes place. These actively limit the area of creative ideas occupied in the figure. If area is too large, creativity may be misidentified. If the area is too small, many ideas are unqualified and unaccepted, and creativity may not be fostered in classroom.
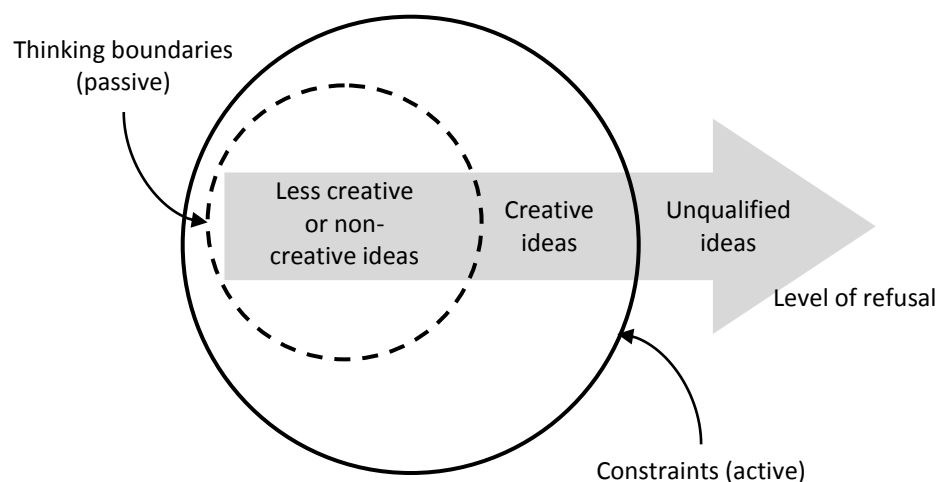

Figure 8.12. Relationship among thinking boundaries, constraints, and creativity

The above figure simplifies the real situation faced by students in design projects, as constraints are never singular as presented by a circle in the figure. There are many

constraints in the real practice. Generating ideas which fulfil all the constraints and at the same time exceed the thinking boundaries is not easy. Besides, different constraints are in tension pulling against each other. Finding a balance point among the constraints is a kind of compromise. Different kind of compromise gives different outcome in the design process.

One officer suggested that creativity is to how a person effectively makes use of all available resources to solve a problem. This thought is comparable to the idea illustrated in Figure 8.12. The available resources mentioned by the officer are confined by the constraints. The effectiveness refers to the manipulation of the resources under the constraints. However, whether more creative ideas are more effective than less creative idea is open to question, as the judgment of creativity is not only on effectiveness.

One teacher interviewee (Teacher D) suggested that creativity has many forms along the spectrum of constraints. That means under a situation with numbers of constraints, creativity exists in one of the forms, and under another situation with less constraints, creativity also exists but in other forms. This is an arresting thought in relating creativity to constraints. Similar to many creativity researchers, the teacher tried to categorise creativity into different types or forms based on the purpose or the outcome of creativity. However, it can be argued that even though the forms of creativity are different, the constituents of creativity have no change. Creativity still exists in between the thinking boundaries and the constraints. Different compromises might generate different kind of outcomes under different situation. Subsequently, creativity possesses a dynamic characteristic that it changes under different situations. The constituents are novelty and appropriateness as defined by many researchers (Atkinson, 2000; Howard et al., 2008; Howard-Jones, 2002; Mayer, 1999; Sternberg & Lubart, 1999). Categorisation of creativity should focus on its nature, for example, the P-creativity and the H-creativity of Boden (2004).

8.5.4. Towards a Criterial Definition of Creativity

From the above discussion, it is clear that creativity is related to many different topics. It is not easy to define creativity as a single definite item, and its dynamic characteristic does not allow us to define it with a single definition. However, the interviewees have given an inspiration in understanding creativity by a criterial definition.

The statements made by Teacher F and one of the officers were of different level compared with other responses. The other responses were primarily concerned what creativity is or is not, what creativity possesses, or how creativity can be categorised. However, the responses from the teacher and the officer suggested that creativity is related space-time and person. This thought gives hint on how creativity is being determined. From their responses, it is noted the novelty is relative, and it greatly depends on the space-time and person with different backgrounds. The thought suggests why creativity has different definitions, and it also suggests the factors affecting novelty in creativity.

Only time-space and person may not describe creativity a full picture. Students Ab, Fb1 and Fb2 also give some hints in defining creativity when they talked about creative output. The emotional impact, the benefits and the inspiration that creativity gives also help understand creativity. Consequently, a framework is developed based on the thought of the teacher, students, officer and literature.

Four essential factors are suggested in determining creativity: time, impact, person, and space (TIPS). The four factors may suggest tips on how the creativity is judged, valued and accepted by others.
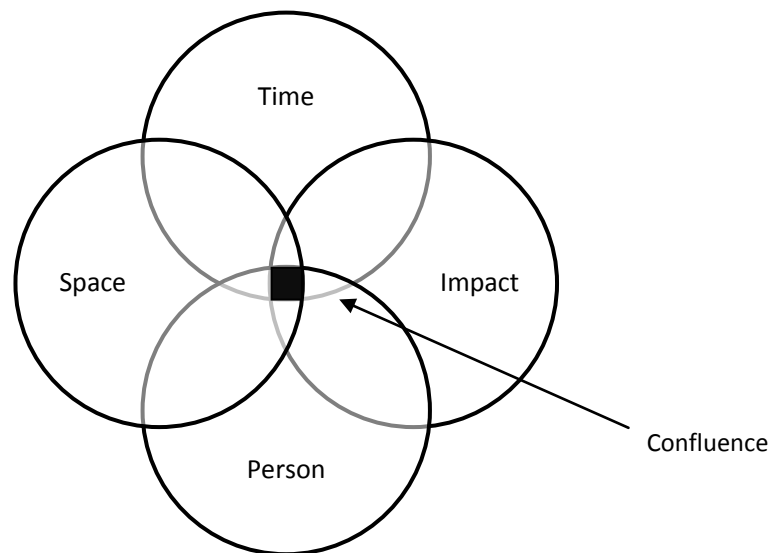
Figure 8.13. Relationship among time, impact, person, and space (TIPS)

Figure 8.13 shows the relationship among time, impact, person, and space. Creativity exists at the confluence of the four. The following sections explain how TIPS make up creativity.

8.5.4.1. Time

The general agreement of creativity in Section 2.1.1 and the responses from the interviewees affirms that creativity possesses novelty. Novelty suggests that creativity is associated with time. Because novelty is not an absolute value as it changes over time, creativity is not definite. Something new at this moment may not be new in the future. Similarly, something new in the past would not be considered new at this moment. For example, the invention of mechanical clocks around 1300s might be very inspiring and creative in comparison with the ancient time measurer such as water clock or sundial (Andrewes, 2002). However, probably no one living in the modern city would be surprised by the technology of automatic clock or digital clock. We can only regard the technology as creative at the time when it was invented. The timeliness nature of creativity is lucid enough to suggest that creativity is not an unchanging concept in the history of human beings. Creativity is a time variable. This is also one of the reasons why creativity is difficult to be assessed.

8.5.4.2.　Impact

Creativity gives impact. In order to be perceived as creative, an output should induce some emotional impacts to the person who comes across with it or who generates it, or induce some changes to the world or to a series of output. The impact referred here is often emotional or functional. Emotionally, in order to be creative, the output should have an emotional interaction with the perceiver. People who come across a creative output are often inspired and surprised of what is created. On the other hand, if a majority of people has no feeling after coming across the output, it is very unlikely that the output is creative. However, emotion is a very subjective entity, and the interaction between output and individual varies from person to person. Therefore, the emotional interaction should be referred to as a collective emotional interaction of a group of people. Functionally, in order to be creative, the output should make some benefits in creative design process. It may improve the solution in a way that it optimises what we have at the moment.

