A STUDY OF CREATIVE TAIWANESE UNIVERSITY STUDENTS IN INDUSTRIAL DESIGN

by

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(Under the Direction of Thomas P. Hébert)

ABSTRACT

University professors in industrial design programs have been trained as designers, and have not been trained to teach highly creative students. In addition, instructors of industrial design have not been trained to recognize students' strengths and individual needs. If industrial design programs are to be successful, educators need to better understand the creative characteristics of industrial design students and their perceptions of what contributes to classrooms that enhance creativity. To address this problem, this research study examined the following questions: (1) How do students in an industrial design program identify their creative characteristics? (2) What are the perceptions of students in an industrial design program regarding creativity and successful creative individuals? (3) What are the perceptions of students in an industrial design program regarding learning environments that enhance their creativity?

This study examined the perceptions of four university students in an industrial design program in Taiwan. Through semi-structured interviews, classroom observations, and document review, the researcher attempted to describe the cultural reality of highly creative industrial design majors.

This study revealed specific creative characteristics of the four students. Their perceptions of creativity and successful creative individuals incorporated both Western and Eastern views of creativity. In addition, open, psychologically safe and supportive classroom climates were highly valued as effective environments to enhance creativity. Furthermore, the participants' highlighted a variety of suggestions for college professors to design learning environments and instructional approaches that enhance students' creativity in university classrooms.

INDEX WORDS: Creative Characteristics, Creativity, Industrial Design, Instructional Approaches, Learning Environment, Successful Creative Individuals.

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DEDICATION

To my mom, Hong-Tao Lin and my aunt, Yue-Er Lin, to whom I owe so much for shaping who I am today.

To my wife, Wan-Ru Wu and my son, Christopher Lin, who have always loved me and encouraged my achievements.

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我的「兩位母親」：林紅桃、林月娥女士，竭盡所能的愛我、喝護我，讓我有今天的成就。

我的太太吳婉如小姐、二歲九個月的小兒子阿福，林懷謙，對我一直以來的關愛、支持與鼓勵。

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CHAPTER 1

INTRODUCTION

Each time I recall my life as a student in industrial design during junior college, university, and graduate school, I enjoy reflecting on my former classmates and the good times we had as we gathered and discussed new design ideas. I can also recall how my colleagues and I teased some of the more demanding teachers who we thought were overly critical of our work. In addition, I enjoy reminiscing about how much fun my friends in design school had together. As young college students, we always believed that we could have learned better if teachers taught in different ways or through more practical and innovative curriculum. As students of design, we so admired and envied our most highly creative classmates who seemed to perform so well. At that time, those highly creative students were considered the superstars of the design program and were destined to become famous designers.

As time passed, however, not all of our most highly creative classmates became successful professional industrial designers. Many of them chose to dedicate their creativity to other fields such as computer engineering, marketing, and even banking. Today they are currently working in different professions. Several of them are at the managerial level while others are working in foundational levels of businesses. Although we are at different places in this hierarchical society, we still maintain friendships. In addition to sharing memories of our good times in school, some of us continue to discuss issues related to the industrial design program. How many times have I heard one of my

friends say, “I could’ve become a famous designer if Dr. John had not said that to me”? How many times has one of us said, “I knew Susie was so creative and full of potential to be a designer, but she never seemed to recognize her creativity”? How often did one of us complain, “I didn’t think Dr. Kate was a good teacher in design because she knew too little about the real profession.” Although we may occasionally complain of our experiences as students, we still care about the field of design.

These conversations with my friends have led me to ask some important questions. For example, I have often wondered what would have enabled all of my colleagues in school to feel positive about their experiences as students in design. My curiosity regarding this issue motivated me to enroll in a doctoral program in educational psychology in order to study creativity in college students and determine how educators may foster creativity in young adults to better prepare industrial design students for their future careers.

This dissertation has evolved out of my personal interests. My prior educational background in industrial design, strongly connects to creativity. Profesional designers need to unleash their creativity to create better products to solve problems, and students in design programs are constantly asked to ehnahce their creativity and stimulate their creative ideas. Obviously, creativity is one of the essential factors to successfully survive in this professional realm. In order to help university industrial design majors enhance their creativity, design educators must know their students, understand their educational needs, and design supportive environments for their success. Therefore, understanding the creative characteristics of students pursuing degrees in industrial design has become an important issue in design education.

Creativity plays an essential role in design education and influences how students perform academically and whether they become successful in their careers. Creativity in industrial designers may look different from expressive creativity. Unlike artists' expressing personal thoughts and feelings, a designer's creation must often address a real world problem rather than be a piece of art; moreover, industrial designers must understand the constraints they face in order to serve the end-users with a better product. For example, theoretical creativity may not emphasize leadership and communication skills; however, designers need to possess both characteristics to promote their new ideas for products so that they, finally, can be successful in their profession.

As a result of my educational background in industrial product design and the many exciting changes occurring in this field, I have become interested in the creative characteristics and personality traits of design students. At the IDSA (Industrial Design Society of America) proceedings, Branham (1999) mentioned that, because of the influences of the information era, designers, in addition to traditional design skills, need to learn new technologies, new design concepts, and new manufacturing processes. This "new knowledge" determines whether a designer will survive in this profession. In other words, designers will not be successful if they only understand "design"; again, they must possess strong communication skills, sharp leadership qualities and an enthusiastic learning attitude so that they can promote their new ideas, be aware of new knowledge and, finally, be successful in the design field.

However, my experience has led me to a different perspective from that of Branham. Based on my observations of my fellow classmates in an industrial design degree program in Taiwan, students who had stronger performance in design studio

classes had various characteristics. Some of them were very talkative and spoke with confidence. Others were deep thinkers. Some of them enjoyed expressing their rough ideas by using a 6B pencil while others insisted on processing their design on a computer. Some of these successful students believed that the curriculum triggered their creativity, but others believed that the environment had nothing to do with their success. No matter what strategies and equipment they used and teaching styles they prefered, they were all successful in their university design programs. My experiences in industrial design programs have caused me to question whether the findings of Branham (1999) are valid. The discrepancy between my experiences and limited literature on this topic has led me to question what truly enables some creative students to be successful in a design degree program.

The purpose of study was to examine what creative characteristics industrial design students perceive they must have in order to be successful. I was interested in learning their perceptions regarding their creative characteristics, how they viewed successful creative individuals, and discovering how these students thought their university learning environments could enhance their creativity as students of industrial design. With this understanding, I may apply my findings to design education programs to enhance students' creativity and assist industrial design educators in creating environments that support creativity.

Statement of the Problem

As I began my doctoral program, I came to understand that university professors in industrial design programs have been trained as designers, and have not been trained to teach highly creative students. In addition, instructors of industrial design

have not been trained to recognize students' strengths and individual needs. If industrial design programs are to be successful, we need to better understand the creative characteristics of industrial design students. One effective way to learn more about this issue is to obtain the perspectives of the individual students. Educators need to understand students' personal perceptions of their creativity and personalities, and how these perceptions influence their work in industrial design. Once we better understand these perceptions, we will be able to develop industrial design programs that enhance their creative talents and the likelihood of being successful. With this knowledge, educators will be better able to create psychologically safe environments with appropriate curriculum and instructional approaches to nurture creativity in industrial designers.

Research Questions

In order to assist university educators in addressing the needs of creative students in industrial design programs, it is important to understand how students view their creativity and appreciate the elements of the environment in which they are able to reach their full potential as creative designers. Therefore, the following research questions guided my dissertation research:

1. How do students in an industrial design program identify their creative characteristics?
2. What are the perceptions of students in an industrial design program regarding creativity and successful creative individuals?
3. What are the perceptions of students in an industrial design program regarding learning environments that enhance their creativity?

Organization of the Dissertation

This dissertation is presented in six chapters. This chapter provided an introduction to the research study. In Chapter Two, existing research and literature on the subject of creative characteristics, creativity in Chinese culture, learning environments to enhance creativity, and definitions of industrial design are summarized. The research methods and procedures used in this study are discussed in Chapter Three. Chapter Four provides a description of the research context and an introduction to the participants. The findings of the study are presented through portraiture in Chapter Five, and a discussion of the results and implications is presented in Chapter Six.

CHAPTER 2

REVIEW OF THE LITERATURE

In order to investigate the creative characteristics of university students majoring in an industrial design department in Taiwan, relevant literature was reviewed, including those studies that examined 1) creative characteristics, 2) adult creativity, 3) Chinese perspectives of creativity, and 4) the various aspects of industrial design. In the review of the literature, common creative characteristics were identified, and the essential personality characteristics influencing creative achievement were highlighted. Secondly, since my research examined college students, adult learning styles and adult creativity were also reviewed. Additionally, Taiwanese perspectives of creativity were examined because the findings will be critical to facilitate creative training programs in universities in Taiwan. Finally, the design of a creative learning environment is also reviewed.

Aspects of Creative Characteristics

Any researcher attempting to define creativity would realize the impossibility of a precise definition. Creativity seems to be a multi-dimensional phenomenon; in fact, different theorists have attempted to explain different aspects of creativity. Of the numerous definitions of creativity, which is the most useful? Which is the most highly respected? Of the various creative personalities, which will lead individuals toward higher achievement? In this research, the idea of creative personality traits, and the essential elements of being successful will be summarized in a review of the significant literature.

Aspects of Creativity

Throughout the centuries, philosophers, scientists, educators, and psychologists have made attempts to understand more clearly the creative personality. The questions such as "What is creativity," "How does creativity occur," and "How can creativity bring one to one's highest achievements in life?" have been reoccurring in the minds of researchers. However, there is still no universally agreed upon definition of creativity – any more than there is of intelligence. In general, the most popular conceptions fall into three categories, depending on the relative emphasis given to the product, the process, or the experience (Amabile, 1996; Boden, 1994; Getzels, 1975). Therefore, some definitions are formulated in terms of a manifest product, which is novel and useful (Boden, 1994; MacKinnon, 1962). Other definitions are formulated in terms of an underlying process, which is very different from a product (Boden, 1994; Ghiselin, 1952). Maslow (1963), however, insists on the importance of the flash of insight – the transcendent sensation itself – without reference to whether it will ever result in anything tangible.

The psychoanalytic perspective of creativity began with Freud in 1901. Freud was the first to develop a dynamic theory of a creative personality. The concept of the unconscious was central to his theory. He believed that a creative person was more capable of retrieving and using unconscious material than a less creative individual was. His concept of creativity was closely associated with neurosis; moreover, the "creative individuals are frustrated and [therefore] channel sexual energy not expended properly into creative pursuits" (Melrose, 1988, p. 20). In the psychoanalytic position, according to Sigmund Freud, creativity originates from conflicts deep within the unconscious.

Unsatisfied wishes and unfulfilled sexual fantasies become the mainspring of both neurosis and creativity. Unchanneled neurosis leads to almost total withdrawal from reality whereas neurosis channeled via sublimation leads to productive creativity. In other words, sublimation attempts to solve the conflict between man's urge towards instinctual gratification and his social and moral sanctions. When the conflicts are resolved or channeled into socially approved media, creativity results.

Although humanistic psychologists agree with psychoanalysts that the individual is in conflict with society, they generally hold a more positive view of human nature. In other words, the humanists tend to look not so much at the etiology or origins of creativity, but more at the characteristics or behavior of creative personalities. These behaviors are also perceived holistically. Maslow (1972) distinguished between primary and secondary creativity. He indicated that primary creativity emerges from the unconscious, while secondary creativity is logical productivity as seen in well-adjusted individuals. To him, true creativity is a result of the successful integration of both primary and secondary creative processes.

Creative Characteristics

In examining creative individuals, personality plays a unique role that distinguishes one individual from another. In most dictionaries, the term "personality characteristics" is defined as "the factors distinguishing an individual from the others." Obviously, creative personality characteristics are the most essential factors that contribute the unique behaviors, attitudes, and thinking styles to a creative individual.

In his classic work, Torrance (1962) described many aspects of the creative personality. Some of these include altruism; acceptance of disorder; energeticness;

persistence; assertiveness; versatility; withdrawnness, and attraction to the mysterious; unconventionality; independence; oddities of habit; fault finding; discontentedness; stubbornness; sensitivity; and the ability to accept the making of mistakes, and temperamentalness. He asserted that creative boys are more feminine and creative girls are more masculine than their less creative peers.

Meanwhile, Henle (1963) posed two conditions necessary for creative thinking: receptivity to creative ideas, and immersion in one's subject matter. Additionally, the abilities to have detached devotion, to see the right questions, and to use errors constructively are also important.

Barron (1963) indicated that "original individuals" are more likely to prefer complexity and imbalance in phenomena, be more complex and have greater personal scope, be more independent in their judgments, be more self-assertive, and reject suppression. In addition, Taylor (1964) named the intellectual, motivational, and personality factors that he viewed as important for creativity to occur. The personality factors included independence, self-sufficiency and self-confidence, femininity, and tolerance for ambiguity. Drive, dedication, resourcefulness, principles, and a desire for order were named as motivational factors. Among intellectual factors were memory, convergence, divergence, cognition, and evaluation. The personality factors highlighted by Barron (1963) and Taylor (1964) have been consistently reported in the literature since their early studies (Davis, 1998; Piirto, 1998).

Runco (1986, 1993) indicated that both parents and teachers believed creative children to be active, adventurous, alert, ambitious, artistic, capable, curious, dreamy, energetic, enthusiastic, and imaginative. However, different results were found between

groups; school teachers pointed out cheerful, easy-going, emotional, friendly, and spontaneous characteristics while parents indicated enterprising, impulsive, industrious, progressive, resourceful, and self-confident features (Runco, Johnson & Bear, 1993; Runco & Bahleda, 1986).

Miller and Sawyers (1989) were interested in children's ideas about creativity and used a social validation instrument with 63 students from the sixth and seventh grades. The 20 creative personality items shown in the research nominated by the children were as follows: "*Working independently, Interest in many things, Questioning, Artistic, Willing to change, Intelligent, Willing to try the difficult, See things different from others, Quiet, Unique, Funny, Disagree with teacher, Different, Imaginative, Outgoing, Invent a new thing, Insist your own way is right, Expressive, Inventive, and Good at designing things.*" Miller and Sawyers placed the most common items (along with five items intended to preclude response sets) in a *Student Self-Evaluation of Creativity*. Ratings using this scale were found to be relatively independent of general intelligence (Miller & Saywers, 1989) and moderately correlated with ratings given by parents (Runco et al., 1993).

MacKinnon (1975) provided comprehensive information on his remarkable research begun in 1949 at the Institute of Personality Assessment and Research (IPAR). The objective was to develop and use assessment to study effectively-functioning people. As the results demonstrated, highly creative people showed a preference for intuition over sensation, perception over judgment, and tended to be introverted. A preference for thinking or feeling was related to the type of materials or concepts in which the creative person would choose to deal. He also discovered the interests of creative people are

similar to those of psychologists, author-journalists, lawyers, architects, artists, and musicians, and dissimilar to the interests of purchasing agents, office workers, bankers, farmers, veterinarians, police officers, and morticians. By tracking back to the subjects' early experiences, MacKinnon found that in childhood, they also enjoyed some special skills and were rewarded for possessing them, had freedom in decision making early in life, and experienced distance in their relationships with their parents. There was usually an effective adult member of each gender present in the child's life: they may have moved or traveled frequently; and were free to choose their own career paths.

Sternberg and O'Hara (1996) asserted that intelligence has been an essential subject of creative personality studies. While reviewing the studies of the correlation between creativity and intelligence, they noted five different assumptions: (1) Creativity is a subset of intelligence; (2) Intelligence is a subset of creativity; (3) Creativity and intelligence are overlapping sets; (4) Creativity and intelligence are essentially the same thing; and (5) Creativity and intelligence bear no relation at all to each other. Despite the differences among these viewpoints, creativity seems to involve synthetic, analytical, and practical aspects of intelligence: synthetic to come up with ideas, analytical to evaluate the quality of those ideas, and practical to formulate a way of effectively communicating those ideas and of persuading people of their value. However, they still emphasized that beyond the basics, it is difficult to find substantial agreement among those working in different fields.

Helson (1999) pointed out that personality psychologists have been interested in learning how to identify creative persons. They are also interested in the factors that affect the development of the creative personality, the stability of creative traits over time,

and how these traits vary from one field or setting to another. Helson defined creative personality as the elements of someone who is *consistently* creative. In other words, she did not count the people who occasionally have a bright idea as creative individuals. The literature suggests that recurrent personality traits of creative people are well documented (Piirto, 1998); however, not all personality traits will apply to creative persons. There are simply too many forms of creativity and different type of creative people to make broad generalizations (Davis, 1998).

Essential Personality Characteristics Influencing Creative Achievement

Although there are some common personal qualities found among creative individuals, no research indicates that all creative people are successful. In other words, some creative personality traits play an essential role in a creative individual's achievement while other personality traits are less important to determining one's success. For example, scholars believe that most creative people have some degree of humor, but no studies stress that a sense of humor is a necessary characteristic to enhance a creative individual's achievement. Based on a review of literature, the following personality characteristics were found as the most likely to influence creative achievement: (1) higher intelligence (Darwin, 1965; Gruber, Terrelle & Werthenuer, 1963; Ochse, 1990), (2) motivation (Bruner, 1962; Gedo, 1983; Henle, 1962), (3) open attitude (MacKinnon, 1962; McCrae & Costa, 1985; Davis, 1999), (4) attraction to complexity, fantasy and novelty (Barron, 1968; Welsh 1975), (5) leadership (Mumford, & Connelly, 1998; Simonton, 1988), (6) intuition (Gardner, & Nemirovsky, 1991; Policastro, 1999; Simonton, 1980) and (7) enthusiasm (Gardner 1988, 1999; Perkins, 1988; Weisberg, 1988).

In addition to the essential creative personality traits, there are other traits accounted for in a number of research studies, such as the ability to use tools and materials effectively, and having a sense of humor (Davis, 1998). These traits are also considered important personal qualities to creative achievers. They may not directly influence people's achievement, but these characteristics help people develop their interpersonal relationships and/or self-discipline which increase their opportunities to reach higher levels of achievement. A hard-working attitude and enthusiasm, for example, builds a strong mind, and motivates people to solve complex problems. Oversensitivity, for another example, allows people to be more aware of the differences in their daily lives, helps people open their eyes, and develop an open attitude, which is one of the essential factors to becoming creative achievers.

Creative individuals also need different abilities in different domains in order to be successful in a certain area. For example, a product designer needs good communication skills to promote his or her ideas, and a scientist must have solid logical thinking skills to find the optimal solutions among a variety of possible answers. Sometimes, the field-specified disciplines become critical when a creative individual attempts to reach higher achievement. For example, 3-D modeling and rapid sketching skills are essential to a successful creative industrial designer.

The literature reviewed above addressed creativity within Western culture. The following section of the review examines the work of Eastern creativity researchers.

Chinese Perspectives of Creativity

The cultural aspects of creativity has begun to attract the attention of creativity researchers at both conceptual and empirical levels. In the past few decades, Eastern

scholars have become interested in their own views of creativity, and have started to conduct investigations or longitudinal studies to disclose the nature of Eastern creativity. Meanwhile, Western researchers have come to Eastern Asia from thousands of miles away to compare and contrast the concepts of creativity between the East and West. Since my research was conducted in Taiwan, Taiwanese and Chinese perspectives of creativity are reviewed in the following section.

Creativity in Chinese Culture

Even though they belong to the same ethnic group and share Chinese culture, aspects of creativity concepts across different Chinese populations vary. Under the huge Chinese cultural umbrella, people living in China, Hong Kong, and Taiwan share the same traditions in many ways: spoken language, holidays, religious, and life styles while they may be very different in other ways: political system, educational system, working attitudes and personalities. According to Rudowicz and Yue's (2000) study, the following results were found among these three different Chinese groups: (1)The core characteristics of creativity identical in all the samples are "originality," "innovativeness," "thinking" and "observational skills," "flexibility," "willingness to try," "self confidence" and "imagination"; (b) The Taipei sample, unlike the other samples, did not associate "wisdom," "assertiveness," and "individualism" with creativity; (c) In all Chinese populations the three factors labeled "innovative," "dynamic," and "intellectual" were distinguishable in the concept of creativity; (d) "Artistic" and "humorous" were missing in the Chinese perception of creativity; and (e) Creativity characteristics were not viewed as highly desirable in comparison to other traits such as intelligence and moral development.

People who live in China, Taiwan and Hong Kong share some aspects of their concept of creativity. One such common feature is that these three Chinese populations seem to include a moral component to understanding and developing creativity. Wu (1996) argued that, in Taiwan, creativity ought to involve some ethical standard, and Chan (1996) indicated that, in Hong Kong, primary and secondary school teachers disliked creative traits that were socially undesirable. Also, Lam (1996) reported that little incongruence was found between the teachers' perceptions of a creative student and that of an ideal student, implying that a creative student needs to be well-behaved. In China, good moral behavior has been consistently reported as an essential element to the identification and development of creativity in gifted children (Liu, Wang, & Liu, 1997).

Another shared feature is that the three Chinese populations generally place great emphasis on the identification of personality and motivational factors in understanding and developing creativity. In China, the essential aim of a creativity education program is to develop a wholesome personality which "exploits to the fullest extent the potential capacity of the trainees by pushing forward their creative trends, motivating their will power and determination to mold a new wholesome personality and then develop their sense of creativity." (Wang, Duan, & You, 1997).

There is clear evidence that Chinese perceptions of people, and consequently educational goals and practices, differ from Western perceptions dramatically. Chinese culture, including Hong Kong, puts emphasis on collectivism (Smith & Bond, 1993). An individual is perceived as an element of society. Like most Asians, Chinese people consider themselves as "bolts" or "screws" of the big "society" or "national machine." Each person has an obligation to remain in harmony with the group to which he or she

belongs. Harmony is thought to be achieved through compromise, moderation, and conformity. Thus, Chinese society encourages cooperation, acceptance, compromise and conformity (Dunn, Zhang, & Ripple, 1988).

Chinese children and students are expected to look for guidance from their parents and teachers who should be inspired by traditional values. Therefore, Chinese students will receive very clear messages of how a character should be properly drawn, how a story should be told, and how things should be done (Rudowicz, Kitto, & Lok, 1994). These sociocultural and educational elements and values in Chinese tradition are often commented on as promoting submissiveness and conventionalism which are incompatible with creative expression and an assertive attitude.

Creativity in Taiwan

Although Taiwan is seen as one of the more Westernized countries in Asia (Bond, 1996; Davison, & Reed, 1998), she still retains most of her traditional Chinese culture (Chen, & Yeh, 1994; Davison, & Reed, 1998). For example, the written language used in Taiwan is called "traditional" Chinese by contrast with the "simplified" Chinese in Mainland China. During the Cultural Revolution (1966-1969) and the consequent educational revolution, Chinese students were encouraged to ignore their teachers' and parents' authority and to pursue conversations on a more "equal basis" (Freeman, & Habermann, 1996). The huge cultural and educational generation gap that ensued almost destroyed Chinese traditions. Meanwhile, on the other hand, the Kuomintang government in Taiwan (also known as the Republic of China, R.O.C.) made a great effort to maintain Chinese culture by promoting Chinese calligraphy, establishing Chinese opera, and conducting various traditional skill training programs. Additionally, many believe that

most Taiwanese people, who mainly immigrated from China in the second half of the 19th century, are the offspring of former officers through many dynasties. Therefore, beside Mandarin, the languages used in Taiwan, including Taiwanese and Hakka, nowadays are also considered as classic spoken Chinese. Undoubtedly, the Taiwanese are deeply influenced by Chinese culture.

Taiwanese scholars, like ancient Chinese scholars, accepted intelligence as an attribute we are born with and an original gift from the sky (heaven). Hence, the concept of heaven is often included in terms for creativeness, giftedness and intelligence: *tiantsai* (*天才*) – genius , *tiantsi* (*天資*) – gift and *tianfu* (*天賦*) – talent, translated as "ability emanating from heaven," "resource coming from heaven," and "endowment bestowed upon us by heaven," respectively, are some examples. An intelligent person is often described as "someone getting a uniquely big share from heaven" (*得天獨厚*) (Chan, 1996). In addition to high intelligence, leadership, productivity, intuition, the ability of quick reaction and broad association are often mentioned by Taiwanese people while describing creative people (Chen, & Yeh, 1999).

Having reached some understanding of creativity in both Western and Eastern cultures, an important issue becomes how educators apply this understanding to designing classroom environments that are supportive of creativity. The following section of this review addresses classroom environments for university students.

Design of Learning Environment to Enhance Creativity

Research describing the environmental factors influencing creativity can be categorized in three different aspects: (1) interdisplinarity provides students an opportunity of free association and makes more sense for students' training program

(Dowds, 1998), (2) awareness of various learning styles helps adult facilitators appropriately and efficiently use creative thinking strategies such as group brainstorming (Larey, & Paulus, 1999), and (3) environmental inhibitors to learning strongly connect to the learners' external motivation (Lohman, 2000). Moreover, these three factors will affect students' exploitation of their creative potential. When educators start a training curriculum, they should be cognizant of these three essential issues. Besides, they may also consider Ekvall's (1973) nine dimensions of creative climate.

According to Ekvall (1973), it is now possible to quantify the climate for innovation. Ekvall's work was further refined and validated by Isaksen (1986), who defined nine dimensions of the climate for innovation. These nine dimensions are: challenge, freedom, idea time (incubation), idea support (resources), trust and openness, playfulness and humor, engagement of interpersonal conflicts, debates of ideas, and risk-taking. These nine dimensions address many of the important factors to enhance student's creativity, and also lead program planners to develop curricula to complement the environmental factors (Isaksen, 1986).

In reviewing the literature on designing creative learning environments for adults, several principles were discovered. The principles for a creative learning environment for adults should be part of the design and implementation of the program. To design an effective creative learning environment, the following five principles should be considered.

The Diversity of Adult Learners Must be Recognized and Understood

Adult learners have their own backgrounds, learning styles and work experiences. The facilitator cannot use only one method of instruction to teach all

students. It is the multifaceted physiological, psychological, sociological, and developmental aspects of the adult learner that contribute to and make the educational challenging and enriching. The various dimensions or characteristics of the adult learner are interrelated; thus one dimension of the individual is affected by every other dimension. Krupp (1982) suggested that to understand this multifaceted characterization is to understand the adult learner from a holistic perspective. This seems most appropriate, especially when working with adults who have diverse reasons for participating, are at various stages in their adult development, and who possess a multitude of learning styles. Moreover, facilitators have an opportunity to assist learners in developing learning strategies and exploiting their creative potential accordingly.

A Conducive Psychosocial Climate for Learning Must be Created

There are various components or variables that contribute to the environmental climate of an educational encounter. Physical environment, a major component, is concerned with ergonomics – the interaction of people with their physical and spatial environments. Some of the elements for consideration would be the arrangement of classroom seating as well as building characteristics such as lighting, ventilation, colorful decoration and appropriate temperature settings. The physical climate is important in the creation of a conducive learning environment; however, in most cases it is not something you have a great deal of control over. Therefore, it becomes more important to provide adult learners with a climate conducive to psychosocial comfort, which is something you can control (MacKinnon, 1975).

Challenging Teaching and Learning Interactions Must be Presented

According to Csikszentmihalyi (1988), one's creativity will emerge while one is in the "flow," where ones skills meet the challenge. By asking them to confront, scrutinize, and question the way they think and act, instructors can lead learners to solve tougher problems, develop higher abilities and enrich their creative experiences. Challenge and confrontation should be viewed as a natural progression within a transactional process and should lead to the development of creative thinking strategies.

Critical Reflection and Praxis Must be Fostered

Learning is comprised of both psychological and social constructs (Galbraith, 1991); therefore, when you encourage learners to examine and understand the nature of their knowledge, values, assumptions, ideologies, judgments and behaviors in a broader context, you are helping them to be critically reflective as well as fostering a sense of how all this is culturally and socially constructed (Marsick, 1987). Within the process of critical reflection, learners begin to question how their assumptions and behaviors, for example, affect the various aspects of their personal, professional, and political lives. Critical reflection is a knowing act that fosters in learners a questioning and critically aware frame of mind.

Independence Must be Encouraged

Developing independent study skills is a creative strategy, too. Creative individuals tend to have the ability to make independent judgments (Barron, 1986; Torrance, 1982). Learners' logical and systematic thinking skills may be developed and creativity may also be enhanced by independent training. Thus, instructors should encourage independence in the adult learners as well as cooperative group strategies.

However, not all learners are comfortable with taking responsibility for their own learning. Hence, instructors should help guide those individuals from a state of dependence to some degree of independence and self-direction in their learning and educational activities.

The literature reviewed above indicates that much has been written about creativity within Western cultures, and researchers from Eastern cultures have recently begun to explore creativity. However, in the field of industrial design, there has been limited research on creative characteristics and personality traits of students planning on pursuing professional careers in design. Therefore, this discussion includes a review of the many aspects of industrial design.

Defining the Field of Industrial Design

Industrial design is concerned with the vast array of goods manufactured by serial- or mass- production methods (Heskett, 1987). At the end of the 19th century, due to the invention of the steam machine, industrial designers started to design for larger populations. They created one or two prototypes, and then machines produced numbers of products from the same model to sell to more customers, even as they created more needs, and lifted civilization to a higher level.

In examining this field, we may find the several meanings of industrial design from different perspectives. In other words, we can approach the term, industrial design, from various aspects, such as the angle of civilization, industrialization, and functional purpose. Furthermore, while looking for the more specific definitions of design, the following definitions were uncovered in the literature:

1. Buchanan and Margolin (1995) noted that "[work in design] involves distinctive discipline and method." In the age of Bauhaus, the German school, design learners received a variety of skill training programs, such as painting, carving, woodworking, etc. Currently, industrial designers work with engineers, marketers, psychologists and ergonomists to determine the form and function of a product. The industrial design program in a university prepares students to design any of the thousands of new products required by consumers every year.
2. According to Lin (1997), design is defined as a systematic process from a designer's rough idea to a completed product sold in a department store. From the position of system theory, a design process can be distinguished in four parts: input (designers), process (general design procedure), output (end users), and feedback (marketing, and pilot studies). Under this systematic structure, designers know what to provide from the marketing investigation, and customers feed designers their opinions through the given questionnaire. Hence, the ideal design process can naturally maintain some degree of balance.
3. Kuang (1993) and Chen (1993) indicated that design is not only an activity which belongs to a certain profession but also a behavior of creation, interaction, and self-awareness. Some design educators also believe that everyone can be a designer while he or she tries to find and solve problems and improve daily life. From this macroscopic viewpoint, design becomes a human behavior rather than a vocation.

4. According to Archer (1965), design is a goal-directed problem-solving activity. Quite a few professional designers, especially the functionalists, believe that each function and pattern of a design should be meaningful; in other words, a button, or a light bulb must have its own function to lead people to operate the product correctly. That is, a product also has its own purpose, and "the needs arise from people, not from the heads of designers of from corporate decision makers" (Papanek, 1983, p.91). Moreover, designers must be sensitive to what users truly need in their daily lives (Chen, 1993); Norman, 1988).
5. Farr (1966) stressed that design plays a role in communication among human beings, products and environments. In this philosophical viewpoint, Farr believes that each new design should solve some problems, serve human beings, but not destroy environments. Therefore, design functions as a facilitator to improve the harmony between human beings and environments.
6. Schaer (1973) emphasized that design is an integrating activity of logic and aesthetics. After the Industrial Revolution within several decades, people started to feel bored with the dull-looking and unfriendly products from the mass production line. Thus, the Arts and Craft Movement asserted that products should satisfy a human's physical need, and emotional perception. From this time, industrial designers started to focus on the aesthetic aspect to process the design job.

7. Kuang (1993) defined design as a creative activity based on the purpose of solving problems. A professional designer should find a clear solution from the complex limitations of problems. Although it is believed that design is the process of creation, designers need to be aware of limitations when creating a product. While digging out solutions to a problem, designers must be aware of the boundaries of the manufacturing techniques, the degree of human being's acceptance of the product, impacts on society, and other ethical issues. These limitations may be complicated; however, the creativity of designers is not allowed to exceed the lines.

By synthesizing the ideas above, we may conclude that design has the following features: 1) the capacity of human beings to create, 2) an intentional behavior, 3) a way to solve problems by using some strategies, 4) must be valued, and 5) a result of applied creativity and imagination. Moreover, an ideal design product should satisfy human beings' needs, and protect our societies and environments as well.

CHAPTER 3

METHODS

Research Design

Features of qualitative research designs include flexibility and openness. One important aspect of a qualitative research design is "to remain sufficiently open and flexible to permit exploration of whatever the phenomenon under study offers for inquiry" (Patton, 1990, p.196). In my study, interviews and in-class observations were used to collect data. Additional data was collected through archival document review, including participants' records of design awards, college transcripts and design projects. The data were analyzed using a qualitative data analysis approach as well. The data collection procedure of this research study is presented in Figure 3.1, followed by a discussion of portraiture and a description of how I collected and analyzed my findings.

Figure 3.1: Phases of the Data Collection Process

	Phases	Actions	Results
Nomination Phase	Instructors nomination	1. Interviewed Dr. Chen, introduced by contact person at NSUST 2. Interviewed former instructors of the third-year class 3. Interviewed current instructors of the third-year class	1. School records were provided 2. Design award records of the third-year class were reviewed 3. 7 students were nominated
	Peer nominations	1. Ten students were informally surveyed 2. Observed the class	1. 8 students were nominated 2. 6 students were selected as prospective participants
	Recruited nominees	Checked on the availability and willingness of the nominees to participate in this study	Of the 6 students selected, 2 female students and 2 male students agreed to participate
Data Collection Phase	First interview of participants	Each student participated in in-depth interviews of approximately one and a half hours in length	1. Interview data 2. On-going analysis
	Follow-up interview of participants	Follow-up interviews were conducted until data saturation was reached	1. Extended interview data 2. On-going analysis
	In-class observations	1. Conducted 3 3-hour in-class observations of the entire class 2. Conducted 4 individual one hour observations of each participant	1. Observational data 2. On-going analysis
Finalization	Transcription	Transcribed interview data	Transcription
	Member check	Participants were emailed the transcription for confirming the accuracy	

Portraiture

To present the findings of this study, I chose to follow the work of Lawrence-Lightfoot and Hoffmann Davis (1997), and crafted portraits to capture the experiences of my four participants. These researchers define portraiture as a "method of inquiry and documentation in the social sciences" which seeks to "combine systematic, empirical description with aesthetic expression, blending art and science, humanistic sensibilities and scientific rigor" (p.3). Lawrence-Lightfoot and Hoffmann Davis highlighted the value of portraiture in the following,

> The portraits are designed to capture the richness, complexity and dimensionality of human experience in social and cultural context, conveying the perspectives of the people who are negotiating those experiences. The portraits are shaped through dialogue between the portraitist and the subject, each one participating in the drawing of the image. The encounter between the two is rich with meaning and resonance and its crucial to the success and authenticity of the rendered piece (p.3).

According to Lawrence-Lightfoot and Hoffmann Davis, portraiture is a process that begins "by searching for what is good and healthy" (p.9). In this method, the researcher asks "what is good here?" in order to capture the subjects or actors in their natural setting. It is important to understand that "portraits are not designed to be documents of idealization or celebration" (p.9). In examining the complexity of people and many dimensions of their personalities, there will naturally evolve many examples of vulnerability and weakness. One who designs a portrait "does not impose a definition of 'good' on the inquiry or assume that there is a singular definition shared by all" (p.9). Rather the portraitist believes that "there are many ways in which goodness can be expressed and tries to identify and document the actors' perspectives" (p. 9).