8.5.4.3.　Person

The judgement of a creative output also depends on the social group. Sometimes an output may be creative in a certain group but may not be accepted by the other group even in the same culture. Take timepieces as the example again. In the 19th century, wristwatches or bracelet watches were designed. It was considered as a feminine fashion for women. Men used pocket watches for reading time, and wristwatches were just too feminine for them (Andrewes, 2002). The new idea of wristwatches may only be creative and attractive for women, but it was not accepted by men. It can be argued that creative output needs to be socially accepted before its value is noticed. A creative output depends on the social groups, and it can be argued that it also varies from culture to culture, from group to group and from individual to individual. This also makes the assessment of creativity less robust, as the assessment is done by human beings.

8.5.4.4.   Space

Even though wristwatches were not worn by gentlemen in 19th century, it became socially acceptable to wear wristwatches for both men and women after World War II because soldiers (who were males) found that it was very troublesome and difficult to use pocket watch in front of the enemies and they started to use wristwatches (Andrewes, 2002). The acceptance of creative output changes in different incidents and situation. Even though the creative output was not accepted by a group of people, it became accepted after some events or scenarios. Apparently, the appropriateness in different situations governs the value of the creative output. Something which is inappropriate and thus not creative in this situation may be appropriate and creative in other situations. For example, having a band performing on the stage of graduation ceremony may not be appropriate. However, the same idea may be acceptable if the band is placed down the stage. Whether an output is creative depends on the place or the situation where it generates. It can be argued that creativity varies from situation to situation. This makes the task of defining creativity difficult.

8.6.   ROLES OF CREATIVITY

The previous chapters explicated creativity and its issues in design education in Hong Kong. Shifts in teaching and assessment were suggested so that teachers are more capable of fostering creativity in D&T classroom. The discussion also clarified what creativity brings to design education, as the roles of creativity are scattered throughout the discussion. In this chapter, the roles of creativity are made explicit. The chapter also addresses the issues concerning the roles and their generalisability.

8.6.1. Roles

Creativity is important in design education, as now design education is no longer a craft-based and skill training subject (Eggleston, 1985). While it is important to foster and promote creativity in design education, promoting and fostering creativity

also contributes to D&T. The roles of creativity are beneficial to teachers and students, and they are elucidated by six verbs: drive, empower, signify, improve, generate, and nurture (DESIGN) as shown in Figure 8.14. The following sections explain the six roles respectively.
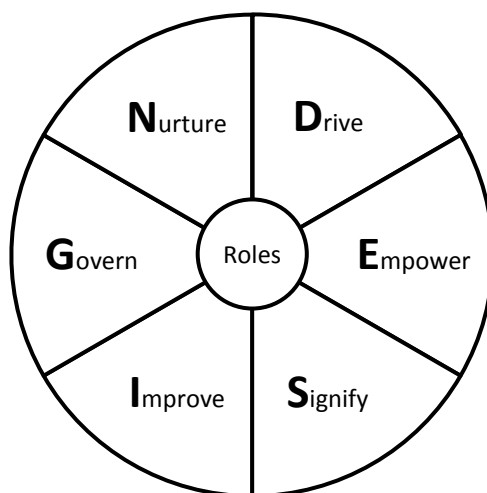
Figure 8.14. Six roles of creativity in design education

8.6.1.1.   Drive

Creativity drives teachers and students to perform better in D&T and also in different competitions. It is also a driving force which optimises the D&T curriculum. If no creativity exists in design education, creativity competitions will not exist in D&T too. D&T students and teachers may not have chances to realise their creativity and experience different difficult situations to enrich their knowledge and creativity skills. Some teacher interviewees expressed that they may also bring the elements of competitions to their lessons so that more students could experience what the participants did. If there is no creativity, D&T curriculum may just remain as a craft-based subject. With creativity, the flexibility of the curriculum increases significantly. Besides, creativity drives students to learn new knowledge. Sometimes students can only be creative when they have acquired some new knowledge.

8.6.1.2. Empower

Creativity empowers students to transfer knowledge from a subject area to another context. Sometimes students may not be able to apply a particular knowledge of a subject area in other contexts. They may not even need to do so in daily life, especially when the technology is so advanced nowadays that there are nearly no design problems in daily life. Creativity offers a platform for students to exercise and apply the learned knowledge in different situations. Knowledge they have learned in different scenarios in their life may be applicable when realising their creative ideas. They can practically use the knowledge and break the knowledge boundaries in being creativity. It can be argued that D&T also has the empowerment effect; however, a D&T without creativity may not allow students to do so. Subsequently, creativity is an essential element that allows students to associate and transfer different knowledge to different contexts. Students can connect their remote knowledge to the problem that they need to solve and thus make their knowledge transferable. Being able to transfer and associate knowledge in different contexts not only benefits the creativity in D&T but also students' learning for future studies.

8.6.1.3. Signify

Creativity also signifies the achievements D&T teachers and students obtained in lessons and in competitions. Competitions which are related to D&T are also related to creativity. If D&T teachers and students participate in creativity competitions, and their creativity is recognised in these competitions, their principal and other teachers will notice the value of D&T. Teachers also reported that in order to be regarded as significant in school, it is important to obtain some achievements in competitions so that the principal and other teachers will notice their contributions to school. Furthermore, other classmates and teachers will also recognise the achievements of the creative students. This may develop confidence among these students. This is particularly favourable for students who are not suitable for the current examination system or do not have high academic abilities. These students may be intelligent or

diligent, but they may not perform well enough to reflect their real abilities in the current education system. Creativity may be one of the channels for them to demonstrate their potential abilities and regain their confidence in front of classmates and teachers.

8.6.1.4.   Improve

Creativity improves teacher-student relationship. When cultivating creativity, the interaction between teacher and students is important as noted in Section 8.2.3. Teachers may need to guide students more attentively in the creative design process so that they can understand their needs, as suggested in Section 8.1.3 and 8.4.2. When numbers of issues arise in the process, sometimes teacher and students have to solve the problem together. The interaction becomes frequent and hence forms a mutual trust between teacher and students. It is also not difficult to understand that if teacher can guide students in solving numbers of problems, their relationship should be improved. Besides, an appropriate interaction will establish a good relationship between teacher and students. With better teacher-student relationship, it is easier to construct an effective classroom (Pianta and Hamre, 2009). The improved teacher-student relationship not only benefits learning in D&T, but also in other subjects that the D&T teacher teaches in schools. Teacher who has a close relationship with students can also help students in dealing with their other problems in their life and give guidance to them. Sometimes D&T teachers are the best counsellor to the students in D&T team.

8.6.1.5.   Govern

Creativity governs the values, growth, and development of design education. D&T without creativity is just a craft-based subject, and a craft-based subject is not desirable by the current education that schools nowadays do not aim at training workers. A D&T which only teaches technical skills is surely not accepted. Interviewees also commented that if D&T does not possess creativity, it is not D&T but woodworking. Creativity in D&T is an important element that helps define what

D&T is. This also explains why it is difficult to change the mindset of other teachers when students are not able to generate creative artefacts in D&T lesson. The value of D&T is overlooked if creativity is not emphasised. Besides, creativity indicates the direction where design education should progress. As the industrial decline in 1980s, D&T loses its direction. Subsequently, it is important for D&T to define its unique value of creativity cultivation, especially when design education at secondary school level is detached from the industrial economy.