One who designs the portrait is interested in developing an authentic narrative that is convincing and records the subtle details of human experiences in order to better understand human behavior. The portraitist attempts to document and highlight the complexity and detail of a unique experience or place. It is hoped that the audience will see themselves reflected in the portrait, and identify with the person being portrayed. A researcher who works with portraiture is very interested in the single case because he believes that embedded in the case the reader will discover universal themes; therefore, the more detailed the description, the more likely the reader will be able to identify with the story being told (Lawrence-Lightfoot & Hoffmann-Davis, 1997).

To summarize the value of this qualitative approach to research, Lawrence-Lightfoot and Hoffmann-Davis (1997) explained:

> Portraiture is a method framed by the traditions and values of the phenomenological paradigm, sharing many of the techniques, standards, and goals of ethnography. But it pushes against the constraints of those traditions and practices in its explicit effort to combine empirical and aesthetic description, in its focus on the convergence of narrative and analysis . . . in its standard of authenticity rather than reliability and validity, and in its explicit recognition of use of the self as the primary research instrument for documenting and interpreting the perspectives and experiences of the people and the cultures being studied (pp.13-14).

I chose to represent my findings by painting portraits of my four participants. This methodological approach was an appropriate match for my study. I wanted to capture the voices of my participants, have them tell their stories and share their insights in such way that readers could identify with the young university students. Portraiture also enabled me to describe my involvement with the participants. In painting the four

portraits, I was able to capture the "goodness" that Lawrence-Lightfoot and Hoffmann-Davis emphasized in describing the four young people in my study and their creative work in the industrial design program. This approach of presenting the goodness was an especially appropriate choice since the readers of my research would be exploring the lives of four individuals from another culture. The cross-cultural differences between the participants and the audience of this research might be reduced and a deeper appreciation for the lives being portrayed would naturally evolve.

Participant Selection

The study was conducted from January to April, 2002, in Taiwan. Research data of interviews and in-class observation were collected from one professor's cohort class in the department of industrial design at National Sunshine University of Science and Technology (NSUST) in Taiwan. I was granted permission to conduct my study from the Chairperson at the Department of Industrial Design. Undergraduate students who had been studying in the industrial design department for at least three years were the targeted group in this study since they were most familiar with the school's curriculum and the industrial design program.

In order to select the participants for this research, I sought the most creative students in the industrial design degree program cohort through selection using the following three criteria: (1) nomination by former and current instructors, (2) students' (peer group) nomination, and (3) potential participants' archival documents (university transcripts and records of design awards) and products. In reviewing the archival documents, I evaluated design-related awards, academic achievements in studio classes, and instructors' general comments.

To begin my participant selection, I first met with the four instructors of the cohort: Dr. Lee and Dr. Chen, the former instructors of the second-year class, Dr. Yang, the former instructor of the first-year, and Dr. Hsiu, one of the three current instructors of the third-year cohort class.

Dr. Chen, the first instructor with whom I visited, assisted my selection of the most creative students among the third-year undergraduates. During our conversation, he showed me the students' transcripts of the product design course in their second-year. He also briefly described the personality traits, academic performance, and learning attitudes of the students in whom I was the most interested. Dr. Chen also talked about the curriculum, class climate, learning environment, and his teaching style in the product design course. Additionally, he also provided me with the students' products in the class and records of design competition award recipients. These archival documents became the first step to select the participants. Before we finished our conversation, he introduced me to Dr. Yang and Dr. Lee to help me gain more information about the students' prior two years of university life. Dr. Hsiu, the current instructor of the design studio class, also helped me to nominate the students. Each instructor gave me a list of nominees, and I found 7 names that were consistently mentioned by all four of the instructors. Then I brought this list of 7 names to the class of students for further information.

After meeting the instructors, I was brought to the design studio and introduced to the students and the class leader, who was elected by the class students. We enjoyed short conversations during which they nominated 8 students whom they considered to be the most creative in the class. From the students' and faculty's nomination lists, I looked for names that overlapped both lists. In doing so, I discovered

that there were six students whose names appeared on both lists. Therefore, I had my pool of participants. I had a short informal conversation with the 6 students to ask if they could participate in my research study. Two of them described a tight schedule during February and March, so they chose not to participate. The four remaining nominees from the third-year class agreed to participate and signed consent forms. Serendipitously, two participants were male, and two were female.

Data Collection

As previously indicated, interviews and participant in-class observations provided the primary data sources and served as the tools for creating portraits of the students at the research setting. Interviews were audiotaped and transcribed verbatim. Due to the participants' limited English capacity, the interviews were conducted in Chinese Mandarin, the official language in Taiwan. After translating the transcription into English, I asked one Taiwanese UGA graduate student and one Taiwanese UGA faculty member who were both bilingual to verify the accuracy of my translation. Several samples of translated transcriptions are presented in Appendices C and D.

Document Review

To assist me in selecting my participants, archival documents were reviewed. The documents used to help select the participants for this study included school records, university transcripts, and documentation of design awards. Documents help researchers to ground an investigation in its context and add richness to the data. Social scientists who use archives enter a new world of information, and these repositories extend the usual methods of finding and collecting data (Hill, 1993; Merriam, 1998). A variety of archival data was available in this setting. In addition to using archival documents to

select my participants, I also had the opportunity to examine the individual portfolios of industrial design products created by my participants. I also examined closely the class notes and idea sketches of several of the participants. Additionally, I was able to review the notes taken during collaborative work sessions and group discussions. Collecting and analyzing these documents allowed me to evaluate students' performance and provided me additional insights into the creativity of the participants.

Interviews

In this research, the primary source of data collection was in-depth, semi-structured interviews. According to Seidman (1998), an in-depth interview allows participants to reconstruct their experiences and to explore their meaning; moreover, a semi-structured format, according to Payne (1999), begins with an interview guide. Using these two interview strategies specifies a predefined range of topics to be addressed within the context of the interview, but the interview format still yields flexibility.

The semi-structured interviews consisted of open-ended questions design to explore a few general topics to gain information directly from the participants and to develop insight on how the students interpreted aspects of their creativity and their industrial program. By interviewing participants and allowing the students to tell their stories, a picture emerged of what each participant believed was happening. A minimum of two interviews were conducted individually with each participant. Each interview took approximately one and a half hours and was recorded. The participants were asked to describe their concepts of creativity, their K-12 educational experiences, and their university training in industrial design.

In-depth interviews involve asking open-ended questions crafted for participants to share their experiences and explore their meaning (Seidman, 1998). In a semi-structured format, the researcher begins with the interview guide that presents a pre-established series of topics to be addressed within the interview; however, the interview format remains flexible, allowing the participants to bring up new topics or elaborate on topics that may be important to them (Payne, 1999). Qualitative researchers have highlighted several advantages to using interview guides. An interview guide allows participants to lead the discussion as the interviewer asks open-ended questions that enable the participants to respond by sharing their stories (Rossman & Rallis, 1998). Patton (1990) indicated that an interview guide is helpful because it allows the interviewer freedom to ask questions in a conversational style while maintaining a research focus. In addition, McCracken (1988) pointed out that an interview guide helps the interviewer control his subjectivities by including scheduled questions that might otherwise be overlooked.

The interview guide I used in my research consisted of open-ended questions that were designed to open up, rather than restrict the conversation. For example, one question included, “Please take a minute to recall your early school experiences, and describe your most influential teacher.” I then followed that question by asking, “Describe how that person supported you as a student.” Later on in the interview, I asked the participants, “Describe the most enjoyable or influential assignment in your industrial design program.” My follow-up question was, “How did that assignment influence you as a design student?” Follow-up questions such as these gave my participants an opportunity to reconstruct their experiences according to their own ideas of what was important rather

than being influenced by my interpretation (Seidman, 1998). Following Seidman's suggestion, I designed my questions so they followed directly from what my participants said, asking them to clarify information, provide concrete details, and elaborate with rich stories. The interview guide used in this study is presented in Appendix E. The frequency of follow up interviews depended on the necessity for more clarification in data collection.

Additional e-mail correspondence took place when necessary to clarify any ambiguities and ask questions that might have been overlooked. Following the final interview, I e-mailed my participants the transcribed interviews to check for accuracy and to provide them the opportunity to share their final reflections on the research questions via e-mail. These reflections were used as additional data and coded and analyzed in addition to the interviews. An audit trail of data and data analysis that consist of tape recorded interviews, interview transcripts, researcher field notes, and email correspondence has been preserved.

Classroom Observations

Observations from participants' classes were conducted as well. Patton (1990) says "to understand fully the complexities of many situations, direct participation in and observation of the phenomenon of interest may be the best research method." Emerson, Fretz, and Shaw (1995) explained, "with immersion, the field researcher sees from the inside how people lead their lives, how they carry out their daily rounds of activities, what they find meaningful, and how they do so" (p.2). Hence, I observed my participants' in-class performance and their interactions with their classmates to outline their personal traits, external characteristics, and creative behaviors. This time spent in observation in

the classroom also allowed me to hold informal conversation with the classmates of the participants, enabling me to obtain more information in order to better understand the creative characteristics and personalities of the students in my study. In addition, I was able to gain insights about the daily performance of the students as well as their interaction with their peers and their instructors. According to Merriam (1998), as observations occur in a natural setting, observational data provide helpful information in addition to other data sources such as interviews and documents. I conducted three 3-hour observations of the entire third-year industrial design class as they were involved in their work. In addition, I observed each of the four participants in studio classes for 4-6 hours and recorded field notes which were expanded and transcribed following each visit to the university classroom. Additionally, I took photographs of the NSUST campus, design studio classroom, the students product exhibition showcases, student-faculty group discussion in class, and students presenting their design projects. These pictures were helpful to me in recalling the physical surroundings where the observation took place, the classroom climate and the impressive quality of the students' work.

Methods of Data Analysis

In portraiture, the development of emergent themes represents the researcher's first efforts to bring interpretation, analysis, and order to the collection of the data. The researcher gathers, organizes, and scrutinizes the data, looking for similar threads, illuminating metaphors, and overarching symbols. In portraiture, data analysis is a disciplined process of description, interpretation, analysis, and synthesis (Lawrence-Lightfoot & Hoffmann Davis, 1997).

The portraitist enters the research study within an intellectual framework and set of guide questions. The framework applied in analysis is usually the result of a review of relevant literature, previous experiences in similar settings, and the general knowledge of the field of the inquiry. The framework also is consistent with the researcher's autobiographical journey— "those aspects of [his] own familial, cultural, developmental, and educational background that [he] can relate (either consciously or unconsciously) to the intellectual themes of the work" (Lawrence-Lightfoot & Hoffmann Davis, 1997, p.185).

Following the suggestion of Lawrence-Lightfoot and Hoffmann Davis (1997), analytic induction was applied when analyzing the data. This type of data analysis has been described in a variety of ways by multiple methodologists (e.g. Coffey & Atkinson, 1996; Miles & Huberman, 1994). Analytic induction is often referred to as a process of data management by coding, categorizing into themes and outlining relationships among themes. Ryan and Bernard (2000) said, "Analytic induction is a formal, non-quantitative method for building up causal explanations of phenomena from a close examination of cases" (p. 787).

In portraiture, the researcher draws out constructs or emerging themes using five types of synthesis, convergence, and contrast. First, the researcher listens for repetitive reframes that are spoken frequently and persistently. Second, he listens for rich metaphors, or symbolic expressions that reveal the way the participants illuminate their experiences. Third, he listens for the themes expressed through cultural rituals that seem to be important to the group. Fourth, the researcher weaves together the threads of data.

Finally, the researcher constructs themes and reveals any perspectives that are not consistent with the emerged findings (Lawrence-Lightfoot & Hoffmann Davis, 1997).

This five-phase approach to analyzing data in portraiture can be viewed as analytic induction. Analytic induction was a useful and practical data analysis method in my study since it involved logical and systematic methods of managing data through reduction, organization and discovering relationships. Through the use of analytic induction, I was able to categorize my data and generate findings to address my research questions. The data analysis approach used in this study was best summarized by Lawrence-Lightfoot and Hoffmann Davis (1997) as they explained,

> The interpretive and analytic process, then, begins immediately and threads its way through data collection until it becomes the central activity of synthesizing, sorting, and organizing data after the researcher leaves the field. The portraitist works to develop a process and a structure for categorizing the data, for tracing the patterns, for capturing and constructing the themes—all the while trying to preserve the nuance and complexity of real lived experience, and always remaining attentive to the "deviant voice" (p.214).

Control for Researcher Bias

My personal philosophy of creativity along with my own experiences as an educator and a former design student probably affected my perspectives as a researcher. I believe that creativity can be taught. Although some people are born more creative than the others, I believe that creativity can be enhanced through appropriate training that accounts for individual learning styles. Since I was trained in industrial design for ten years, my viewpoints of creativity, and creative instructional approaches were influenced by my experiences in three industrial design degree programs in Taiwan.

I believe that industrial design students need to develop systematic problem solving and logical thinking skills in order to create products suitable for mass manufacturing. The skills of problem solving and logic enable students to efficiently develop products that will be appreciated by the users. As of a result of being trained in industrial design programs in Taiwan, I believe that most university students are able to endure strict criticism from their instructors. University design students realize that ultimately different clients hold different expectations for products and will critique the design according to their individual needs. Therefore, a student designer must be prepared to face criticism when professionally employed. In addition, I believe that a broader knowledge of a variety of fields will better prepare design students to develop different product designs appropriate for different user groups. For example, just as the knowledge of automobiles would help design students to effectively design automobile interiors, additional knowledge of computers would enable a design student to create user-friendly computer accessories.

My personal views of creativity described above along with my experiences in the design discipline firmly shaped how I view creativity in industrial design and I realized that I carried these personal assumptions into my study. I recognized the potential research bias that I brought to the study with my own ideas about how creativity is defined, how students create a new idea, and how students use teamwork to work as a group. My initial inclinations indicated that students might have some specific behaviors, performances or perspectives to express their creativity and reflect their creative characteristics. I needed to address this bias before even beginning my research, trying to

be open-minded about my interviews and observations, and being careful not to build additional perspectives around any preconceived notions I had.

In order to control this potential bias, I emailed the participants the transcripts of their interviews and had them complete member checks. These member checks allowed my participants to review the raw data to verify representation of their experiences (Lincoln & Guba, 1985). Feedback and corrections from member checks provided them an opportunity to verify my representation. By completing these member checks, the participants assisted me in minimizing the effect of the potential bias.

CHAPTER 4

DESCRIPTION OF CONTEXT AND THE PARTICIPANTS

In order to provide a clear and complete understanding of the current status of education in Taiwan, I would like to introduce the education system in this chapter. Following the introduction of the education system in Taiwan is a brief description of the school environment where I conducted this research. Additionally, descriptions of my participants are presented in this chapter. In order to protect the identities of the participants, their professors, and the university community, pseudonyms are used.

The System of Education in Taiwan

Since Taiwan was deeply influenced by Japan and the United States, the current education system resembles the educational systems of both countries. The education system in Taiwan is similar to the States at the elementary school and junior high school levels. After students graduate from junior high school, the system divides into three tracks: academic senior school, vocational senior school, and 5-year junior college. The three tracks are described below, and a chart comparing the education systems of the United States and Taiwan is presented at the end of this section (see Figure 4.1).

Ages 7 to 13: Elementary School

According to the Taiwanese constitution and governmental educational regulations, all children must receive compulsory education beginning with elementary school at age 7. Public schools are located in each schooling district. Although attending private school is an option, most children go to public school. Depending on the local government's financial status, gifted and/or special education may also be provided.

Ages 13 to 16: Junior High School

After graduating from elementary school, students must enter junior high school to continue their compulsory education. In junior high school, most students learn general subjects including mathematics, Chinese literature, spoken English, social science, and physical education. In addition to these core courses, some talented and gifted students will receive advanced curriculum, such as art, music, dancing, and opera performance, accordingly. Males and females are educated separately in the majority of junior high schools. With philosophical concerns of different principals, in some schools, students are also placed in different classes according to their academic skill level.

Ages 16 to 19: Academic and Vocational Education

With graduation from junior high school, a distinction is made between academic education and vocational education systems. By the end of the three-year junior high school education, students can take several kinds of high school entrance examinations to enroll in an academic senior high school, vocational senior high school, or 5-year professional junior college. The type of exams that students select is a decision made by the student and family members.

The main purpose of academic senior high schools is to prepare students to successfully pass another entrance examination to enroll in an academic university or college. This path is currently the most common educational track in Taiwan. Although most parents still highly value an academic university education, many students would rather enroll in the vocational education or 5-year professional junior college to prepare their life-long technical skills. The differences between the academic system and the vocational education track are illustrated in the following section.

Academic Education System

Students in an academic education system receive the same curriculum as in their junior high school but at a higher level. Most student clubs and after-school activities occur in this stage. For most students, it is their first time experiencing social life in groups and experiences with organizing student clubs.

By the end of their academic senior high school, students can apply or take an entrance examination to an academic college or university to continue their higher education. If students show outstanding ability in a certain field or win awards from significant national or international academic competitions, they will automatically have an opportunity to be sent to a related department at a national university.

Vocational and Technical Education System

In the vocational education system, junior high school graduates enter senior vocational schools or various categories of 5-year professional junior colleges, either by passing an entrance exam or through special selection. Senior vocational high schools provide a three-year course of study, while 5-year junior colleges provide a 5-year course of study. After graduation, students may either find employment in various technical and vocational positions, or they may enter to a college or university of science and technology to continue to a higher level of education.

In a senior vocational high school, students receive some general subjects and solid training courses in a field, such as vehicle repair or electronic mechanism maintenance. By the end of their study, they can take an entrance examination to go to a 4-year college or university of science and technology. However, they may not have too many options to choose regarding the educational focus; they must enter a department

related to their professional major in their vocational senior high school. For example, a student from a fine art program may only enter a fine art, commercial art, industrial design, or graphic design department.

Students who enter a 5-year professional junior college will learn general courses at an advanced level, including calculus, English literature, Chinese history and a course on the Chinese constitution, for the first two years. Then they will follow a structured professional curriculum to enhance their skills. They will earn a diploma equivalent to an associate bachelor's degree in the United States. After they graduate from school, they may take a transfer exam to enroll in a third year of a technical university. They may alternatively take another kind of transfer exam to begin the second year of an academic university.

Students graduating from either an academic or technical university will earn a bachelor's degree in their professional fields, and they may also pass an entrance examination to enter into graduate school. Additionally, an integrated senior school is another high school educational option to the academic and vocational high school. The integrated program provides both a vocational program and a general academic program for students. Thus, students may choose to enroll in a general academic class to prepare for an academic university, or a vocational program to prepare for their future career.

Figure 4.1: Comparison of Education Systems Between Taiwan and the US.

<table>
<tr><th>USA</th><th colspan="3">TAIWAN</th></tr>
<tr><td>Age: 6-11
Elementary
School</td><td colspan="3">Age: 7-13
Elementary
School</td></tr>
<tr><td>Age: 11-14
Middle
School</td><td colspan="3">Age: 13-16
Junior High School</td></tr>
<tr><td rowspan="2">Age: 14-18
High
School</td><td>Age: 16-19
Academic
Senior
High School</td><td>Age: 16-19
Senior
Vocational
High School</td><td rowspan="2">Age: 16-20
5-Year
Professional
Junior College</td></tr>
<tr><td rowspan="2">Age: 18-22
College/
University</td><td rowspan="2">Age: 19-23
Academic
College/
University</td><td rowspan="2">Age: 19-23
College/
University
Of Science and Technology</td></tr>
<tr><td>Age: 20-23</td></tr>
<tr><td>Age: 22+
Higher
Education</td><td colspan="3">Age: 23+
Higher Education
Master and Doctoral Degrees</td></tr>
</table>

National Sunshine University of Science and Technology

This research study was completed at the National Sunshine University of Science and Technology (NSUST) in central Taiwan. Sixteenth City, where NSUST is located, is a medium size town. According to local governmental statistics, in 2001, Sixteenth City had a population of about 102,000 within 93.7151 square kilometers. Besides NSUST, there are several senior vocational high schools, academic senior high schools, and a technical college within the city. Due to economical innovation and modernization, Sixteenth City has steadily and gradually transferred to an industrial city from an agricultural town. Today, there are two large industrial parks surrounding the city.

NSUST is a relatively new technological institution in Taiwan established in the 1990s. With the full financial support of the central government, the university's funding is unprecedented. Billions of New Taiwan dollars were awarded to construct and ensure the best facilities and quality in the country. In the past 10 years, with astronomical efforts of the faculty and students, NSUST is now one of Taiwan's leading two technological universities. NSUST has promoted interdisciplinary and multi-disciplinary scholarship and offers a distinct contribution to professional higher education by emphasizing theory and practice in technology and the humanities.

With 6,000 full- and part-time students, NSUST has an integrated campus and occupies a 60-acre estate. It is famous for its spacious and scenic campus and artistic buildings. The huge picturesque surrounding area along the University Drive has been designed to host the key important county administrative buildings.

Department of Industrial Design

The College of Design is one of the most popular academic schools at NSUST. It offers bachelors, masters, and doctoral degrees in industrial design, visual communication design, and architectural and interior design. At the undergraduate level, the department of industrial design offers the following five instructional programs: (1) Computer Assisted Industrial Designation (CAID), (2) Applied Ergonomics in Industrial Design (AEID), (3) Product Development and Design (PDD), (4) Design Administration and Management (DAM) and (5) Exhibition and Houseware Design (EHD). This department has been in existence for 12 years since the university was established. The departmental enrollment is approximately 140 students served by 26 faculty members.

The Third-Year Class

Research data of interviews and in-class observations were collected from the third-year cohort class of the Department of Industrial Design. This class had 42 students with a male to female ratio of 3:1. The majority of the students were graduates of their vocational high schools. In these vocational settings, they had previously studied in the Department of Fine Art (*美工科*), the Department of Mechanical Drafting (*機械製圖科*), the Department of Wood Pattern Modeling (*木模科*), and the General Department (*普通科*). Those who majored in the departments related to art or design were considered to have higher ability in product design since they had been trained in sketch drawing, painting, exhibition design, and some other relevant skills.

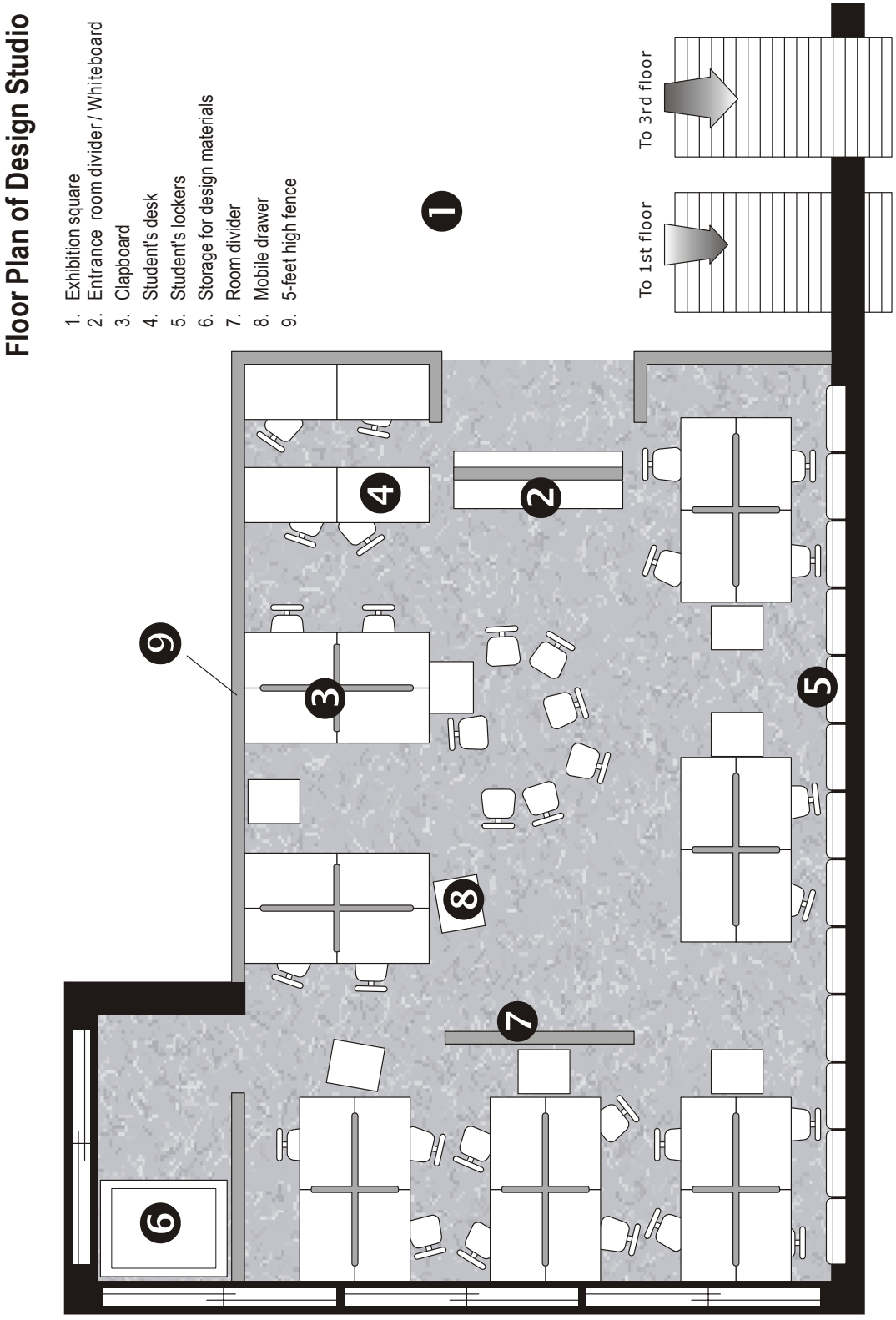
According to the curriculum plan, by the end of their second year, students have learned the following required professional subjects: basic design skills, design concepts, color theories, computer aided design, design management, and basic product

design. After they become third-year students, the only requirement is a design studio class. In addition, students choose their favorite instructional program and register for the relevant electives. For example, in CAID (computer aided industrial design) students may take 3-dimensional CAID; in AEID (applied ergonomics on industrial design) students may enroll in the class of human factors on design; and in DAM (design administration and management) students may register for strategies of planning a design project. The purpose of the curriculum design is to train students to be more familiar with their interested fields and to learn how to apply the design theories to a practical design project.

Design Studio

Design studio is the primary subject for third-year design students. This four-credit-hour class provides a one-hour lecture and a six-hour practicum. Three instructors representing the three different instructional programs teach the class in this academic year. Each week, students come together with the three instructors in the first hour for a lecture. Then, depending on their instructional program, they will have discussions with one of the instructors for the next six hours. Although students are not restricted to have discussions with only one professor, most students do not tend to talk with the other two instructors. Students work in the design studio, which is available for the third-year students only. In this 2,000-square-foot room, every 4 students share a large working table with a short clapboard divider in the center, so that each student can have a semi-private space to work. The four big windows bring sunshine and fresh air into the design studio. Plenty of ceiling lighting allows this room to be no different during the day and night. A floor plan of the design studio is presented in the Figure 4.2.

Figure 4.2: The Floor Plan of Design Studio



Because students spend most of their time here at school, they decorate their personal working booths to feel more at home. Some students stick sketches of their rough ideas on clapboards, and other students enjoy their working spaces decorated with plants, snapshots of their families, friends, travel experiences, and posters that reflect their personal interests. Internet jacks are installed on the wall, and students can plug into their computer to connect to the Internet here. This design studio functions not only as a classroom, but also a place where students do homework, work on their research and even socialize.

Introduction to the Participants

In the following section, the participants of this study are introduced through descriptions of their backgrounds and school experiences leading up to their being admitted to the industrial design program at the National Sunshine University of Science and Technology.

Joy Fang

The first participant I met at NSUST was a 20-year-old woman, Joy Fang. She just had her first design studio class of the third-year in the afternoon. She seemed very happy and talkative when we were first introduced. We met in the hallway when Dr. Chen walked me to the elevator, and she came over and greeted me. She was very interested in my educational background and current study. When asked to participate in my research, she accepted without hesitation. Smiles always spread across her face, and, actually, she looked like a beautiful blooming sunflower under spring sunshine.

Joy was born in a middle class family. Her father managed a well-known appliance company in Taiwan. Because of his work, he knew industrial design very well,

and encouraged Joy to enroll in this department as her university major. Thus, Joy had some prior knowledge regarding industrial design before she decided to take the entrance examination to this school.

Joy told me that she loved drawing, so she entered a mechanical drawing department after graduating from junior high school when she was thirteen years old. She found that she was very interested in and had high potential for learning mechanical drawing for engineering, mold drawing, and machine design. She had always maintained outstanding academic performance. Although the mechanical drawing department in her high school was male dominated, she often earned grades that were higher than most of her male peers. Moreover, her creative potential and ambition to strive for higher achievement always caught the attention of her teachers. Her striving for excellence is evidenced in the following reflections of her school life at the vocational senior high school and of winning a championship in a national engineering drawing competition:

> Maybe because the teacher thought that girls were too emotional, and not enthusiastic about the engineering things, he didn't encourage the female students to participate in the national [youth engineering drawing] competition. I worked very hard to express my motivation, and finally the class advisor nominated me to be a part of the representative team for our school. I still remember the first day when I walked into the room to meet my teammates. I was so shocked because I was the only girl in the team. After no more than a second, I made up my mind. I said to myself, "I must do my best to help this team win." Plus, the most important thing to me was to show them that girls were not losers. Finally, I didn't let my team down; we won the second place. I was so happy.

Joy had a very positive experience at the senior high school because of her strong skills in craftsmanship and high motivation. However, when she first entered the

department of industrial design of NSUST, she was very frustrated. She found that the professors in the department did not appreciate the aesthetic concepts that she incorporated in her products. Joy became discouraged with the negative feedback from her instructors. Feeling like a failure, she considered transferring to another department. Fortunately, help and support from her peer group gave her the much needed energy to continue her study in the industrial design department. During the second year, she finally regained her confidence after she discovered that she had strong talents in design administration; therefore Joy chose the Design Administration and Management Program (DAM) as her emphasis in the industrial design department.

Joy had always maintained strong interpersonal relationships with her peers, teachers, and family. She loved group activities and maintained good relations with others. In her first year, she was elected to be the class leader and even the president of the Departmental Student Council. Although she was commended by most of her schoolmates, she did not view herself as a born leader. Instead, she described herself as an optimistic, energetic, easy-going, and happy person. She believed that because of these qualities, she was elected to be a representative of the class. As a result of her humble and amiable manner, she usually received great support from her peers and teachers. The overwhelmingly positive feedback made her more willing to serve other people. Moreover, she thought communication skills were very important for teamwork, and finding herself in a leadership role so often, she found she developed abilities in communication, organization, and planning.

Joy's hometown was Taipei, the capital of Taiwan. Taipei is a place full of information and fashion, and everything changes rapidly; therefore, Joy believed Taipei

was an ideal place to do design. However, she felt her current environment, a suburban university with fewer stimuli, was too boring to inspire her creativity. She was a person who needed to "see with her eyes" and "touch with her hands" to facilitate her learning. Therefore, she used the Internet and studied at the library to search for pictures of new products while she was at school, and went to design exhibitions while she was away from the university campus. In order to compensate for the lack of new design information and remain current on the latest product design trends, Joy built a personal database to serve as her learning aid. This young, intellectually curious and energetic woman who served her peers as a class president and maintained the respect of her teachers enjoyed being constantly stimulated by the world beyond her field of industrial design.

Kalki Young

Kalki Young, a 20-year-old young man, was graduated from the Department of Art in a vocational senior high school. Since he was a little boy, Kalki had a great interest in drawing and gardening through which he developed an appreciation for aesthetics. While he was a third-year student in junior high school, like many others, Kalki had two questions to answer: "Should he enter either an academic or a vocational senior high school?" and "In which department should he study?" To determine his answers, because he was highly interested in both gardening and art, Kalki conducted a little experiment to discover which one was his primary interest. He temporarily stopped gardening and painting, which he was used to doing every day, in order to find out which hobby he missed the most. After a few weeks without touching paintbrushes and gardening water pots, he found that he would rather die than live in a world without drawing. Therefore,

he made the choice to study in the department of art after he graduated from junior high school.

In third grade, Kalki suffered a traumatic experience when his parents divorced and his mother moved to Japan. Kalki had been very attached to his mother, and his relationship with his father was distant. When his mother left, he remained emotionally removed from his father and became even more independent. Due to his father's shift of jobs, Kalki had been traveling frequently with his father before he was 16 years old. He lived in variety of places, from highly developed cities to very quiet rural villages. Eventually, he realized that he was more comfortable in a smaller quiet community. Some of his fondest childhood memories were of his time spent hiking through the woods and catching fish in a river near his home.

Kalki did not have many good friends his age, but he was very close to people older than he, such as teachers and students in higher grades. When he described this situation, he explained,

> Since my mom left us, I gradually realized that I must depend on nobody, and only I would be the one who would never leave me. So there was a time when I became very isolated. I didn't have friends, and I didn't want to have friends. I started to seek what my life's purpose was, how I could get it, and what I should do next. After doing this for a while, maybe 2 or 3 years, I found that I was more precocious than my classmates . . . I was in my first year of junior high school [at that time]. . . Because I was not very close to my peer group, I had few friends in my class, maybe only one or two friends. However, I was very close to my teachers: Chinese teacher, English teacher, math teacher and physics teacher . . .They recognized my potential in art and design as early as junior high school . . . They knew that my math ability was awful, but they

> didn't strictly force me to learn. So I'm not afraid of math now, and I'm still willing to learn. I really appreciate that.

Kalki had good relationships with his teachers. They always gave him advice, and he took most of their suggestions. Although his design program in his vocational senior high school provided him training primarily in two-dimensional graphic design, his teachers recognized that he had the ability to master three-dimensional design concepts. One influential teacher encouraged him to apply to an industrial design program. That teacher's advice was a significant reason he entered the industrial design department at NSUST. Additionally, in the second year of his industrial design study, Kalki decided to dedicate his talent to the Product Development and Design Program (PDD), where he believed that he could better unleash his creativity.

Aurora Wu

Aurora was the number one student entering this department. Although she had the best academic performance, she was not like the other participants who gained relevant knowledge and skills before enrolling in the university. Aurora graduated from a General Program of an integrated senior school. In the general program, Aurora had taken core courses, such as general math, English literature and Chinese literature. Additionally, because she was interested in logical analysis and science, she also enrolled in electives such as primary calculus, chemistry, physics, and geographic science.

Like many students, Aurora was from a middle class family. Her father worked in a National Vocational Training Center and was familiar with the industrial design profession. Additionally, her cousin had majored in industrial design in another university, and he often talked about his major and interesting school projects to Aurora.

Both her father and cousin encouraged her to apply to the industrial design department and believed that she would enjoy learning in that field. With her family's encouragement, Aurora applied to this department and earned admission with the highest entrance score in her class.

Aurora had always been an outstanding student since elementary school. She was very popular and usually surrounded by her friends. She also maintained a very good relationship with her teachers. All of the teachers loved this straight-A student. Her classmates admired her for always being kind and enthusiastic, and the teachers commended her superior academic achievements. Because of her excellent performance, she was elected to be class leader and student club president during her second year. Sometimes the teacher even let her be a "little tutor" by assisting other students with math, practicing English conversation, and conducting physics experiments in a small group. Due to her many tutoring experiences, Aurora found that she felt very happy when teaching others to learn something. Additionally, she discovered that her academic abilities were increasing gradually where she tried to explain a concept to her partner or clarify some similar theories to her teammates. Thus, when she was very young, she made up her mind that she wanted to be a teacher, and put forth a lot of effort toward reaching this clearly defined goal.