8.6.1.6. Nurture

Creativity nurtures the emotional and creative abilities of teachers and students. When teachers and students are working on creative ideas, they may encounter different emotional issues. As suggested by the interviewees, teachers need to take care of students' emotions, and students may need to resolve the quarrels among them. Both teachers and students learn in the process. Teachers learn to be more capable of handling students' emotional issues, and students learn how to coordinate with other classmates. Besides, their creative ability is also nurtured, as they have more experience in being creative. They learn more knowledge in each creative design process, and they will be more willing and able to take risk and be persistent, as each successful experience will encourage them to be more creative. They will have more creative methods after they gained the experiences. The emotional and creative abilities nurtured not only apply to D&T but also to other areas. These abilities are valuable for life long.

The six roles are in relation to each other. They coexist in the context of design education. For example, in the creative design process, the drive for learning facilitates the empowerment of students' transferability of knowledge. Students' abilities may then be nurtured in the process, and they may generate some creative ideas. The creative ideas signify the values of D&T and also the students' creativity. In the entire process, teacher-student relationship may be improved. Creativity plays an important role in governing what D&T is. This example illustrates one of the

ways that these six roles are linked together. Different relationships among the roles may exist in different situations.

8.6.2. Issues

The DESIGN roles of creativity explain how creativity is affecting design education in Hong Kong. In addition to the roles, some issues are closely related to creativity. They are the difficulties that current D&T is facing. Some of them also explain why it is not easy to promote creativity in D&T in Hong Kong. Similar to the roles of creativity, these issues are also scattered throughout the discussions in the previous sections. They are described by six verbs: bypass, endure, hide, impede, neglect, and demand (BEHIND) as shown in Figure 8.15.
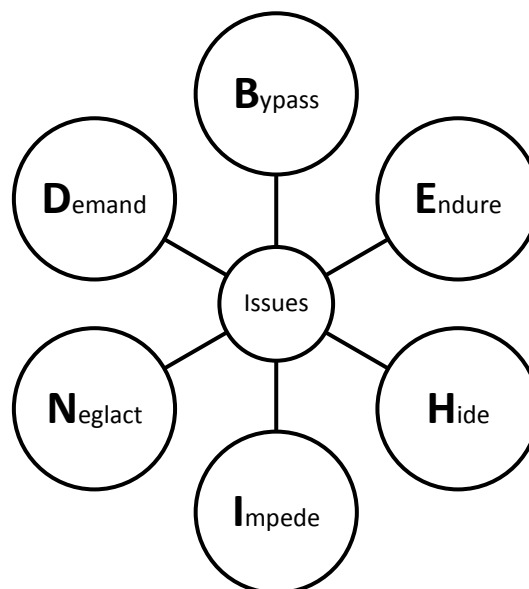
Figure 8.15. Six issues of creativity in design education

Some of these issues can be solved by giving more trainings to teachers and having better cooperation and understanding among teachers and the principals in school. However, most of these issues are related to the historical background of D&T, outdated craft-based perception towards D&T, the East Asian educational belief, and the unique educational environment of Hong Kong. It is not easy to alter the deep-rooted perceptions and practices. There is also no standard formula to solve these

issues. Sometimes teachers in classroom and in school have to make their own decisions and adjust themselves so that the effect of the issues can be minimised.

8.6.2.1. Bypass

Some teachers and students may try to bypass creativity. For example, teachers who do not want to spend extra time on guiding and supervising students' project or idea generation may assign the class to work on less creative artefacts. They may give many instructions and requirements to students so that students' artefacts may not have many variations. Teacher may take the highest control of the classroom so that students do not need additional time to finish project. On the other hand, if teachers allow more freedom and creativity in classroom and are able to devote for creativity, some unmotivated students may choose to submit the simplest design to just get a pass. Students who have a very good performance may not want to take the risk of creativity, and students who do not do well for a long time may not be motivated to work for creativity.

8.6.2.2. Endure

D&T teachers sometimes have to endure the pressure from teachers of other subjects. When students have chances to go overseas to participate in international creativity competitions, some teachers of other subjects may question the use of money. D&T teachers sometimes have to fight for the subsidies so that students can take part in competitions. On the other hand, D&T is also one of the subjects which have a large amount of budget for buying consumables and maintaining machines. When the principal wants to save money for some other activities, he may think of D&T and cut its budget and resources. If resources and budgets are limited, it may affect students' creativity, as teachers may not be so generous in giving resources and materials to students in this case.

8.6.2.3. Hide

Teachers and students in Hong Kong are not creative as commented by officer interviewees. However, it is possible that teacher and officer interviewees are not able to notice the small c creativity among students. Creativity is hidden by these teachers and officers. Besides, in the government documents of D&T, creativity is underemphasised, based on the analysis in section 8.4.3. The resources for teaching creativity are allocated in gifted education but not in design education. The principals and teachers of other subjects also have outdated perceptions towards D&T. The outdated image of craft-based D&T hides the creativity which exists in D&T. It seems that creativity and the possibility of teaching for creativity in D&T has been hidden and not recognised by other people.

8.6.2.4.   Impede

East Asian beliefs impede creativity cultivation. The highly examination-oriented curriculum and conformity which teachers emphasise in classroom hinder the development of creativity among students. Students focus on skill training and knowledge acquisition for examination. Students do not concern themselves with generating new ideas, as this may not help getting good grades in examination. Teachers prefer students who are diligent and passive. Students who are sceptical and egoistic are not welcomed by teachers (Ng & Smith, 2004). All these impede the development of students' creativity. Furthermore, students' creativity is stifled since childhood, as suggested by one of the officers and Cheng (2004) that Chinese education often delays the development of creativity at early education.

8.6.2.5.   Neglect

Some students are being neglected in D&T classroom when teacher assigns students to work on creative projects. They are not willing to work creatively, and what they would do is to submit a very simple artefact to the teacher. Teachers also do not know how to deal with them, as they understand that they cannot force students to design creatively. One of the teacher interviewees (Teacher A) suggested that it is

the cost of creativity. Whether these students are the victims in creativity cultivation are of question, as it is bound to have some students who are not willing to learn. It can also be argued that this is students' own decisions not to learn creativity. However, it is also one of the issues that educators should concern.

8.6.2.6. Demand

Teaching for creativity demands teachers to devote more time and put more efforts on students' projects. Teachers also need different kind of abilities to guide students and solve problems in creative design process. Without these abilities, it is difficult for teachers to take care of students. However, teachers only have limited time, as they have heavy workloads on teaching other subjects and handling administrative work. It is also found that teachers at present may not have creative and emotional abilities to help students be creative. The demand of creativity on teachers is heavy, and it puts teachers under great pressure.

8.6.3. Applicability and Application

Even though the DESIGN framework suggested above was formulated based on the case of Hong Kong, it has its referencing values in other secondary school design education worldwide, especially in East Asian context. The DESIGN framework explicates what creativity should be in design education. The roles of creativity would not change in other contexts, as creativity perceived by different regions should be the same. Some of the roles, for example, signify, may be even more suitable in East Asian context than in other contexts, as the secondary school design education in East Asian context do need more recognitions and significations. Besides, the framework is also applicable at other levels of education, as the roles describe how creativity benefits design education, and these are not limited to the secondary education. The roles are also constructive for children in primary schools and young adults in universities.

However, the BEHIND framework may not be applicable in its full extent in other contexts, as the issues and challenges that Hong Kong education is encountering are unique. Some East Asian countries may share similarities with Hong Kong, but the issues would not be exactly the same. The BEHIND framework does not intend to explain all the cases; however, it may give a reference to other countries in monitoring their design education.