Aurora's parents provided her with a highly democratic climate in the family. Unlike many students, Aurora was never forced to participate in a talent program after school and on the weekends. This did not mean that her parents did not care about her academic life and leisure time. Contrarily, in order to help Aurora recognize and develop her interests, her mother introduced many different talent classes to her and allowed her

to decide whether she would participate. Thus, without much pressure from parents, Aurora registered in several programs, such as Chinese writing, piano, and Western watercolor painting. Although she was fully allowed to determine when to discontinue participating in any talent class, her mother always advised her to think twice before making any changes. She recalled,

> I remember there was a time, I told my mom that I felt bored when attending the Chinese calligraphy class, and I didn't like it anymore. My mom said to me, "You can decide whenever you want to quit learning Chinese calligraphy, but you can't blame me for not convincing you to keep learning it." Finally, I decided to quit the calligraphy class; I felt good in the beginning, but a few years later, I regretted it because I felt my written Chinese could've been better if I had kept training my penmanship. So, I told my mom that she should have forced me to continue to learn in that class, but she said, "That was what you wanted, and I hope you have learned something from your rough decision." Thereafter, I always remembered this experience and take her advice: thinking twice before making any changes. I think I'll use the same strategy to educate my children once I have them because I believe an open and democratic climate can help children learn and think better independently.

Aurora described her early experiences at the university metaphorically. She explained that she felt like a "dry piece of sponge that was always prepared to absorb water—knowledge of the industrial design." Because she did not have prior learning experience in the related fields, such as art or modeling, she had to pay more attention in class and spend more time on practicing new skills. She thought that with only putting forth more effort, she could catch up the other classmates who had learned some design skills in vocational senior high school.

Although she did not have prior knowledge when she first came to this department, Aurora's creativity and eager-to-learn attitude impressed many teachers of various subjects. She was not afraid of failure and not frustrated with repeatedly doing the same project. She believed that through training over and over, she could accumulate knowledge and master the design skills. Therefore, her performance in professional courses was getting stronger and her creativity was affirmed by both her teachers and peers. Additionally, Aurora chose to be in the Applied Ergonomics on Industrial Design Program (AEID) so that she could release her creativity to continue doing research for the field of industrial design.

Carpenter Liu

Always wearing a loose shirt and a backpack, Carpenter seemed very quiet and shy when we met for the first time. Carpenter, a 20-year-old young man, graduated from a vocational senior high school in which he specialized in wood pattern modeling. His program in high school had prepared him well for the industrial design degree program in NSUST. In vocational high school, he had mastered concepts of developing three-dimensional products better than most students. Because of his superior talent, he caught the attention of the teachers. In addition to his outstanding performance in his program, he had earned awards in many prototype design competitions. As a result, he was always recognized as the "superstar" of the school.

Carpenter decided to apply to the industrial design department because he thought he could have more freedom to create products on his own and unleash his creativity. While at the vocational senior high school, he had limited knowledge of industrial design, however, he thought that the techniques and concepts he was learning

could be applied to industrial design. He thought his vocational high school background would be an appropriate match for his future in industrial design at NSUST. However, this perception changed in his first basic design course at the university. When asked about his first impression of this department, he described his feelings about his first academic year in the university:

> I found that my design skills were not as good as [the other classmates] from a fine art or painting program in the vocational senior high school, and it was laborious to catch up to their level of doing design in my freshman year. At the vocational senior high school, [students] had not been trained to have original ideas for their products. Due to the lack of creative thinking skill training, I realized that I had difficulties expressing my thoughts during the first year in the university. In fact, I didn't even know where and what my creativity was!

During the first two years of his university life, Carpenter felt that he had learned tremendously from many teachers. He enjoyed having individual discussions with teachers in which he learned many new concepts and techniques of developing and designing product shapes. In his second year in the university, Carpenter decided to focus on the Exhibition and Houseware Design Program (EHD) in which he believed that he could better apply his practical modeling skill and express his creativity.

However, he thought that although he could make a real-life model, he had yet to develop his personal design philosophy. He realized that he must learn more theory from his teachers. He was motivated him to learn design theories while most other students were happy simply practicing design skills and molding techniques. Because he realized he had benefited from consulting individually with teachers in high school, he continued this practice. Following classes, he knocked on the doors of the instructors'

offices to ask them for further explanation of the abstract concepts. He followed the advice provided by his teachers and went on to excel in his program.

Carpenter had a very linear style and appreciated those teachers who gave structured classroom instructions in a step by step approach. In his point of view, group discussion with a teacher was better than individual instruction since he not only obtained suggestions from the teacher, but also received opinions from peers. In the process of learning design, Carpenter was gradually aware that practical experience interacted closely with theory; this awareness made him more willing to learn more about theory, which he had not learned effectively in the past.

He described himself as a man of few words but hard working. He preferred to work alone, however, he realized the teamwork provided him more learning opportunities since design involved giving and gaining feedback from others.

Although he did not initiate relationships with others, his easy-going personality and hard working attitude earned him friendship. Many of his classmates came to him to learn modeling skills, and he taught his peers wholeheartedly. When he was in a group, he did not talk very much, but each time he expressed his opinion, he always brought up issues directly and gave appropriate suggestions. Therefore, both his teachers and his peers appreciated his intelligence and admired his abilities.

CHAPTER 5

FINDINGS

The portraits of the four participants are illustrated in this chapter. Following the portraits, the findings are summarized in the end of this Chapter to display the similarity and differences of the 4 participants' creative characteristics and learning styles (See Figure 5.1); perceptions of creativity and successful creative individuals (See Figure 5.2); and their opinions of the learning environment, curriculum design and teaching styles in their current design program.

Joy: Fun-Loving, Easy-Going, and Personable

Joy was always an active and outgoing person. Her peers and teachers were all surprised with her energetic lifestyle. Joy was also very imaginative, and this was reflected in not only her design projects, but also her daily life. Additionally, because of her well-maintained interpersonal relationships, Joy's classmates would obey orders under her leadership when she was elected to organize an event for the class or the department. Joy was a friendly and easy-going person to everyone who knew her.

In the beginning of her university experience, Joy felt frustrated. Joy had a hard time adjusting to her new industrial design major, which was totally different from her mechanical drafting major in high school. Joy was now expected to be able to sketch in a free hand style of drawing, whereas in high school she had only been exposed to mechanical drawing which involved different drafting concepts and more

precision and accuracy. Joy had been a superstar student in her vocational senior high school, but suddenly she found herself encountering difficulties in school that she never expected. In addition, Joy found difficulty having instructors frequently criticizing her work. Although she felt frustrated, she did not give up easily. She tried very hard to understand the overarching conceptual ideas involved in industrial design. In better understanding the field of industrial design, she thought she would be able to better understand her teachers' requests on class projects. Fortunately, Joy was not afraid of asking teachers for help. Her assertive style proved to be helpful in her vocational high school, and she continued feeling comfortable consulting with her instructors in this new learning environment. She described her experiences:

> You know, I was not a design or art major in [vocational senior high] school before, so how come she expected me to provide a nearly perfect product in my first semester? Basically, I didn't agree with her teaching attitude and her way of talking to students . . . I realized that I couldn't depend on her since she was the only instructor in the Basic Design course. If I wanted to learn better and [improve] my design concepts and skills, I must ask for help from other teachers to learn design and improve my sketching skills which I had never learned in high school. I remembered that I spent so much time running to several faculty offices one by one. I would bring the same design—my project from a class—[to different instructors], and ask for their opinion and consult with them on how I could improve my design. Gradually, I felt that my ability increased little by little. Of course, I better understood what design really was and what that strict teacher's requirements were. Man! That was really a hard time for me.

Although Joy experienced much frustration during her first year in the program, she did not allow her feelings to get in the way of her developing positive relationships with her peers and instructors. Joy had an easy-going temperament and a

very good sense of humor. She described warm friendships with several students from her hometown with whom she had entered the university. She maintained those friendships and developed new relationships with new classmates. Her friends described her as always happy and willing to help others under any conditions. These characteristics were evidenced in several ways. In observing Joy in the industrial design studio, students were constantly approaching her for help. She would always put down her work, and assist them with their problems. Her kind and helpful manner led her to be chosen by her classmates to organize the class graduation trip. In addition, Joy's friendly and easy-going personality enabled her to feel so comfortable with her instructors that she was often recruited by her classmates to approach professors with a request to postpone a class assignment deadline.

Joy always had a sweet smile on her face, and greeted everyone she met. Her friends commented that Joy's sense of humor could be found anytime anywhere. Observing Joy tell a joke was evidence of her joyful spirit. When she was told a joke in the design studio, her laughter could be heard even outside the classroom. When Joy retold the joke, she presented it comically and in her own dramatic style. Joy had such an outgoing personality and seemed to enjoy everyone she met. When this thoughtful young woman was asked how she had developed her positive attitude and joyful manner, she offered her philosophy of life,

> I don't see any reason we can't be happy. Life is short. Even though you see some people as old as 100 years old, it's still nothing compared to the earth, the universe. I think people should be happy every day despite the troubles they face. We can't waste time being sad, and feeling sad won't help us solve problems . . . I love my friends, and I believe they would feel the same way. I like to be with my friends, and we help one another. Remember

> my frustration in the beginning of the first semester? Many students felt the same. So, I suggested to the class to have the more experienced students help those who didn't know much about design to improve their designing skills. Everyone thought that was a good idea. So we started to work together, learn together, and have fun together. We were really like siblings in a whole big family. They were nice to me, talking to me when my products were criticized by the picky instructor. Additionally, they taught me how to improve my designing skills. See, I benefited from the big group of friends a lot. Life is good if you believe life is good.

Joy was a good manager of people. Because of her friendly attitude, Joy could gather her classmates quickly for any reason, whether a problem solving session was needed or students needed to prepare for a design exhibition. Joy's opinion was always well respected and brought up the most discussion in any group. Because she was elected as the contact person for the class, she carried a telephone list of all of the students in her class, a cellular phone, and a notebook. Therefore, Joy was always ready and willing to organize a meeting. Joy was such an easy-going and thoughtful person that most of her classmates were very cooperative when she directed the class to accomplish a task such as organizing a committee, or establishing a new system for organizing students in carrying out a variety of their assigned responsibilities such as maintenance of equipment and arranging transportation for guest speakers. Although Joy admitted that she did not enjoy forcing other students to carry out their responsibilities, with her pleasant personality, she was able to convince her classmates to work together as a team. Joy's easy-going personality and leadership style were evidenced when she described how she facilitated collaboration amongst her peers. Joy explained,

> Sometimes people had thousands of excuses for refusing to take responsibility. Maybe they weren't in the mood to do it at that particular moment. I think it's no use to force them to go any further. You should listen to them, and then tell them why we have to finish the job. If they do have difficulties working with the class, I always try to help them to solve their personal issues, or tell them, "You can leave us this time, but you must work with us harder next time." Most of the time, they would listen, finally come back to the group and work with us together. I don't know if this strategy works for others, but it works so well for me. I don't force, but I try to convince and try to help.

According to her classmates, Joy was also a "super busy" student. Because of her enthusiasm for group activities, she was usually elected or volunteered to be an organizer of a class or departmental event. Joy frequently emphasized that she loved to be with her classmates, and she believed in the value of close friendships; therefore, she enjoyed organizing social group activities for the class or the entire department. She gathered the whole class together for birthday parties for her classmates each month. At the end of school year, she planned a trip to the beach or a camping trip in the mountains for her class. According to one of Joy's classmates, Joy's reputation as a public-spirited organizer earned her the designation of the "most popular buddy" in her department.

In addition to maintaining good interpersonal relationships, Joy was also a very hard worker. This could be seen in her design work. In order to obtain relevant information for any design project, Joy would spend several days surfing the Internet to find out the rationale for the design. She would look at related products in different stores to stimulate her new ideas. She described how would conduct her own informal research by interviewing customers in local stores regarding why they would purchase

particular products. This serious researcher would question people about whether they were purchasing products because of function, color, style, design or price. After collecting enough information, Joy would spend a great deal of time analyzing the enormous amount of information and then discuss her findings with her instructors.

When asked to describe her preferred way of learning, Joy emphasized that she was definitely a visual learner. Joy claimed that she learned better when surrounded by various existing products. They provided her creative inspiration. She described how she would spend hours in department stores studying the design of new products in order to take these ideas and transfer them to her design projects in the studio classroom the next day. She could soon analyze the numerous features and functions of the products, determine which were needed for her design, and then incorporate her findings with her new ideas.

In addition, Joy found creative inspiration through discussion with people. Her learning style was evident in a group discussion. Joy always gave the most useful and practical ideas in small groups. Joy's teammates were highly impressed by her flexibility and novelty of problem solving strategies. Additionally, Joy often presented ideas that seemed unrelated to the existing problem in a group discussion. However, after giving a detailed explanation, she would always have her ideas accepted by the team. Alice, one of her teammates on a group design project, highlighted this quality when she described her observations of Joy,

> You would never know what she thinks because her thinking process is just leaping so fast and so far. If you give idea A to Joy, she can tell you a newly creative idea F, without thinking through B, C, D, and E. I do so admire and envy her creativity and rapid thinking style.

Joy believed that creativity was a way for people to express their thoughts and feelings. For Joy, everyone had the ability to create, and creative activities could happen any time and anywhere. When she was asked to describe what creativity meant to her, she explained,

> Creativity is just like something popping out from your head. That thing must be somewhat novel, interesting, and something that nobody ever thought about. Well, I think that's not enough to define creativity because creativity has too many aspects, and you'll get a different answer if you examine the question from a different perspective from mine [as a designer].

Joy pointed out that creativity would be defined differently by designers, artists, mathematicians, and scientists. Therefore, she believed that there was no one universal definition for creativity. She emphasized that although there could not be a universal definition, different viewpoints of creativity should be respected.

Design students spend much of their time in school developing products. Although she was majoring in industrial design, Joy believed that a physical product was not essential to creative expression since not everyone was able or capable of creating a visible prototype. Joy also stressed, "Some people are very creative in management, and some people can act creatively, but there is no 'visible' product to represent their creativity."

Joy believed that evaluating creativity was challenging. When she was asked to weigh the value of creativity seen in a product that has influenced society versus one that has not, she explained, "There is no difference between big 'C' and small 'c'. On the other hand, I believe the value of useful inventions by Thomas Edison, an elementary school teacher and a nobody on the street to be the same."

Joy also noted that different creations impact society on different levels; however she asserted that different people's creativity was all equally valuable. She explained,

> I do admit the quality of creations could be different. For example, Thomas Edison's invention of a bulb, and Alexander Bell's telephone have [had a greater influence] in this world then a teacher's creative instructional supplement does. Well, maybe there is a student enlightened by the creative instructional supplement, and that student becomes an important person to this society. In this case, the teacher's creativity might impact us greater. Overall, I think creativity is an inestimable property of human beings, and we can't easily determine how much a creation is worth.

When asked to consider how she would define successful creative people, Joy had a clear definition,

> Basically, I think everyone is creative to a degree. As a matter of fact, some people know how to use this energy wisely while others never even perceive it's existence. So, I think in order to be a successful creative person, one must have the following criteria. First of all, one must know they have the creative power. Then one's creation must be efficient, be accepted by our society, be applied to the real word, and improve our lives. Finally, this creative person must be very friendly, humble, and open-minded.

To Joy, having creativity is not the only requirement for being a successful creative person. Ethical considerations also play a role in determining whether a creative individual becomes successful. Joy provided an example when she pointed out that a tricky strategy used by a bank robber was not creative. "I would call this 'little evil intelligence,' but not 'big beneficial wisdom'." Therefore, Joy believed that any

illegal activities that undermine society do not represent creativity, and the person who carries out that type of activity is neither successful nor creative.

Joy thought that learning and teaching must be conducted in a conventional classroom; however, she did not like the arrangement of the furniture in the traditional classroom. To her, a traditional furniture arrangement suggested a one-way communication, which was the direction that the teacher talked to the students. Meanwhile, Joy believed that in a big group discussion would better help idea incubation since students could listen to others' ideas and stimulate their own thoughts. When asked to compare an open and closed class environment, Joy said,

> I don't think an open environment, such as outdoor class, works for the students and the teachers. Students' can't concentrate in an open environment, and teachers' have to "yell and shout" to them when talk to the class. I, personally, prefer to have class in a conventional classroom. However, I don't like the traditional furniture arrangement since you can't see other students when discussing if all students must face to the teacher. It's more like a one-way communication from teacher to the students than a discussion. If there is a chance, I always suggest teacher to arrange the students sitting in a "U" shape so that the students and the teacher can face to face and discuss. Also, I like to study and discuss in a bright environment instead of in a dark room. I know there is a teacher preferring to have presentations by using PowerPoint in his class, but I don't like it. Students fall asleep easily, and your eyes get tired easily while watching at the screen for a long time. Additionally, the learning couldn't be too comfortable if we are learning theories or listening to a lecture class. I think a stricter environment can better help us to concentrate to the class.

While asked what kind of materials could better facilitate students' study in design program, Joy said, "Many of my classmates plan to be professional designers,

but they feel some of the current curriculum design were not easy to apply to the real world." She strongly emphasized that the course contents should meet students' needs and include professional practical skills, such as the most popular software need in design companies. In addition to criticizing "bad design", she thought it would be much better if teachers tried to teach students to appreciate "good design." She said:

> The skill of how to view a product will definitely help students enhance their appreciation of aesthetics in design. These basic abilities are just like useful tools for designers. See what I'm saying? While I know what good design is, I, of course, can distinguish the "bad design" from it without learning. Also, I can design a better product just because I have the tools to help measure people's acceptability. Moreover, theoretical lectures and practical trainings are both essential to students since everyone has different learning styles. Thus, the best way to enhance students' design ability and creativity is to provide both courses proportionately and consistently to each other.

Joy gave another example happening in the CAD class,

> There is a teacher who likes to teach us a package of CAD software, Micro Station. Actually, I don't know why he likes this software. He told us Micro Station is popular in the professional design field, but I think he should say 'was.' As a matter of fact, there is no design company using this software. They are using the other two suits instead: Pro E, and Rhino to build 3-D models in the computers. I don't know how long he didn't update his 'professional knowledge.' So I'd encourage him to visit some design companies to get the most up-to-dated information.

When asked how instructors could better facilitate students' learning in industrial design, Joy suggested,

> If teachers have difficulties to bring fresh air to our class, they can take us out. I know there are so many design companies near the university, and the instructors can design some field trips to visit these offices. We'll see how designers work, and what they are using to build 3-D model in the computer.

When Joy was asked to describe her preferences for teachers' teaching styles in order to trigger students' creativity, Joy indicated, "I thought all teachers were able and capable to lift students' knowledge levels and increase their creativity." Furthermore, she believed that teachers would help students more if they initiated students' interests and potential by giving positive encouragement and making their expectations clear. Because of her previous negative learning experience in the beginning of her university life, she thought that a teacher's role was to help students recognize their strengths and needs and then guide them on the way of learning design. Joy indicated,

> Although most students in the Department of Industrial Design had prior knowledge in design or art area, there were still a number of non-design background students struggling in learning design. These students did not know much how to draw, how to make prototype models and how to present their ideas. However, because the University did not have a placement test to evaluate which student went to which level of design, all students studied in the class and learned the same curriculum content. Hence, some students who did not have prior knowledge in design area were struggling in the design class while some others could easily reach the instructors' requirement.

Kalki: Innovative, Confident, and Motivated

I personally thought that Kalki was probably the most creative of the four participants. He was also considered to be the most creative student in his class according to the faculty and students. When I asked instructors to nominate creative students in the beginning of my study, all instructors referred to Kalki as the best student in the class throughout his third year cohort. Because of Kalki's solid fine arts training in high school, he spent the least time adapting to the new environment in his university. Kalki's classmates highly admired his sense of design and the creative ways he expressed his ideas since the beginning of his program at NSUST. Kalki's gift for design caught the attention of his faculty very quickly, and all the instructors encouraged him to participate in various design competitions. During my observation in the class, I had an opportunity to have a conversation with David, one of Kalki's "buddies." David described his friend:

> Kalki's creativity seems endless to me. You can see him [involved in] non-stop drawing sketches of his ideas throughout the whole day. Each idea is very unique. [Teachers in this program require a certain number of submissions.] Because he submits so many drafts, you probably think many of his ideas are submitted to simply meet the requirement, and would not be of high quality （濫竽充數）. I'll tell you what, you are wrong. If you ask him how his ideas are developed and what makes them creative and special, he'll confidently explain to you, and you'll be so impressed by his creativity.

Kalki was a student who frequently questioned teachers' opinions. While observing his class, I had a chance to witness how he convinced the instructors to accept his design. It was the first stage of the design project, and students had to

provide their findings regarding what they wanted to design, what problems were founded with the existing products, and how they would resolve the problem and improve the product. One of Kalki's teammates told me that Kalki was interested in the transportation design, so he and his group were focusing on a "two-wheel moving tool design." They decided to select such an ambiguous theme rather than choose an explicit topic such as "motorcycle design" or "scooter design" because they wanted to avoid being blocked. Kalki said that he was the one who convinced the teammates and the teachers to use this concept to begin their design. He explained,

> We spent quite awhile determining the theme to better define what we wanted to do. First of all, we all agreed with creating a product that can help people "move." Then we seven teammates finally narrowed down the various thoughts, and decided to design a "tool" that can help people "move." Meanwhile, most of us suggested that a 2-wheel transportation tool was easier to move and park, so we focused on "2-wheel." However, I suggested that maybe we should avoid using the word "transportation" because there was already a strong image in this vocabulary. We couldn't easily think beyond the limitation due to the definition of the word, while we incubated new ideas. Therefore, we thought "2-wheel moving tools" was the most appropriate one. I mean if things are too clear, then there will be less room for creativity. On the other hand, we can best unleash our creativity if things are chaotic and complex. Ha! Ha! Ha! They all agreed with me.

In addition to the decision making of the theme of the design project, Kalki also provided a solid rationale and plenty of research studies to the instructors when they doubted the efficacy of the power system used in their design. Kalki, patiently, explained why he decided to use Ni-Ca and Ni-MH batteries instead of other types of batteries. Additionally, he showed how new technology could support his design, and

make the power system safer to use and faster to recharge. In the face of the overwhelming research based documents, the three instructors did not have too much to say to Kalki, and Kalki seemed to successfully defend his proposal of the design project.

After class, I had a short conversation with Kalki. When he was asked why he was not afraid of arguing with teachers while most students chose to accept the suggestions of their instructors, Kalki responded,

> That's easy. I think I always tell the truth, and I can provide enough evidence for every word I say. I admit that sometimes I may have many ridiculous ideas, but I can spend the most time digging out the related rationale to support my thoughts. Finally, after some necessary adjustment, the idea becomes not so ridiculous anymore. I don't mind if the teachers criticize my idea, and I always walk into their offices and ask for a reason. If the reason they provided can't convince me, then I'll give them more evidence to prove to them that I am right. It's just pretty much like a great debate, and we try to convince each other. I believe that the truth is always the truth, and a wrong concept won't be easily changed just because you are a teacher. Of course, I'll completely accept their suggestions if they can tell me what mistake I have made or which part I have overlooked. That's what it's all about.

Kalki had highly abstract thinking skills. He told me that he did not like teachers talking or describing the curriculum clearly. Kalki would rather discover a solution for an unclear situation in his own way than follow the instructors' specific learning strategies. Additionally, Kalki's outstanding verbal ability and good communication skills enabled him to freely and systematically express his thoughts, just like what I observed in his presentation class. Moreover, due to his excellent

metaphorical and vivid talking style, Kalki was often elected to be the person who reported for his team in the class or for the department. During my second interview with Kalki, he received several phone calls, and one of them was to remind him to compose a script for local television news reporters to broadcast the exhibition of the industrial students held at the end of the semester. I asked if he was often elected to take on this sort of responsibility and Kalki responded,

> Yes. I think maybe my classmates think I have higher verbal ability, better writing skills, and a more vivid descriptive style, so they always consider me as the representative for the 3-year class or the department. (Laughs) I think maybe in the near future, I can speak for this university. (Laughs)

Kalki's leadership emerged in different ways. Kalki was considered a very smart student in the class. Because of his well developed design skills, Kalki earned the high admiration from his teachers and peers. Each time the class discussed how a problem could be solved by designing a product or establishing a working system, Kalki always had the most ideas, and each idea was considered valuable and highly practical. Additionally, Kalki's outstanding verbal ability and communication skills allowed him to easily convince the class to accept his suggestions. This admiration was evidenced in comments made by William, a teammate of Kalki's, as he described Kalki's work:

> Last weekend, our team had a meeting to discuss [the design project], and develop [the presentation for today]. Kalki brought the most practical ideas and examples of the energy sources for the greatest number of existing products. He introduced each type to us, just like he was the inventor or the salesman of batteries. You should've been there! It was so interesting.

Kalki's hardworking attitude could be found in many different aspects. Kalki did not dedicate himself to schoolwork a lot, instead he spent his time on searching new design concepts and professional trends by participating in various design competitions. Kalki said that he could run 3 to 5 different projects at the same time and prepare his schoolwork as well. Kalki's classmates were amazed by his tight daily schedule and high energy. During two interviews with me, Kalki answered eight phone calls from different people for different purposes. I overheard him explain a design process to a classmate, clarify a few things to another student, and provide his daily schedule to an instructor who needed his help. From listening to his phone calls, I knew that he was running at least two design competitions, organizing an end-of-semester exhibition for the design department, supervising a design project for a design company, arranging a guest speaker for the class, and being a spokesperson for several departmental events. It was apparent that no matter how busy he was, Kalki always looked very energetic and managed his time efficiently.

When he was asked to describe how he unleashed his creativity, Kalki emphasized that he liked ambiguity and disorder even more while learning and thinking. In my interviews with him, he frequently stressed his preference for searching for a solution and discovering an order from the chaotic information. He said,

> In the class, I don't like teachers providing specific or explicit steps when they give a design assignment. I appreciate the ambiguity. For example, don't tell me to design a "glass," just tell me what you "want," such as, "I need a thing to carry liquid to satisfy my thirst," or "I need a thing that I can hold within a hand, and use it to contain things." I want to have more room to create a new design with less boundaries. When I process a design,

> I don't like to reference a lot of existing products; however, I'd rather go outdoors, and enjoy a bit in the woods. I believe that the beautiful shape of a running wolf can trigger more ideas of my mountain-bike design, and the eagle or owl's big sharp eyes can make me develop better shapes for my eyeglass design competition. I just can do better, and feel more comfortable if I can develop my own design in my own way.

Based on his open-minded characteristic and preferred abstract learning style, Kalki's perception of creativity was flexible; however, he still had standards to measure whether a product or a person was creative. Like his metaphorical talking style and interests in nature, Kalki's definition of creativity was imaginative and influenced by Zen philosophy. He said,

> I think creativity is very fine thinking that yields various possibilities. It's like clouds, stars, and the sea which are physically existing and also abstract concepts. You can see them, but it's not like what you see. You can describe them, but they are not like what you say. If you insist that, from the scientific view, they are just conducted by some single elements, such as moisture and air, reflection of the light from other planets, and water then you are far off in your views of creativity.

Kalki shared more of his thinking that reflected the influences of Zen philosophy on his views of creativity. He elaborated on his belief that creativity was a part of Mother Nature. "You can't really tell what creativity is;" Kalki provided a metaphor from nature as an example to illustrate his view of creativity,

> Speaking of the application of creativity on industrial design, I think a product is the best way to represent a designer's creativity. A product is like a tree, and creativity is like fertilizer. You can add different, but appropriate fertilizer to a small tree, and it will grow better, if you fertilize it more.

Novelty and originality were two important factors of creativity to Kalki. Additionally, despite the flexibility of his creativity definition, Kalki insisted that the definition of creativity should be more strict and more specific when discussing the application of creativity in design. When he was asked to explain his notion of "industrial design creativity," Kalki emphasized,

> The ability of being identified and recognized by the most people is also important to be a creative person. In other words, if your creativity cannot be acknowledged by people, I don't think it's creative. Well, maybe I should put it this way: if a creation is only appreciated by a small number of people, it may be creative based on the art viewpoint, but it's not creative to an industrial designer. That's also why I insist a product is important and the most direct way to express a designer's creativity.

Kalki's view of a successful creative person was as flexible as his definition of creativity. Kalki suggested the following criteria for being a successful a creative individual: (1) one must have a pure naïve thinking style, (2) one must have a personal design style (3) one must be open-minded, and (4) one must have superior communication skills and interpersonal relationships. Kalki gave two examples to explain his viewpoint,

> Joy Fang, the girl whom you just finished interviewing, is very creative to me. She's got a pure mind, and naïve thoughts; her performance is so natural, just like a child. Every time I hear her idea, I'm just very impressed with her pure thoughts. They are just like something from heaven. It's just a start, and she can develop more applicable ideas from the original thoughts. Besides, her communication skills are also amazing. Although she often mentions that she doesn't know how to express her thoughts, I think she has done a good job. (Laughs) Maybe she was just humble. Joy's creativity is natural, something she was born with, and nobody can imitate her style.

> Another creative example is David Huang. He doesn't have the most products in our class, but each of his design projects is excellent. I like his simple design style. You can soon catch which one is his design among our 35 projects without the designer's name listed. His design is so special and no one can forget it.

When he was asked to describe his preferences in learning environments, Kalki explained, "I can study everywhere if I want to learn; on the other hand, I can stop learning if I'm not interested in the material or not comfortable with the class format." I found that Kalki was a highly autonomous and confident person since he recognized that he must be independent following his parents' divorce. Kalki seemed always to know what to do, and what to learn; thus, he would try to adjust himself to the physical environment if it was not suitable to him. Kalki said,

> The classroom environment is not critical to me, but I do have my preferred learning climate in order to enhance my creativity. I prefer a class format such as discussion, communication, and debates. I think an open discussion class format can trigger my imagination and help me incubate new ideas. I can associate the existing ideas with more and better ideas. Besides, I think an open climate can allow students to express their thoughts. Also, everyone can help you notice the benefits and drawbacks of your ideas.

When asked what kind of materials could better facilitate students' learning in design programs, Kalki had the same feeling on this issue. He stated,

> Joy's saying is correct. I think some teachers are just not [progressive]. They don't know what they don't know, and they don't want admit that they don't know. They use the same lecture as [they did] 10 years ago, which is even worse.

Additionally, Kalki thought that the goal of curriculum was to develop the abilities of independent thinking and group communication skills. Therefore, although there were certain programs including design administration, modeling and expression, design ergonomics, and computer-aids-design (CAD) in the department, students should have more opportunities to learn from other fields and discover other strengths. When asked to elaborate more on this opinion, he stressed,

> An industrial designer could face any kind of customers and encounter very different request of service. People might have you design a lipstick, a bike, a computer, a car, or even a tank. You can't say that you don't know anything about the clients' requests . . . You must do everything to keep your good relationship, or others will. You lose your customers, you lose your job. That's what happens in the real world every day. So I think teachers should encourage students to learn everything from other departments, so that students can better know computers, automobiles, makeup, machines, and airplanes, and the relevant knowledge will definitely help us create better designs. The additional skills provide us more opportunity to survive in the design profession. On the other hand, the inflexible curriculum kills students' creativity and lower students' academic performance.

Kalki described his favorite instructional approach. He thought that teachers should encourage students' creative motivation, but not just being critical. Kalki recalled his class in the first year,

> In the class of Basic Design, I was trained to develop the aesthetic concept, and then created shapes for a new design product. Because I had received extensive related training in high school, I was one the few students who did not receive much negative feedback from the teacher. However, I strongly disagreed with some teachers' teaching strategies to stimulate students' creativity by rejecting and criticizing their products. Teachers'

> brutal words could easily destroy the beginners' self-confidence in this major and decrease students' learning interests in the industrial design field. Due to this inappropriate instructional approach, many students assumed that they were not the right person to design and decided to transfer to other department before attending their second year.

Kalki also mentioned that some teachers were highly biased in favor of the students who performed better in class, and these prejudgments annoyed many students. Kalki's frustration with this bias can be seen in the following:

> Some favored students, including me, take a lot of "advantages" from some teachers' unfair teaching attitude. You see what I mean? Once they become teachers' pets, they don't have to work hard; they just turn in an "OK" product, and teachers could still give them a good comment. It's so unfair. I see some students who have never caught their teachers' eyes are struggling with the prejudging teaching style. They try so hard to improve their design, but still can't get higher grades. I think teachers should pay more attention to the lower graded students, and then recognize their needs and enhance their abilities.

Meanwhile, Kalki thought that teachers should be more sensitive in their evaluation of students' products. He said,

> I don't think teachers are able to evaluate all students' products since they don't know all aspects of design. Sometimes, it's so obvious that the teacher doesn't know how to give advice to a student, but she still offers some inappropriate suggestions. The student follows her direction, tries the wrong way, turns in a worse product the next week, and is humiliated by her again. It's so ridiculous; how come she totally forgotten the advice she had given to the student a week ago? I think teachers should be more humble.

Aurora: Communicative, Thoughtful, and Intuitive

Aurora was the only participant who graduated from a General Program in vocational high school. She did not know much about industrial design before enrolling in the university; however, Aurora earned the highest score on the entrance examination and the applicant evaluation. Although she did not receive any design or art related training in high school, Aurora's talent in art and sketching caught the most attention of the instructors. When asked about her art interests, Aurora replied,

> I didn't learn drawing or painting in my high school, but I've always been interested in creating. I remember that the application to this department required a portfolio, including any achievements in art or traditional academic areas, and any design related products. Because I didn't have very formal products or huge projects set to turn in—but other students such as Kalki did, I submitted several of my projects done in different subjects. For example, I had a self-selected project for my Chinese Literature course introducing the evolution of Chinese characters, and I spent several weeks searching for the references and research studies; then I drew several full-sized posters to present my findings. I earned the best score on that project, and the [Chinese Literature] teacher admired my art talent. So I submitted the archives of that project and some other similar projects from the other courses, such as the math and physics, for my portfolio section of the application. After I entered the department, many teachers told me that they were so impressed by my portfolio, and encouraged me to learn more in this department. So I was not afraid of this new field at all. I mean, even though I was not formerly and regularly trained in the design field before, I believed if I could put more efforts in it for enough time, I still could learn well and unleash my creativity. No need to fear.

Aurora's motivation and endurance was expressed not only in the art field, but also in her studying math. When she recalled her school life before the university, Aurora said that her math score was not as high as the other subjects in junior high school; actually, she did not dislike math, but she was so afraid of it. The 14-year-old Aurora recognized that if she wanted to reach her career goal—being a teacher in a university— she must learn math well to pass the entrance exams of senior high school and university. Therefore she ran into the math teacher's office every day to learn everything she wanted to know about math. About a year later, Aurora's math score became the highest in her class, and she became interested in math. During the three years in the senior high school, Aurora was assigned to be a "little tutor" to assist her classmates learning in many subjects, including math. She described what she learned from this experience,

> I sensed that I could conquer every subject if I attended to learning and practicing it. I have the ability. So each time I'm frustrated in learning a new thing, I always remind myself of this special and successful learning experience.

Aurora's logical thinking skills and analytic ability was also remarkable. She enjoyed searching for some rules from overwhelmingly chaotic and complex information. She explained how she enjoyed solving problems,

> Just like to prove a math theory, you must have a clear mind and enough patience to repeat the trial and error, and then you can possibly discover an end of the thread from the whole mess. This thread may or may not lead you to the truth, and you have to determine whether you'll buy it. Also, I'm always excited if I can clear the mess and solve a problematic situation. It's so much fun to dig out some answers in your own way for solving a problem considered a "mission-impossible" by the other people.