The DESIGN roles and BEHIND issues imply that even though creativity has a number of beneficial roles in current design education curriculum in Hong Kong, it is associated with number of issues which are difficult to solve. Practically, educators, researchers, policy makers, and teachers can use the DESIGN framework to assess or examine creativity cultivation in design education and D&T classrooms. For example, some issues which are not yet noticed may exist if he finds that teacher-student relationship is not improved in promoting creativity in classroom. When creativity is promoted and fostered successfully, the six roles should be found. If one of the roles cannot be found, some potential problems which hinder creativity cultivation may exist. Subsequently, the DESIGN framework also serves as a guideline for teachers in assessing the effectiveness of cultivating creativity.

The BEHIND framework reminds educators, researchers, policy makers, and teachers about related issues in fostering creativity. The framework helps teachers examine the potential issues that needs to pay attentions at. It also reminds teachers that even though creativity is beneficial to design education, and teachers should promote creativity, they have to get prepared and develop their own strategies to encounter the difficulties in their schools and classrooms. Policy makers and educators should take references to the framework, and design curriculum and policies which can avoid the potential issues in fostering creativity.

8.7. CONCLUDING REMARKS

All the sections in this chapter are linked together, and some discussions are overlapped, as none of the 4P's can exist in isolation (Rhodes, 1987). As a whole, some perceptions of the interviewees towards creativity are comparable to the

literature. Some suggestions are made so that creativity in design education can be fostered.

In the section of output, it is found that there are two kinds of appropriateness: valuable and functional as suggested by Averill et al. (2001) and Howard et al. (2008) respectively. Functional appropriateness is the basic requirement of valuable appropriateness. Appropriateness is not as simple as it seems. It involves interactions among functions, users and the product. Therefore, when teachers assess appropriateness, it is better to assess the appropriateness of a creative output such as idea and concept, rather than the appropriateness of the product, as it is difficult for secondary school students to produce creative products with both kinds of appropriateness. Another element of creativity, novelty, not only refers to a new output but also the novelty that generates from combination. Combining existing ideas may also generate something new. Also, teachers have to be aware that assessment should be based on the P-creativity, i.e. the creativity with respect to the creator, as it is difficult for students to reach the creativity standard of teachers. Appropriateness and novelty are not the only characteristics of a creative output in this study. A creative output may also give inspirations or emotional impacts to the other people.

In the section of process, it is found that some teachers did not have a clear concept on creative thinking process, design process, and creative design process. However, those who had a clearer understanding believed that creativity is achieved through illumination, and this perception is surely not desirable in educational context. It is important for teacher to understand that creativity can be achieved through methods but not only through illumination, as it may affect how teachers teach for creativity based on their implicit theories (Dow, 2004). There are also some methods suggested on the gifted education website for fostering creativity. However, D&T teachers may not be aware of these resources. Besides, one student interviewee (Student Ab) doubted if data collection in the analysis stage of creative thinking process would limit creativity. Teacher should give adequate guidance and supports to the students with this kind of belief. Teachers also need to possess emotional ability so that they can give emotional support to students. Teacher-student interaction is important in creativity cultivation.

In the section of person, it is found that the characteristics of a creative person suggested by interviewees are comparable to the literature. Noted in their responses, East Asian educational beliefs also have a role to play. Also, group creativity was highlighted in the discussion because it concerns how team members coordinate with each other to generate creative ideas. It is essential in the discussion, as group project work is popular in D&T. Besides, some teacher interviewees thought that particular personalities and personal characteristics are a must for being creative. This perception limits the development of creativity among students, as students with these characteristics are considered not creative. Teachers should consider these personal characteristics and personalities as some kinds of abilities which can be acquired. In addition to the discussion of characteristics of creative people, the section also discusses the difficulties of promoting creativity in some particular groups of students. Students with good performance and those with very bad performance are not easy to let down their previous achievements and failures respectively. They may not want to be creative, and teachers have to take special care of these kinds of students.

In the section of environment, the freedom that teacher interviewees gave to students was discussed. Generally teachers gave maximum freedom to students to realise ideas. As long as the task is safe, teacher would allow students to perform the task. Teachers also had a positive attitude towards mistakes and errors, and the environment constructed by this kind of teachers is conducive to creativity. Giving enough time and resources to students is also essential. Moreover, issue regarding fairness is raised, as some students may need more time and materials to realise the creative ideas. One of the teachers (Teacher D) suggested a method which may be useful in solving this issue. In accordance to literature and the responses given by the interviewees, it is clear that a student-initiated classroom is necessary in cultivating creativity in classroom. It is not an easy task because this may use up more time of the teacher. Supports from other colleagues are necessary.

The 4P's constitute what creativity is. In the section of definition, it is found that rearrangement and modification is also a kind of creativity. However, it is unknown which one is more creative. In discussing the perceptions of teacher interviewees

towards creativity definition, it is found that teacher would not consider a non-functional artefact creative. This perception affects students' decision on whether they should work on creative ideas. Teachers should not take the accomplishment of artefacts as a must because students sometimes may not be able to realise their creative ideas due to different constraints. While assessing students, teachers should focus on the small c creativity and focus on the possibility of the artefact. In addition to these discussions, the section also covers the topics of boundaries and constraints. While creativity should have no boundaries, constraints also exist. Boundary is passive that it differentiates creative ideas from less creative ideas. Constraint is active that limits the number of creative ideas. A criterial definition of creativity is developed based on literature and the responses of the interviewees. Four factors which govern how creativity is judged, valued and accepted are suggested. The four factors are time, impact, person, and space (TIPS). The TIPS framework suggests reasons on the difficulties of creativity assessment and the constitution of creativity.

Figure 8.16 summarises the necessary shifts in design education suggested in this chapter.
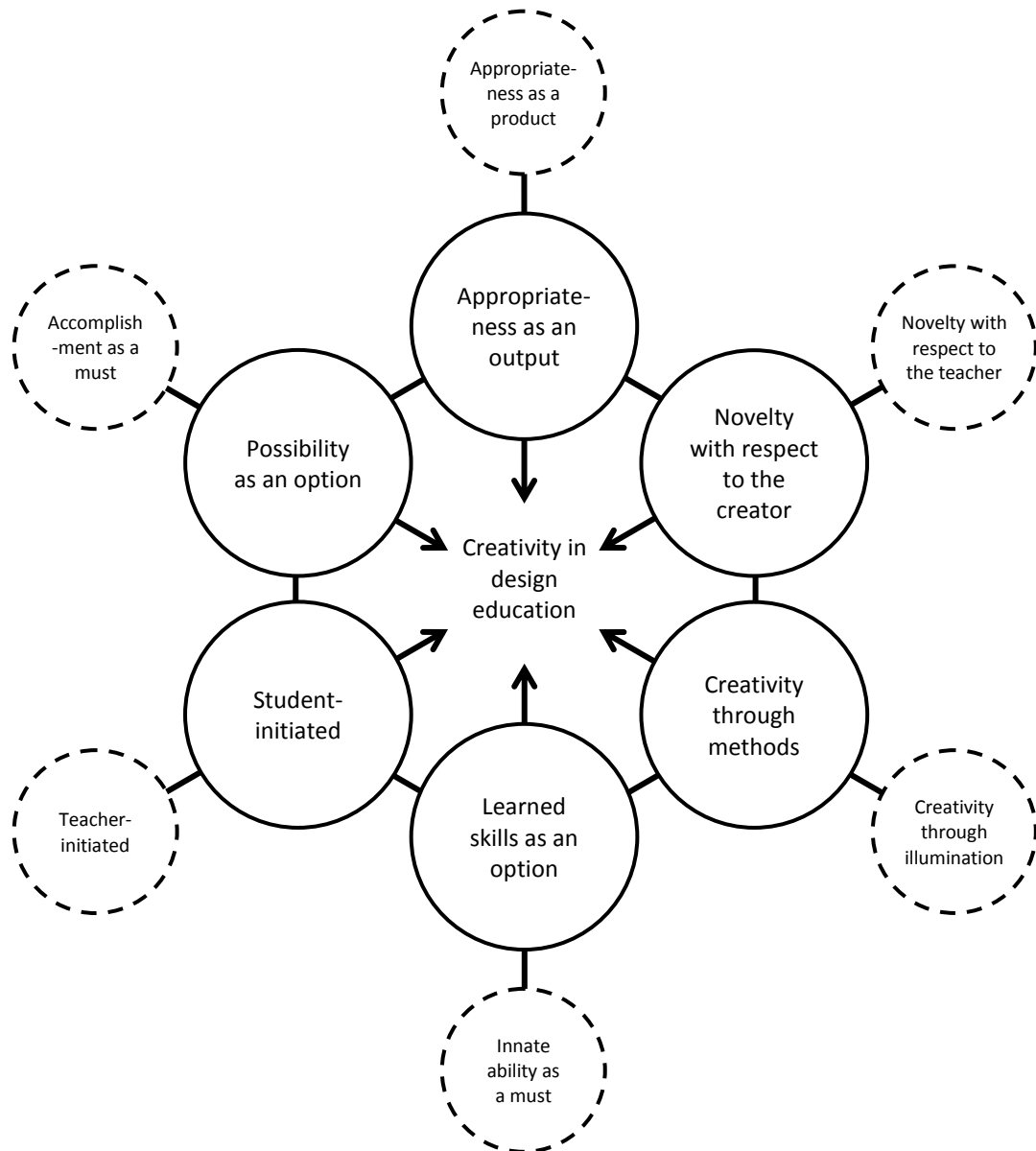
Figure 8.16. Summary of the necessary shifts in design education

According the preceding sections of 'Towards an Educational Perspective', it is clear that teachers should be aware of the shifts so that creativity can be cultivated in design education. Teachers should consider students' creativity in terms of the appropriateness of an output instead of that of the product, provided that a product is the outcome of the many different ideas and an output is only one of the many different ideas. Teacher should also consider students' creativity in terms of the novelty with respect to the creator but not the teacher himself/herself. Teachers could teach students to achieve creativity through some kinds of methods, and consider

creativity as a kind of learned skill. Classrooms should be student-initiated instead of teacher-initiated. Last but not least, teachers should emphasise on the possibility of students in being creative instead of the accomplishment that students have made. It is noted that these shifts are also applicable in other regions because they are also beneficial for creativity cultivation in other design education.

Furthermore, roles of creativity are identified in this chapter. Six roles should be found if creativity is successfully promoted in the classroom. The six roles are drive, empower, signify, improve, govern, and nurture (DESIGN). They are useful for teachers to assess the effectiveness of creativity cultivation in classroom. If teacher finds that one of the roles disappears in promoting creativity, it may imply that some potential issues exist. This framework is also applicable at other levels of education and other design education worldwide.

However, at the same time, D&T teachers are encountering some issues which are detrimental to creativity. First, the diversity of artefacts' quality is large, and some students submit simple designs to teachers because teachers want to give more freedom for students to be creative and thus give fewer instructions to them. If teacher give more instructions to students, students will have less freedom for creativity. This is the cost of creativity. In this circumstance, teachers have to cater individual needs of students attentively, as some students may want fewer instructions and some may need more. Teachers have to understand students' need and guide them accordingly.

However, it is questionable if teachers have the abilities and time to guide students in creative thinking. Majority of D&T teachers in Hong Kong are not creative, and they are unwilling to change, because of their traditional training and the craft-based background. Teachers also have large workloads in school, and they are not willing to spend additional time to supervise students. Creativity is not welcomed by them. Furthermore, majority of students are not creative as well, and most students in Hong Kong focus heavily on examinations. It is also not easy to cultivate creativity among low achievers, as it takes more time for them to learn the knowledge needed for creativity. Even if students acquire the knowledge, their knowledge learned is not transferable and cannot be applied in different contexts.

Moreover, school culture is not always supportive for creativity cultivation. Some D&T teachers face pressure from their colleagues, as a large amount of money is spent on D&T students participated in international competitions. However, achievements are important to get D&T recognised. If teachers do not wish to offend their colleagues and they do want to work peacefully in school, they may not spend time on this kind of extra-curricular activities. Some teachers of other subjects still look down D&T, and overlook its importance on association and integration of knowledge. If the principal does not understand D&T, the situation will be more severe.

As commented by some officer and teacher interviewees, Hong Kong education stifles creativity. Students' creativity has been limited since childhood. The conformity and the highly examination-oriented curriculum of Hong Kong classroom may be a cause of this. Besides, the craft-based perception of D&T still exists in some government documents. It is ironic that on one hand D&T curriculum are advancing towards creativity, but on the other hand it is still perceived as a craft-based subject. The resources of teaching for creativity are also not made known to all D&T teachers.

A framework was developed to illustrate and summarise the issues. It contains six issues that are related to creativity cultivation in design education. The issues are represented by six verbs: bypass, endure, hide, impede, neglect, and demand (BEHIND). They remind teachers to get prepared and work out a plan to encounter these issues when promoting creativity. Even though this framework is not applicable in other countries because of the uniqueness of Hong Kong education system and the historical background of design education, the framework can serve as a reference guide for other regions to monitor their design education.

Chapter 9
Conclusion

The previous chapters review the creativity literature, investigate creativity's current role in design education through the 4P's, and examine the perception of teachers, students and officers on creativity in design education. The roles of creativity, the issues relating these roles, and the shifts necessary for the cultivation of creativity were discussed. This chapter concludes the study. Answers to the research questions formulated in Chapter 1 were summarised. The future development of creativity in design education was discussed, and further studies on creativity in design education were suggested.

9.1. ANSWERS TO THE RESEARCH QUESTIONS

Design education is a kind of creativity education. This does not imply that creativity education is equivalent to design education, as many other disciplines, such as art and drama, are able to cultivate creativity in students. The distinctive features of design education make it one of the best platforms allowing students to apply different kinds of knowledge and ideas to realise their creativity (Eggleston, 2000). However, design education in secondary schools, known as D&T, is underemphasised. It seems that creativity is being overlooked in D&T. If Craft (2003) and Spendlove's (2005) assertions of creativity's importance are accurate, there is no reason to neglect a subject which can foster that creativity. This study investigates

creativity's role in design education. Five research questions have been formulated, and the responses to these questions are as follows.

9.1.1. Q1 – Understanding on Creativity

Creativity and its definition were approached by the 4P's through interviews with teachers, students, and officers. On the topic of output, the interviewees believed that creativity is related to novelty and appropriateness. In addition, they suggested that a creative output affects and improves a product or user. Combination may also be an element of creative output, but whether it is a novelty is unclear. On the topic of process, some teachers mixed up the creative design process, creative thinking process, and design process. They were not sure what leads to creativity. Some teachers thought that creativity is achieved by illumination, but some believed it could be achieved methodologically. Officers highlighted investigation and the application of ideas into other contexts. On the topic of person, teacher comments were diverse, claiming that some creative students behave well while some do not. Creative students do not like to follow instructions. Most are calm, persistent, and have good presentation skills. Interviewees also commented on whether creativity can be learned. Most teachers believed that creativity is both an innate and learned ability, but that it is difficult for students to be creative if it is not inborn. Students commented that creativity is an inborn ability that can be trained, and that everyone has the potential to be creative. On the topic of environment, teachers and students believed that environments can both demand and trigger creativity. Responses to the 4P's suggested perceptions of the definition of creativity. Teachers also commented that creativity is associated with boundaries, constraints, modifications, and arrangements.