In addition to her outstanding logical thinking skills, Aurora's intuition was also noticeable in her class. Kendra, one of her teammates, described Aurora's imagination and intuition,

> She doesn't talk very much, unlike her performance in the Student Debating Club, but her opinions are always very creative and straight to the point. She has the ability to give a solution by thinking of a totally different situation. Like, when she developed an idea of "panel PC" – a concept similar to notebook for elementary grade students learning purpose— she read the four books of Harry Potter. I mean, I would never do this because I don't have that much free time to read such leisure reading. However, she thought that if she could create a panel PC "book" just like Harry Potter's novel, the little children would never put it away. So while she read the book, she came up with a theme – My Magic Pal. Now, you can see her rough sketches, all of her designs are so cute, and express a strong image: "I'm a magic book, come read me, and you'll gain more knowledge." It's so cool!

In addition, Aurora also demonstrated strong leadership. Aurora's leadership could be found when a group discussed several ideas or made decisions. Aurora did not talk very much in the beginning of a group discussion; she usually listened to others' opinions and analyzed the advantages and disadvantages of each idea. Finally, she could summarize an optimal idea and give suggestions to the team. Most of the classmates thought Aurora had a sharp mind. Amy, one of her classmates, gave an example that happened in a group discussion that took place in planning a collaborative design project:

> As usual, we were asked to find a theme for this design project [just like what Kalki did]. So we had a meeting. I remember it took like two hours or so to discuss what we desired to design, and everyone had so many

> opinions. As a matter of fact, I think there were TOO many. Aurora did not say a word until about ninety minutes passed. And the first sentence she said was something like "we've been talking too much tonight, and I think we have to sum them up." And she pulled several pieces of paper to the center of the desk. Guess what, she had taken notes when we argued. She easily synthesized all of our opinions in about three categories, and directed the group to discuss in a more effective way. Then we focused on the three and picked the one that everyone was interested in, so everybody was happy at the end of the discussion. I think the discussion couldn't have been done in two hours if Aurora was not on this team.

Aurora believed that people must be knowledgeable in some field even though they might not perform well in academia. While many students criticized some particular instructors' teaching styles and complained about the curriculum content, Aurora would rather try to accept the instructional approaches and the learning materials in the beginning because she highly valued and respected the instructors' experiences and their academic achievements. Aurora indicated,

> I believe an old Chinese proverb, "If three of us are walking together, at least one of the other two is good enough to be my teacher（*三人行必有我師焉*）." So, everyone could be my teacher, not to mention the professors in my class. I know some critical teachers don't earn good reputations among students, but I think if I can learn some of their expertise, that's enough. So I always accept whatever teachers say in the class, and follow their instruction to start my research. I'm not saying I'm a good student, but I think that's my responsibility as a university student.

Sooner or later, after she read enough related references and did some more research, Aurora started to judge what was useful to her current study plan and future career goals. Furthermore, she concentrated on learning the knowledge that interested

her the most, and then conducted more research and brought up more questions to the class or to the instructors individually.

To facilitate her learning, Aurora believed that she was a "visual person," and pictures would be helpful to her. Aurora had a strong ability to visualize a new theory she learned. She said that a diagram, a statistical plot, or a flow chart could better facilitate her learning than thousands of words could. While listening to a lecture in the class, Aurora usually sketched some pictures or charts on a piece of paper to help her learn the theory faster. On the other hand, she also had a strong ability to read and interpret a complex diagram. Similar to her "decoding" procedure from constructing a graphic from texts, Aurora's outstanding verbal skills allowed her to convert the pictures to a paragraph of words fluently and accurately. She explained,

> Sometimes you can see a theory written in a several-page handout, and you probably can't understand the whole thing if you just repeat reading it. Actually, I can't do that either. So I think I just sit down, and read only one paragraph at once, then represent it by drawing some circles and charts in my way. After going through the article, I have the basic concept on the paper. Now I just look at the diagram to find what details are most confusing to me, and check back to the corresponding paragraph. I think I can learn better and faster in this way. Actually, in [senior] high school, I used this graphic method to help my studying of Chinese history and geography, and I always spent the least time studying and succeeded in earning the highest scores.

Additionally, Aurora preferred a presentation that had substance, was rational, and was sequential in nature; moreover, she also stressed that she learned better from authorities and through vicarious experiences. While many students criticized the teacher's instruction, Aurora thought in other ways. Despite her preferred

instructional approach, Aurora did not blame any teacher. Since she believed that teachers must have their expertise, she would rather focus on studying the subject content than struggling with inappropriate teaching styles. Aurora said,

> I believe that all teachers' have their own strengths and also weaknesses. I can easily learn much from their experiences and opinions if I can just pay attention to them; however, if I don't want to listen to the class just because I don't agree with the teaching style, I don't think they will feel hurt, but I definitely lose the great opportunity to boost myself to a higher knowledge level.

In addition to the burdensome design projects from each subject, Aurora dedicated herself to the Debating Club. Due to Aurora's great efforts, the Debating Club had become one of the most popular student activity clubs at NSUST. As president of the Debating Club, Aurora held several training courses for the members of the club, and planned a series of speeches for students who were interested in understanding or learning debate. Aurora described her student club life:

> I think it's interesting to join a student club. You can't always stick on textbooks, right? I joined this [debating] club because I thought I could enhance my logical thinking skill, and make friends. Now I'm the president of the club, and I'm so happy to hear many newcomers tell me that they have benefited here.

Aurora also enrolled in a Teacher's Certificate Program in the university because she had always dreamed of becoming a teacher after graduating from NSUST. Aurora had to take six additional credit hours each semester for four consecutive semesters to complete the program. Although her schedule looked very tight, Aurora

still maintained her interpersonal relationships. Aurora seemed very happy and able to juggle her schoolwork and social life very well.

When asked to define creativity, Aurora responded with the following:

> If a teacher tells me to be "more creative" or to "add more creativity" on my design product, I would interpret that message like this: I have to be more flexible, I need to listen to others' opinion to improve my product, I have to better unleash my association and intuition to catch more unrelated ideas and apply them to my design. I think creativity is a result of having an open mind, communicating ideas with other people, and enjoying free association.

"Listening to others" had become one of Aurora's ways to learn, and she believed only listening to others' opinion could better know her own products from a customer's viewpoint. To Aurora, if an industrial designer infused too much of their own personality ideas and beliefs without considering the customers' opinions obtained from marketing research, then the product would not be easily accepted by the end-user. Therefore, Aurora believed that having extensive feedback was an essential factor to being a successful industrial designer.

Aurora's humble and calm personality traits were also reflected in her thinking of what constitutes a creative person. She identified a creative person as an individual with a higher E.Q. (Emotional Quotient). She stated, "While I hear that somebody is very creative, I assume that he can control his manner and not to be emotional, or he has both active and quiet personality traits." Aurora also thought that creative people must abound with various ideas, and could easily associate an idea with many other totally irrelevant ideas. Additionally, Aurora defined a creative individual as a "highly inner-directed person." She believed they must have a higher

ability of independent study, and a thinking style that allows them to leap from one idea to another. According to Aurora, creative people also have the ability to evaluate everything in their environments. She added, "Most importantly, their ideas and products must be accepted by the mainstream society."

Aurora summarized her thinking on creativity as follows: "Creativity is a natural ability, and everybody has this ability; however, some people can perceive it, recognize it, unleash it and become very creative while the others do not."

As a future teacher, Aurora insisted that creativity also could be taught and enhanced if the instructor used some appropriate materials and teaching styles. "It is also important that teachers recognize students' individual differences and apply differentiated curriculum to facilitate students' developing creativity."

When discussing her views on creative individuals, Aurora thought that they must have all of the following characteristics: 1) having a subtle mind to discover details that nobody sees; 2) demonstrating a personal design style; 3) having a personal perspectives on everything; and 4) refusing to become discouraged when others criticize their ideas. Aurora gave two examples of creative individuals whom she admired,

> I think Kalki is very creative because he can always notice the details overlooked by most students. I think he has such a good memory that he can remember many details. Kalki is also a person who has his own perspectives on everything. He can state what he thinks clearly. Moreover, Kalki has his strong personal style in design, and his products are distinguished by his style. In other words, you can always recognize a product created by him. David Huang, is another very good example of a creative person. I do appreciate his style of simplicity. You won't find too

> much detail in his design; however, each line, curve and shape [appears] "born" there, and you don't want to change any of them. Additionally, both David and Kalki tend to insist that everything they believe is right. Especially David, his words are so firm and nobody ever wants to challenge his ideas.

Aurora's view of successful creative individuals was a little different from her definition of creative people. Although she thought people who insisted their ideas were right could be creative, Aurora believed successful creative people were those who could make other people accept their creative ideas. Therefore, in Aurora's mind, good communication skills necessary in convincing others of one's ideas became important to be a successful creative person. Aurora said,

> I think Kalki is successful because he can convince everyone to buy his ideas by using his superior verbal and communication skills. So I believe, in addition to the creative personality that I just described, only people who have good interpersonal and communication skills can be successful.

Aurora could really appreciate a traditional classroom for learning theoretical knowledge since she thought that teachers could better introduce a new concept and give lectures on their own stage. In addition, Aurora thought group discussion could easily delay the progress of the lecturing, and she did not like being interrupted frequently while she was concentrating on listening to the instructor's explanation. Aurora said,

> Of course I like group discussion because I also could benefit from the various thoughts [of other students] for creative thinking. However, I think a group discussion is not appropriate when we need to seriously learn some theories. I'd rather have teacher stand in the front of the classroom and give

> a lecture for a complete period so that I can listen to the lecture without interruption. That's my preferred way of learning theories.

Aurora needed more private room to process her creative thinking. Aurora believed that group discussion could facilitate idea incubation and brainstorming, but she preferred to have her own space to work on her creative thinking process independently. Occasionally, she needed to discuss her ideas with a classmate or two, hence, she did not want to be totally isolated. Aurora explained how the environment could facilitate her creative thinking skill,

> In the beginning of a new design, we need to define a real problem of a product. I think a group discussion strategy could help us in this stage because all students have different life experiences and different viewpoints about the product. At this stage, I prefer a group discussion to help me collect a variety of opinions. Then, in order to determine a theme of my new design, I need a semi-open space to think about and analyze the opinions that I collected from the group. After the theme is selected, I want to go back to the group to brainstorm and gain more ideas. Then I need some privacy, again, to incubate and finalize my design idea. So I think my design process [fluctuates] between the group and individual. I believe a semi-open space could better help my creative thinking process since I could have my own room to think and also can consult with other classmates when I need to. A semi-open space can be like a booth; I can sit in the booth to have my own space, and walk out to chat with everyone. I can also hear others' conversations, and join their discussions as well.

Aurora mentioned another issue that teachers should consider in helping students to distinguish a good design from a poor design and creative products from those less creative. Aurora stated,

> In most classes, teachers show many examples to tell students what a bad design is, but they rarely bring a good design sample to the class. They always remind us not to do this and not to do that, but they never tell me how to design a product right. Every time I asked teachers why they never told what a good design was, they responded that they were trying to prevent us from making the same mistakes and designing a bad product, and that was more important. However, I haven't accepted this kind of explanation. I think they should more frequently show us models of good design and then explain to us why they are good, and how we can apply these good [ideas] to other design project. In addition, I think only telling us the limitations makes us feel that we can't make a "good design," because no matter how creative it is, teachers can always find a tiny defect. This is so discouraging to students.

When asked about her preferred teaching style, Aurora indicated that not all of the instructors noticed that industrial design students arrived at the university with different levels of prior knowledge. Some students were far more experienced than others because of their majors in high school. However, teachers expected all students would reach the same standard level with each design project. If students failed to meet the requirements of the class, some instructors would scold them or even humiliate these students in public. Most students were frustrated by this type of teaching style, including the students who had extensive prior knowledge in design and art. They thought this style of teaching would just hurt students and would discourage them from pursuing their degrees in this field.

Aurora thought everyone could be her "teacher," in terms of learning design in this class. Although some teachers were considered too strict and mean to students, she thought that discipline helped students to develop stronger minds and

gain more solid knowledge. However, she still had some thoughts regarding teachers' instructional approaches. When she was asked which teaching style could better facilitate students' learning and enhance creativity, she shared the following:

> Perhaps because my parents always listened to what I was saying and allowed me to express my own opinion, I have benefited from the mode of having healthy communication. Now I think, if I were a teacher, I could do what my parents have always done for me: listening, listening, and listening. To the teachers who have seen tons of good design students, maybe the beginners' products suggest they are not qualified to be a designer, but the instructors must not forget that's the reason why we learn here. If students can present high quality design products, why do they even bother to learn here? They could have been working in a design company and making a big fortune. I would, if I have a chance, suggest to the teachers to calm down and listen to students express their ideas in their own way before they strictly criticize their projects. They should recognize students' strengths and meet their needs on the way to learning design. Otherwise, they will scare anyone who is interested but not familiar with design. So, [teachers should] always listen, and then give suggestions. It is the best way to enhance students' creativity, and I believe this concept can apply to any subject or major.

Aurora also suggested that teachers should keep updating their knowledge in their field of design, and introduce the profession of in industrial design to students in authentic ways. She explained,

> I think teachers can also invite some famous designers as guest speakers to explain their lives as professional industrial designers. Maybe holding a design conference would be another good idea to have students, teachers, and professional designers communicating and sharing experiences.

Aurora's philosophy of listening to parents and teachers influenced her perceptions of instructional approaches. She thought that teachers must listen to students' presentations carefully in order to understand how design products and ideas were developed. She said,

> I think teachers can't prejudge students' products before students complete their presentations. Maybe design is a very subjective field, but if the instructors don't attempt to establish objective evaluation criteria, their strict critiques would easily hurt students, decrease their interest in design and destroy their self-confidence. Therefore, I think teachers should listen to students, discuss their ideas, and then give advice.

Carpenter: Hardworking, Practical, and Enduring

After receiving solid wooden modeling training in vocational senior high school, Carpenter made the best model in the industrial design class. He did not encounter too many difficulties in representing his idea with a 3-dimensional model; thus, the departmental instructors were very impressed with Carpenter's modeling skill from the beginning of his university program. However, 2-dimensional drawing was a struggle for him. While he was still in high school, Carpenter did not expect that he would need freehand drawing skills to express his thoughts instead of making 3-dimensional patterns.

Carpenter was a workaholic according to his close friends. Because he realized his lack of designing skills, Carpenter seized each opportunity to develop his designing ability. For example, while most students would only do a project once in order to accomplish the class requirement, Carpenter spent more time trying to finish the same projects in two or three different ways. He did not think the repeated

practices wasted his time; Carpenter believed that his designing ability had been steadily enhanced gradually. He provided me an example,

> I remember my first assignment in the beginning of the second-year class. The instructor wanted us to design class furniture for young children in elementary school. I saw most of my classmates draw their ideas on the paper, but I created many 3-D models by using poly-cardboards. In fact, it took longer to make models than draw graphic on paper, but I thought that making 3-D models could better express my ideas. Thus I made about 20 little chairs and desks during the weekend. Then I found that I still had 3 days before the due date so I tried to draw my ideas on paper, and finally I turned in the 20 sets of modeling furniture and my idea sketches on 15 pieces of paper. You know what, most students only had 10 pieces of paper and the quality was not good. The instructor was impressed by my efforts and recommended me to participate in the Furniture Design Competition, in which I earned my first design award.

Carpenter highly valued the instructors' opinion, and each time he finished a new design, he would bring the product to several teachers from different courses to ask for their comments. After spending much time in accumulating the design knowledge and training in designing skills, Carpenter was a good designer and speedy learner in the eyes of his instructors.

Carpenter was also good at logical thinking and had strong analytic skills. Carpenter was always calm. One would hardly ever see any extreme emotion in his demeanor no matter how happy or angry he was. In fact, Carpenter told me that he was hardly ever "very" excited or mad at a person or a situation. Peers and teachers were impressed by his good manners and polite attitude, and they thought of Carpenter as a well self-trained meditator, full of wisdom. Carpenter's lifestyle seemed peaceful with

a steady tempo of performance. His sure-footed way to work and friendly personality had earned him a high reputation for courtesy. One professor commented,

> He was a very good student. I had never seen him angry or too emotional in my class. Even though sometimes I thought I was too critical of his products, he was still very polite and asked me how to improve his design.

Although Carpenter had planned to be an industrial designer for his future career, he still had some confusion about the design profession; therefore, he often chatted with teachers, and graduates of the program about current professional trends to better prepare himself for his career. Carpenter also participated in many design competitions and earned numerous awards; however, he felt that he still might not be qualified to compete in the mainstream of the profession. I suspected that he did not have strong confidence, and asked him to explain why he felt so insecure about his ability and future. He replied,

> I know what I can do, but I think that I can't stop improving my abilities if this world doesn't stop changing. Especially in this information era, everything changes so rapidly. I still remember in high school, the teacher taught us AutoCAD to draw mechanic plots, and the AutoCAD was so popular and used in almost every design company; however, only 2 years later, another software Pro Engineering has replaced the AutoCAD and become the mainstream in the world of the computer vectorial graphic. That's why I'm always worried about my future. I can't see if I can survive in the changing industrial design profession. Additionally, even though I can make the best wooden pattern to present my design ideas, I can't always do this in every condition. See, I can make only 2 models per day, but Kalki can draw more than 20 ideas by noon; moreover, in the competitive design profession, the quantity of your ideas matters. I'm allowed to use as much time as I want in a design competition, but once I

> become a front-line designer, my clients won't let spend 2 weeks making only 4 models. So I have to improve my freehand drawing skills to extend my idea presentation ability from 3-D to 2-D.

Since he worried about being behind in 2-dimensional drawing skills, he practiced speed drawing and filled many sketchbooks with his ideas and sketches of his sculptures. With this extensive practice at 2-dimensional drawing, his skills improved a great deal by the time he became a sophomore. Through his practice in drawing skills, he would spend lots of time working on perfecting only one or two techniques until he felt certain that he could totally handle the skills and apply it to his design projects. His former professor admired him and explained,

> He always did the most in any design project. I wanted each student to come to my office once a week to report their progress in design and discuss their problems, but Carpenter came twice or three times a week. He did not only present in front of me, but also brought several new ideas or product each visit. He was really a good student.