Some of the interviewee responses were comparable with the literature. For example, on the topic of output, the interviewees believed that creativity is related to novelty and appropriateness, echoing the general agreement on creative output (Atkinson, 2000; Howard et al., 2008; Howard-Jones, 2002; Mayer, 1999; Sternberg & Lubart, 1999). Their understanding of the characteristics of creative person was also similar to the literature (see Table 8.1). They had the similar belief that difficult

environments can trigger creativity (Guilford, 1977). However, some interviewees also had mixed concepts of existing frameworks. For example, some teachers mixed up the creative design process, creative thinking process, and design process. Their comments were diverse and were sometimes supported by the literature. For example, while some teachers thought that creativity is achieved by illumination (Wallas, 1926), some believed it could be achieved methodologically (Chen, 2006; Pelt & Hey, 2011; Yang & Chen, 2011).

Furthermore, some perceptions of teacher and students, especially narrow perceptions, affect the cultivation of creativity in the classroom. For example, some teachers believed that if an artefact is not functional, it is not creative. Students may have good, creative ideas, but cannot finish an artefact due to their skills or the limited resources available to them. Some teachers emphasise functionability, and neglect ideation and creativity. This affects student decisions in choosing to work on creative ideas, as creative ideas are often more difficult to realise than less-creative ideas.

However, the interviewee responses provided some perspectives which contribute to the current literature. For example, some students suggested that a creative output also improves or affects a product or user. Some teachers and officers suggested that creativity is associated with time and space. As these contributions circumscribe the definition of creativity, a framework of criterial definition is necessary to link the literature and interviewee responses. This framework, known as TIPS, suggests that creativity is associated with four criteria—time, impact, person, and space—and also explains why creativity is not easily assessed.

9.1.2.   Q2 – Practical Issues in Design Education

Some practical issues relating creativity in design education were found during the data collection process. First, scrutinising the exemplar artefacts on the government website reveals that most of the artefacts are not creative, as they are limited by the close project brief given by the teachers. The projects under public examination are similar to those on the government website. They fail to stimulate students and

capture their imaginations. Project briefs are closed, and the projects are linked only precariously to students' social and cultural backgrounds. Some of the projects do not encourage students to investigate context. Only a few open project briefs allow students a choice in selecting the nature and design of the artefact under a theme.

On the topic of process, it was found that some teachers believed that creativity is achieved through illumination. Even though illumination is a way to be creative, it is not favourable in teaching for creativity, as it cannot be taught. It was also found that it is important for teachers to give students adequate support to be creative. In the creative design process, students may face different challenges and difficulties and may have different emotions. As facilitators, teachers should give appropriate guidance to them. Teachers who can provide emotional support to students are more likely to have a creatively effective classroom (Pianta & Hamre, 2009). It is also important to foster good teacher-student interactions so that teachers can understand their students' needs. However, the data also revealed that some teachers are unaware of their students' emotions. It is doubtful that these teachers can guide students in being creative.

Officers commented that some D&T teachers in Hong Kong are not creative. This is due to their traditional training, backgrounds, and large school workloads. Hong Kong students are not creative as well, due to their passivity and lack of ability to express themselves. They are not able to transfer the knowledge they learn to other contexts, and this limits their ability to be creative to the extent that they cannot easily associate different types of knowledge.

These issues are closely related to Hong Kong's East Asian education beliefs. Students who are sceptical and individualistic are not welcomed by teachers (Ng & Smith, 2004). The classrooms are often authoritarian, with teachers in control. In addition, Hong Kong's educational system is highly examination oriented, which does not favour creativity (Cheng, 2004). Teachers also face a lot of challenges and pressures in school, as some do not support the cultivation of creativity. They also do not have time to guide and supervise students in being creative. Even though Hong Kong society exhibits some understanding towards creativity, D&T is underemphasised in schools. The value of D&T in cultivating creativity is

downplayed. However, it was also found that design education is detaching itself from industrial development due to the economic restructuring of Hong Kong. When the training of skilled workers for industrial purposes ceases, cultivation of creativity and problem solving skills in D&T become more important than ever.

9.1.3. Q3 – Teachers' Actions

From the discussion of the interviewed teacher responses, it was found that six shifts in teaching for creativity in design education are necessary. Some of these shifts are inspired by the literature, and some were taken from the teacher responses and discussion of these responses. The shifts indicate that teachers should:

- assess appropriateness in an single creative output instead of the entire artefact;
- assess novelty with respect to the creator (student) instead of the novelty with respect to the teacher;
- teach students to achieve creativity methodologically instead of through illumination;
- believe that the skills necessary in creativity can be learned instead of believing that innate ability is a must;
- cultivate a student-initiated classroom environment; and
- assess the possibility of an artefact instead of focusing on accomplishment and functionability.

These shifts suggest adjustments that teachers have to make in their teaching methods, perceptions, assessments, and classroom management. They are also related to the 4P's of the creativity that the elements of 4P's are incorporated into these shifts.

In addition to the shifts, teachers also have to give adequate guidance and emotional support to their students. Teacher-student interaction is important in cultivating

creativity. Teachers also need to pay attention to students with lower motivation to help them be creative in the classroom.

9.1.4.   Q4 – Roles of Creativity

Creativity is beneficial to design education and general education in different ways. Six roles of creativity were identified based on the data collected in the study. These roles are represented by six different verbs: drive, empower, signify, improve, govern, and nurture (DESIGN). In brief, creativity:

- *drives* learning;
- *empowers* transferability of knowledge;
- *signifies* the achievements of D&T and creative students in school and in the classroom;
- *improves* teacher-student relationships and classroom effectiveness;
- *governs* the values and development of design education; and
- *nurtures* the creative and emotional abilities of teachers and students.

The six roles relate to each other and coexist in the design education context. The framework can be used to assess and examine how creativity performs in design education or in a D&T classroom and serves as a guideline for teachers in the cultivation of creativity. It can also be applied to any form of design education in which creativity is emphasised.

9.1.5.   Q5 – Issues in Cultivation of Creativity

Creativity is associated with a number of issues which that are difficult to solve. Teachers should be aware of these issues when they are cultivating creativity. They need to be prepared to face the challenges and plan their own strategies in their classrooms. Similar to the roles, these issues are represented by six different verbs: bypass, endure, hide, impede, neglect, and demand (BEHIND). The following list describes the six issues.

- Some teachers and students may try to *bypass* creativity, as it is not an easy or favourable task.

- Teachers have to *endure* pressure from colleagues and principals, as some colleagues and principals may not understand the need for creativity in design education.

- Creativity is *hidden* in teachers, students, and the Hong Kong education system, as their creativity may go unnoticed.

- The cultivation of creativity is *impeded* by East Asian beliefs, as the characteristics and practice of creativity are not welcomed by teachers.

- Some students may be *neglected*, as teachers may spend more time on creative students.

- Creativity *demands* that teachers invest time and effort and possess different kinds of ability which they sometimes cannot afford due to heavy school workloads.

These issues are difficult to solve, as they are firmly associated with the historical background of D&T, the East Asian belief in education, and Hong Kong's unique education environment. Teachers have limited time and heavy workloads. D&T carries an out-dated craftsmanship image. Teacher training courses and resources for creativity are inefficient, and some experienced D&T teachers are resistant to change. Even though these issues reflect Hong Kong's unique situation, they can serve as a reference to other areas of East Asia that wish to monitor their design education.

9.2. CONTRIBUTION OF THE STUDY TO KNOWLEDGE

To conclude, the study contributes to both knowledge and practice. It suggests a criterial definition for creativity. It helps understand creativity through another perspective. It identifies the roles of creativity in design education through examining Hong Kong teachers', students' and officers' perceptions of creativity through 4P's. This suggests what teaching creativity is and helps understanding creativity in an educational setting. Besides, the study identifies the issues of cultivating creativity specified in design education in Hong Kong. This pinpoints the

difficulties that teachers are facing and further highlights the potential issues in cultivating creativity in the context of Hong Kong education, so that a clearer picture of creativity and design education in formal education of Hong Kong can be obtained. Practically, the study suggests the necessary shifts that D&T teachers should be aware of in teaching creativity. The shifts help teachers in teaching creativity more effectively in practice.

9.3.   FUTURE DIRECTIONS OF DESIGN EDUCATION

In view of Hong Kong's current design education, D&T is facing a great challenge: its value is downplayed, and its value for fostering creativity is underemphasised. While Hong Kong society praises creativity, D&T is being neglected. Even though creativity may still be found in current D&T, it does not exist extensively in curricula.

It is anticipated that a growing emphasis on creativity in D&T is a must. If it continues not to be emphasised in a conscious way, it will not be valued. As D&T is not a compulsory subject at the secondary school level, principals in Hong Kong schools may choose not to offer the subject to students. If its value is not recognised, D&T may become extinct in the education system. However, emphasising creativity in D&T is not easy, as the current emphasis is on technology.

In this study, teachers with creative experience or who had led students in creative competitions were invited for interviews. Most of the competitions these teachers have participated in were associated with higher technology such as robotics and were more welcomed by D&T teachers. This may be because most D&T teachers have been trained to teach woodwork or metalwork and are based more in engineering. There were also some competitions related to aesthetical design, such as an eyewear design competition; however, these competitions were not popular among D&T teachers. If creativity is an element of D&T, as shown in the literature and interviewee comments, and D&T in Hong Kong is more inclined towards technology and engineering, this turns the discussion towards the cultivation of

creativity in technological, engineering, and industrial design at the secondary school level.

One officer commented that D&T is now developing in an engineering direction. This is also evidenced by the increased time for technology in the DAT syllabus (CDC & HKEAA, 2007). However, one (Teacher F) teacher reported that it is difficult for students to be creative in technology, as students may not be capable of learning the necessary technological knowledge beforehand. If it is so difficult for students to be creative in technology, should they be encouraged to generate creative ideas in technology-oriented projects? Chapter 6 shows that technology-oriented artefacts on the government website have very few variations. The only variation appears to be the decoration. Most students, in choosing their topics on public examination, also avoided topics related to technology. Even though D&T in Hong Kong emphasises technology more than design, students seem to avoid technology, and are sometimes unable to be creative in it.

More importantly, D&T is now often studied by lower achievers in Hong Kong. Most Hong Kong schools with higher bandings either do not offer D&T or DAT to students or intend to close their D&T. Schools which offer D&T or DAT are former industrial schools, and most of their students are weaker academically. These students may face more challenges in being creative in technology-oriented D&T. If it is difficult for lower achievers to be creative in technology, and D&T is studied by lower achievers, how creativity may be promoted in technology-oriented D&T remains in question.

This could explain why creativity does not exist widely in the curriculum. It may be argued that while creativity is an important element in D&T, the current D&T curriculum is not able to include creativity extensively. It is ironic that while the government pushes D&T to emphasise technology and creativity, students are not able to be creative in technology because D&T is now often studied by lower achievers. Even though few schools produce remarkable achievements, many other schools are not able to train students to be creative and produce creative artefacts. Indeed, most D&T students will eventually only produce conventional artefacts.

Teachers who suffer from inadequate resources, training, and support may not be able to do much for creativity.

It may be easier to cultivate creativity if more focus is placed on designs which use lower levels of technology. Projects which are associated with our living environment and objects which are closely related to our everyday life can be assigned to students. In such cases, students with lower academic abilities may also have a chance to practise their creativity and realise their own ideas. Furthermore, Williams (2006) suggested that designers are now more focused on designing for experience, rather than designing to solve particular problems in the real world. This paradigm shift may have implications for learning and teaching in design education. Designing for experience may be more favourable for Hong Kong students, especially those with lower academic abilities, in practising their creativity.

However, most D&T teachers in Hong Kong are currently not qualified and cannot meet teaching design needs. Providing more training courses for teachers may solve the problem, and this may require cooperation with some design schools and institutes in Hong Kong at the tertiary education level. Design education at the secondary school level currently cooperates with the Vocational Training Council (VTC), as the current DAT syllabus is designed with its support (CDC & HKEAA, 2007). However, D&T is not categorised as a kind of applied learning or vocational training in the Hong Kong education system (Education Bureau, 2007b; 2007c). Why it does not cooperate with local design schools such as the School of Design in the Hong Kong Polytechnic University remains in question. There may be some hidden issues which are unknown to the public.

Nevertheless, if D&T continues to develop in its current direction, creativity will be hardly fostered amongst students, and its value in D&T will decrease in the future. Understanding creativity and the current D&T is essential. The roles of creativity identified in this study should be able to support creativity development. In addition, it is crucial for the government to reallocate design education as a kind of general education for all students, so that all students in Hong Kong have opportunities to realise creative ideas in practice. The government also needs to give adequate support to D&T teachers and schools so that creativity may be promoted. If the

government does not take action on D&T, D&T will face even greater difficulties in Hong Kong education.

9.4. FURTHER RESEARCH

Even though D&T is not emphasised in Hong Kong, its uniqueness and irreplaceable values draw the attention of researchers and educators worldwide. The breadth of research in design education has increased in recent years (Williams, 2011). Creativity studies of D&T creativity should not stop at this stage, as these studies are continuing around the world.

This study identifies the roles of creativity and their related issues. An explorative study like this may need further research using other approaches for verification. For example, quantitative research using questionnaires can be conducted to verify if the roles suggested in the study extensively exist in creative classrooms. More schools, teachers, and students may need to be involved so that the findings in this study can be verified empirically in the further research.

Further studies may also be conducted in other areas and in other Asian/East Asian countries to verify the roles and reveal worldwide issues. Comparisons can be made so that references may be taken from practices and contribute to the worldwide development of design education. However, it is difficult to conduct studies in some East Asian countries such as Mongolia, Japan, and Korea due to political or language issues. It is thus necessary to cooperate with other researchers who are familiar with the relevant languages and cultures to conduct studies in these places. Some of these places also produce many creative products, and it may be worthwhile to investigate their creativities and design educations.

Furthermore, this study finds that some of the challenges to cultivation of creativity encountered by Hong Kong design educators are related to East Asian beliefs. These beliefs play an important role in the cultivation of creativity. However, current knowledge frameworks on creativity which account for East Asian beliefs may not be adequate. Whether there is a difference between creativities that are perceived by

the East and West is also quite ambiguous. Studies on Eastern and Western creativities may be conducted for clarification. To this extent, interviews and questionnaires may be used for data collection in this explorative study, and classroom observation may also be performed. Comparisons should be made so that a clear framework on Eastern and Western creativity differences could be identified. This suggested research may be able to refine the essential elements of creativity in East Asian beliefs based on the western literatures and hence redefine creativity in East Asian context. A unique approach which only specifies for East Asian countries can then be developed.

The methods used to foster creativity in Western society may not be directly applicable to the East Asian context, and their effectiveness in East Asian societies is also in question. Experimental studies may be conducted to test the effectiveness of creativity methods existing in East Asian societies. Such studies may involve students at different levels in different East Asian groups. Control groups may be set up in different groups so that the effectiveness may be compared. This kind of studies may also suggest methods specifically designed for East Asian societies.

9.5. CONCLUDING REMARKS

This chapter concludes the major findings and discussion of the study. This study finds that creativity is not fostered to its fullness in D&T, though some perceptions of the interviewees were comparable with the literature. Some perceptions of teachers and students, especially the narrow perceptions, affect the cultivation of creativity. Based on the literature and the discussion of the interviewee responses, six different shifts related to perceptions, teaching, classroom management, and assessment were suggested so that teachers may cultivate creativity more easily in their classrooms. Classrooms which promote creativity show six creativity roles: to drive, empower, signify, improve, govern, and nurture (DESIGN). In addition to these roles, teachers also have to be aware of the issues relating to cultivation of creativity, represented by the following verbs: bypass, endure, hide, impede, neglect, and demand (BEHIND). Teachers must prepare and work out plans which are suitable for their own classrooms and schools.

The development of design education should aim at creativity cultivation, as there is no longer a need for workers with training skills. The roles of design education at the secondary school level should be identified so that society may value it. However, D&T is currently focused on technology and engineering and is more often studied by lower achievers. It is not easy for students with lower academic abilities to apply technological knowledge to creativity. Emphasis should shift towards a less technology-based and more design-based curriculum so that D&T students may acquire knowledge more easily. Support from the government and related tertiary institutions are crucial.

Further studies relating to creativity and design education were also proposed. Studies on the roles of creativity could be repeated in other East Asian countries, and more generalised results and issues may be obtained. Comparisons could also be made so that references may be taken from other practices. In addition, explorative studies which investigate the differences between Eastern and Western creativities may facilitate knowledge construction in other studies. The effectiveness of the existing methods in cultivating creativity in East Asian societies could also be examined, and studies that do so may propose methods designed for students with East Asian backgrounds.

According to Spendlove (2005), creativity development is parallel to the development and evolution of our culture and society, and creativity should be considered "the elusive and ultimate goal of education" (p. 9). Design education is one of the best platforms for cultivating creativity, and it is crucial for educators and researchers to understand creativity and its roles thoroughly so that it can be fostered in design education.

Appendix I

Interview Guide for Teachers

<u>Teaching and experience in competitions</u>

1. Can you describe the competition you participated?

   - What is the requirement of the competition?

2. How do you and your students generate solutions to respond to the problem posted in the competition?

   - Which one is the most creative?
   - How is the process?
   - How did you feel in the process?
   - What difficulties have you and your students encountered?

3. How do you guide students to unleash their creativity?

   - What difficulties have you and your students encountered?

4. When students propose creative ideas which are unlikely to be realised, what would you do?

   - How are those ideas like?
   - How would you guide them?

5. Have you ever received any creative artefacts?

   - Can you describe the artefacts?
   - Can you give some examples? Or do you have the artefacts in school?

6. Have you ever encountered any creative students?

   - What or how did they do or perform so that you think they are creative?
   - How are they like?

7. How do you find when dealing with creative students?

   - Can you share your experience in classroom?

Activities designed for students

8. Have you ever designed creative activities for students?

    - What are these activities? If no, why?

    - How were students' responses?

9. Have you ever designed activities which develop students' creativity?

    - What are these activities? If no, why?

    - Why would you think these activities can develop students' creativity?

    - How were students' responses?

About creativity and D&T

10. What do you think about creativity?

    - What is creativity?

11. Do you think creativity is innate, or it is developed or acquired?

    - Why do you think so?

12. Do you think people generate creative ideas through a general route that other people can follow, or in random?

    - Why?

    - If there is a general route, can you suggest a route?

13. How do you think about the relationship between creativity and D&T?

    - Are they related? Why?

    - Can you explain by using your experience?

Curriculum and Practice used in Teaching and Assessment

14. How do you think about the connection between creativity and the D&T syllabus and curriculum?

- Why? Can you give any concrete examples?

15. What is the attitude of your colleagues and the principle towards D&T curriculum?

    - Do they think the same as your D&T colleagues? Why?
    - Do you know the reasons? What are they?

16. How often do you consider creativity in the assessment?

    - Can you describe the rubrics you use for assessing creativity?

Other Information

17. How many years have you been teaching D&T?
18. What other subjects do you teach in schools?
19. (Only for schools which offers DAT at senior secondary levels) How are the DAT lessons arranged in your school? How many electives are offered to students? What are they?

Appendix II
Interview Guide for Students

1. Can you describe the competition you participated?
   - What is the requirement of the competition?

2. How do you generate solutions to respond to the problem posted in the competition?
   - Which one is the most creative?
   - How is the process?
   - How did you feel at that moment?
   - What difficulties have you encountered?

3. How did you generate the creative solutions?
   - What difficulties have you encountered?

4. When you propose creative ideas which are unlikely to be realised, what would you do?
   - How are those ideas like?

5. Have you ever made creative artefacts?
   - Can you explain what the artefacts are like?
   - Can you give some examples? Or do you have the artefacts in school?
   - How do you feel when you finished the artefacts or were working with the creative ideas?

6. Have you ever encountered creative classmates or teachers?
   - What or how did they do or perform so that you think they are creative?
   - How are they like?

7. How do you find when dealing with these creative people?
   - Can you share your experience of dealing/working with them?

8. Do you think people generate creative ideas through a general route that other people can follow, or through random ways?

   - Why?
   - If there is a general route, can you suggest a route?

9. Do you think creativity is innate, or it is developed or acquired?

   - Why do you think so?

10. What do you think about creativity?

    - What is creativity?
    - Which kind of objects is creative?

11. Which school subject is related to creativity?

    - Why do you think so?
    - Can you explain by using your experience?

12. Have you ever participated in creative activities in school?

    - What are these activities? If no, what is the reason?
    - Do you think these activities were successful? Why?
    - How do you feel after doing these activities? (What is the emotion? What have you learned?)

Other Information

13. Which secondary level are you studying at?
14. What are your favourite subjects? Why? Why is D&T included/not included?

Appendix III

Interview Guide for Officers

1. In your opinion, which element(s) is(are) essential in the current D&T curriculum? Why?

   - Why is the element of creativity (not) included?

2. Is creativity important to the D&T curriculum? In what sense it is (not) important? Why?

   - How is creativity beneficial (not beneficial) to D&T?

3. In your opinion, what is creativity?

   - What elements should a creative product possess?
   - Any examples?

4. In your opinion, what is creativity in D&T?

   - How do you distinguish the creativity in D&T with the creativity in general?
   - Or there are no differences?

5. Based on your knowledge, how do the current D&T assignments and design projects incorporate creativity?

   - In your opinion, do you think the artefacts done by students possess certain level of creativity? Why?
   - How does creativity affect assignments and design projects?
   - Are there any issues concerned when creativity is being incorporated in a real practice? If yes, what are they?

6. Based on your knowledge, how do the current D&T teachers incorporate creativity into their lessons in D&T?

   - How would you incorporate creativity if you are one of them?
   - Do you think they have successfully incorporated creativity into their lessons? Why?

- How does creativity affect teachers' teaching methods?
- Are there any issues concerned when creativity is being incorporated in a real practice? If yes, what are they?

7. Based on your knowledge, is creativity considered in formal and informal assessment?
    - How is it considered in assessment rubrics?
    - How does creativity affect assessment?
    - Are there any issues concerned regarding assessing creativity? If yes, what are they?

8. Based on your knowledge, how do secondary school students perceive creativity?
    - Do you think students value creativity? Why?
    - How does creativity affect students' learning?
    - Are there any issues concerned regarding students' learning in the topic of creativity? If yes, what are they?

9. Do you think that creativity is promoted in D&T? Why?
    - Should creativity be promoted in D&T? Why?

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