Carpenter's creativity appeared to be developed and through gradual self-training rather than the result of inherent ability. His introspective personality allowed him able to better understand his strengths and also see his weaknesses; furthermore, Carpenter's hardworking attitude had effectively enhanced his ability to meet his needs. He said that, "When I entered this department, I found my sketching skill was awful, so I practiced drawing everyday. Now I found my sketches are so much better, and I'm so satisfied with the results."

In addition, Carpenter also demonstrated some leadership. Carpenter's leadership was observed when a group discussed several ideas or made decisions. Carpenter did not talk much in the beginning of a group discussion; however, he

usually listened to others' opinions and analyzed the advantages and drawbacks of each idea. Finally, he could summarize an optimal idea and give a fine suggestion to the team. Carpenter recalled the most recent meeting of design idea development,

> I could see they had so many ideas on how to improve mass transportation system; however, I didn't see any solid research study supporting their thoughts and assertions. Then we just sat at a round table to have a brainstorming discussion. I did not say anything, but I jotted down the most ideas they said; meanwhile, I tried to categorize and analyze the ideas. After 2 hours or so, I suggested to them that we stop the endless-like meeting, and start summarizing our meeting. I found that there was no one who remembered what the group had said, and there was another endless-like conversation. So I pulled out my notes immediately—I didn't want to waste time for whole afternoon and evening. I started reporting my findings and suggesting everyone search for the needed theories and practical techniques of improving mass transportation system. Of course they all agreed with me.

Carpenter believed that he could learn a thing or two from people in particular fields although they might not perform well academically. While many students criticized some of the instructors' teaching styles and complained about the curriculum content, Carpenter preferred to listen to the teachers in the beginning because he highly respected the instructors' experiences and academic achievements as well. When he read more related references, Carpenter started to conduct some more research to satisfy his curiosity, and judged what was useful to his current study plan and future career goals. He explained his plan,

> After determining what to study, I will concentrate on learning the knowledge that most interests me, and then conduct more research and

> bring up more questions to the class or to the instructors individually. I think that's the way I can learn better.

Carpenter's learning style was more practical than the other 3 participants'. He would rather see an existing substance instead of listening to a lecture with teacher's hands drawing in the air. Carpenter also sensed that he had to develop the mind qualities of abstractness and randomness; therefore, he put much of his efforts into learning design theories and art concepts. Additionally, Carpenter was trying to increase his ability by applying the theories to his design. When he was asked how he planned to achieve this study goal of developing both practical skills and theoretical concepts, he replied,

> Because of the difference between the two educational systems, academic and vocational senior high school, I was trained to prepare for a career after graduation, and not taught much about theories. I think somewhere in my brain is still a spread of desert waiting for to be developed, and it's called "theory learning area." Now I pay more attention to learning theories in class. Sometimes, I can't understand the implications of design philosophy or the application of a theory even though I think it is good. However, I don't really mind. I just keep them in mind, and someday, when I have enough experience in design, I'll sense what I have learned, and what the theory means.

Carpenter was a man of few words but when he spoke, he went straight to the point. When this practical young man was asked to describe his perception of creativity, he answered briefly:

> Creativity is a sense, an intuition, and an energy that you have to search for by yourself. You can look at pictures which impress you, then feel the styles, and "listen to" the words the author wanted to say.

In other words, Carpenter believed that a creative person was able to immerse himself in a piece of artwork that served to inspire. By placing himself in the picture, he would feel like the original artist, and be able to create similarly to the artist who had inspired him. Similar to definitions addressed from the scholarly literature, Carpenter's definition of creativity included novelty and originality. Additionally, because he was such a practical industrial design student, Carpenter emphasized that the acceptability to customers was also an essential component of creativity in terms of the professional design field. Carpenter explained,

> Every time I hear teachers tell me that, I must be more creative, and then I think I have to create something extremely new, that he has never seen, or even I've never thought about. That's creativity. Additionally, logical thinking is also important in my creative process.

When asked to share examples of creative individuals, Carpenter described three current classmates whom he admired:

> Wilson is a very creative person if we are not talking about industrial design profession. He plays computer games very well, especially the strategic games, such as the popular ones 'Age of Empire II,' 'The Chinese Three Kingdoms Romance,' and 'Railroad Tycoon III.' I'm so amazed by his strategies on each battle or running business. He can use the least time to develop a strong empire, destroy the enemy's troops, and unify the whole world. Maybe I should say that he is a born gaming genius due to his clear and sharp mind.

Carpenter also highly commended Kalki's creative achievements because he thought Kalki's products could completely express his creativity. Carpenter described Kalki's creativity,

> There is another creative person in my class, and his name is Kalki Young, one of your participants. I'd vote him for the most creative student in my class. While looking at Kalki's design, you can see his thoughts reflected in his product clearly; in other words, you are able to recognize what Kalki wants to say through his product.

Carpenter offered a third example of a creative person he admired,

> David Huang is also an outstanding design student in this department. David has his own designing style, which is simplicity. Keeping everything clean and neat can help end-users better understand how to operate a new design product. For example, you may be comparing the style of Japanese and European stereo design, and you may find that Japanese products look luxurious, but you can't use them without reading a dictionary-thick instruction book. It's too much to a user who just wants to listen to a light music, and providing too many switches and buttons is confusing to people. So I think David's simplified design is wonderful. No one can imitate his design style. That's creativity!

Obviously, the three types of creative person reflected Carpenter's thoughts about creativity, which were: 1) physical products were not necessary for non-design professional creativity; 2) creativity should reflect the creative person's thoughts and feelings; 3) creativity should have the acceptability of most people; and 4) creative individuals in the design field should have their own creative style.

When asked to define a successful creative person, Carpenter explained that he believed creative people who wanted to be successful must be familiar with teamwork, be cooperative with others, be accepted by this society and have good leadership and communication skills. Carpenter explained,

> I think being a creative person is not easy, but being a successful creative person is even tougher. While you just want to be creative, you just do

> whatever creative activity you want to do. If you want to be creative, then you have to work with other people. For example, industrial designers can't successfully have their new design produced if they don't want to communicate with prototype maker, workers on the production line, mechanic designer, marketing research, and sometimes even the sales. So I believe they must have outstanding communication and verbal skill to discuss with others, and have leadership to coordinate the team. Of course, their design must also be accepted by the most end-users in order for them to be successful.

Carpenter needed a clean, bright and quiet space to develop his design ideas. He appreciated independent study since he could easily concentrate when he was alone. Carpenter did not talk too much in a group discussion, He explained,

> Although I know more discussions may facilitate one's idea incubation, but it's not true for me. I find that some group discussions are all right, but too many discussions may be wasting time. I prefer to spend my time searching references through the Internet and consulting teachers in person. I admit sometimes you can gain a valuable idea from an inexperienced person, but I think you'll get nothing the most of the time. However, if I ask for help from an expert, I can absolutely get the information I need. Similarly, I can easily type some keywords and dig out tons of information of products, research studies and professional designers' experiences through the Internet. I mean, I'm not criticizing group discussion strategies, but I just prefer to work alone. It's a more effective way for me in terms of incubating ideas and unleashing my creativity.

Carpenter had some suggestions for the faculty regarding the curriculum in the industrial design program,

> I know many teachers are or were professional designers, and they must have so many thoughts regarding design. I'd suggest that teachers introduce

> their professional work to us so that we'll have better concepts of what a professional designer's work looks like, and what we'll need in the future. I'm so worried about that I can't be a good designer right after I graduate from the university.

Regarding effective instructional approaches, Carpenter did not have too many suggestions to offer. He said,

> I know many students didn't like some mean instructors, but I think the instructors just tried stimulating students' creativity using a "special" method. Because I made the best model, all of the instructors treated me so well, and they never pushed me hard, I didn't have the strong feeling on this,"

Carpenter had some strong opinions regarding the attitudes of some of the faculty. He described how he felt about the way instructors appeared to be threatened when they could not answer questions posed by the students. He said:

> I think teachers must be more humble. They must admit that they are not omnipotent in all design areas. Some of them are good at furniture design, and some of them are good at designing transportation whereas the others are outstanding in design of the 3C products (computers, communications, consumer electronic). If they don't know how to give advice to students who are working in an unfamiliar area, they shouldn't be too critical. Moreover, I think they should just say that, "I'm sorry, I don't know much about this. I can introduce you to . . ." Just let the right people give the right suggestion. I found some teachers gave wrong suggestion on making wooden pattern, and I tried to correct them in a polite way; however, they seemed not to want to loose face, and twisted their words to tell me that their thoughts were applicable too. Whatever . . . You know, I felt powerless.

Summary

Although they were all considered the most creative students in the third-year class, the participants' personalities and creative characteristics were not identical. It is noteworthy that some creative characteristics found among the participants were completely different. As the findings reported above, I would like to present a table to summarize the findings The following table (Fig. 5-1) helps to present their similar and individual creative characteristics, learning styles, and their strengths.

Although all of my participants highly valued creativity and creative people, their personal definitions of creativity and perceptions of successful creative people were not completely the same. The following Figure 5.2 summarizes the findings regarding the participants' perceptions of creativity and successful creative individuals.

Figure 5.1. Findings 1. Summaries of creative characteristics of the research.

Participant	Joy Fang	Kalki Young	Aurora Wu	Carpenter Liu
Program Emphasis	Design Administration and Management (DAM)	Product Development and Design (PDD)	Applied Economics on Industrial Design (AEID)	Exhibition and Housware Design (EHD)
Similar Creative Characteristics	Leadership, Willing to change, Inventive, Good at designing things, Hardworking attitude, Broad interests, Motivated, Open mind			
Individual Creative Characteristics	■ Imaginative ■ Logical ■ Outgoing ■ Practical ■ Questioning ■ Sense of Humor	■ Abstract thinking ■ Artistic ■ Disagree with teacher ■ Divergent thinking ■ Expressive ■ Imaginative ■ Intuitive ■ Questioning ■ Sense of humor	■ Abstract thinking ■ Divergent thinking ■ Endurance ■ Intelligent ■ Intuitive ■ Logical ■ Reasoning	■ Artistic ■ Intuitive ■ Quiet ■ Logical ■ Practical ■ Reasoning
Learning Styles	■ Visual learner ■ Prefers concrete and practical knowledge ■ Leaping thinking style	■ Prefers chaos ■ Enjoys finding order in his own way ■ Appreciates ambiguity ■ Highly intuitive	■ Visual learner ■ Able to visualize theories ■ Prefers diagrams ■ Sensitive to symbols ■ Highly respects expertise	■ Appreciates practical ■ Highly respects expertise ■ Prefers to follow teachers' instructions to learn
Strengths	■ Spatial ■ Logical and analytic	■ Spatial ■ Intuitive ■ Communicative	■ Verbal skills ■ Logical and analytical	■ Spatial ■ Logical and analytic

Figure 5.2. Findings 2. Summary of participants' perceptions of creativity and successful creative individuals.

Participants	Definition of Creativity	Perception of Successful Creative Person
Joy Fang	■ Cannot be valued ■ Creativity is all equally valuable ■ Effects of creativity are different in terms of degree ■ Ethical acceptability ■ Everyone is creative ■ Novelty ■ Originality	■ Self-aware of creative ability ■ Accepted by society ■ Friendly ■ Humble ■ Open-minded
Kalki Young	■ Acceptability to end-user ■ Imagination ■ Novelty ■ Originality ■ Result of having an open mind	■ Pure-minded thinking style ■ Personal designing style ■ Open-minded attitude ■ Superior communication skills ■ Good interpersonal relationships
Aurora Wu	■ Flexibility ■ Free-Association ■ Intuition ■ Originality ■ Result of having an open mind	■ High EQ ■ Listening to others ■ Superior communication skills ■ Good interpersonal relationships
Carpenter Liu	■ Acceptability to the most people ■ Flexibility ■ Novelty ■ Originality ■ Reflection of one's thoughts	■ Acceptability to most users ■ Superior communication skills ■ Good interpersonal relationships ■ Personal designing style

Although the four students' personality characteristics and learning styles were different, when asked how the environment, curriculum, and instructional approaches could better enhance their creativity, their responses were similar. The summaries of their opinions are presented in Figure 5.3. They believed that a traditional classroom with the furniture arranged in a "U" shape could better facilitate students to concentrate on the lecture, and a seminar formatted class could provide an opportunity for students expressing their thoughts when working on creative thinking. Joy thought a group discussion helped her stimulate ideas while Carpenter would rather incubate his ideas independently. As Kalki walked in woods to 'grab' the inspiration from Mother Nature, Aurora preferred to have a semi-open working booth to develop her thoughts and consult with other peers.

Undoubtedly, in contrast to the theoretical academic fields, industrial design departments need to offer more applicable, practical and realistic subjects to students. All four of the participants believed that practical courses would better develop their professional abilities and prepare them for their future career following graduation from the university. In addition, the four participants had fairly similar answers when asked how they thought instructors could help enhance their creativity and learning interests. They all wished that teachers would listen to students' explanations of how they designed their products, and how they thought their products were creative and helpful in solving problems. They wanted the instructors to function as facilitators to help students learn better, and not to frustrate students' motivation. In addition, they believed that in order to give appropriate advice to students, teachers should recognize students' strengths and weaknesses.

The participants all described situations in which some instructors were too strict and frustrated students' interests in design. None of them agreed with the instructors' teaching style. Instead of criticizing students' creativity on the products, Kalki suggested that teachers should try to understand students' thoughts before they offered any reactions to them. Kalki believed that the best way for teachers to accept the differences in each individual's abilities and appreciate the variety of creativity in their classroom. Furthermore, the students felt that instructors should attempt to recognize students' strengths and weaknesses. This understanding would help them to develop better curriculum to enhance students' creativity in a psychologically safe, healthy, and comfortable learning environment.

Joy suggested that teachers should tell students what "good design" should be, and not only criticize students for bad design. Kalki thought that teachers should be more open-minded, try to understand what students thought, and appreciate how they felt. Aurora's opinion of teachers reflected her personal philosophy—listening to students; she asserted that teachers should provide enough opportunity and allow more time for students to present their ideas before the instructors could critique students' products.

Figure 5.3. Findings 3. Summary of participants' perceptions of learning environments to enhance students' creativity.

Participants	Psychological and Physical Environment	Curriculum Contents and Instructional Approach
Joy Fang	■ Open climate for discussion ■ Flexible furniture ■ Discussions in a big group ■ Furniture can't be too comfortable ■ Traditional classroom can better get attention	■ Teacher can't be too critical ■ Curriculum should be applicable and practical ■ Instructors' knowledge must be most up-to-date ■ Guest speakers can help bring new info from the real world
Kalki Young	■ Open climate for discussion ■ Some small group discussion ■ Isolated room for independent study and incubating ideas ■ Physical environment does not matter	■ Teachers can't be too critical ■ Encourage students to be creative ■ Emphasize the practical design skills and their usages ■ Listen to students' thoughts about their design ■ Teachers can't be too assertive ■ Teachers can admit what they don't know ■ Curriculum should be integrated
Aurora Wu	■ Open climate for discussion ■ Some small group discussion ■ Semi-open working space	■ Recognize students' strengths and needs ■ Some instruction can help initiate learning ■ Listen to students' thoughts about their design ■ Encourage students to be creative ■ Curriculum must be practical ■ Curriculum should be integrated
Carpenter Liu	■ Open climate for discussion ■ Isolated room for independent study and incubating ideas ■ Visiting design companies	■ Curriculum must contain both practical and theoretical ■ Guest speakers can help bring new info from the real world ■ Pay attention to students' progress ■ Teacher should update knowledge more often

CHAPTER 6

DISCUSSION AND IMPLICATIONS

This study is the first qualitative research to reveal the perceptions of creative students regarding their creativity and the learning climate in an industrial design degree program. It is safe to say that, as an educator in this professional realm, only when we understand what students think and perceive, we can better deliver appropriate knowledge to them and enhance their creativity. The findings in the previous chapter have displayed participants' 1) perceptions of their creative characteristics, 2) views of creativity and the successful creative person, and 3) perceptions of learning environments, including the physical classroom, learning climate, curriculum and instructional approach. Participants demonstrated their creative characteristics in different ways and gave strong and valuable suggestions of how instructors could facilitate students' learning in the department of industrial design. This study establishes the foundation of my research agenda on applying creative education to the design area, and the results of this study provide me solid ideas of how I could enhance the creativity of my students and stimulate their learning motivation in the future. Additionally, I can also avoid creating ineffective learning environments and prevent discouraging teaching approaches as well.

A closer examination of the participants' creative characteristics was illustrated. According to the participants, implications for learning environments and instructional approaches are also discussed in this chapter.

Creative Characteristics

Creative characteristics have been defined and described by a great number of educators, psychologists and related researchers in the past century. Although research on creative characteristics is not new, only a few attempts have so far been made to study creative characteristics in the industrial design realm. The 4 participants of this study are currently studying in the Department of Industrial Design in Taiwan, and the emerged findings reflect the creative design students' thoughts about creativity and perspectives on design education. The implications for applying the findings of this study to professional design training programs are discussed in this section.

Various Types of Creative Students in Industrial Design Programs

These four creative students demonstrated different types of creativity and creative characteristics: they perceived creativity differently and processed creative thinking skills differently. While Kalki walked in the woods to stimulate his intuition by listening to Mother Nature, Joy appreciated an opportunity to stand on a crowded business street to trigger a new idea through the variety of novelty existing in this situation. Meanwhile, Aurora and Carpenter would rather knock on professors' doors, consult them for their experiences, and then search for solutions based on their teachers' suggestions. Despite the fact that their creativity was manifested differently and how they incubated their designs were not the same or even similar, they were all considered the most creative students by the instructors and classmates. Additionally, they were all creative achievers to their peers and instructors. This finding suggests that, not only one, but various types of creative students can be successful in industrial design.

The different types of creative characteristics discovered in this study have also been recognized by other researchers throughout the past few decades. First of all, the findings on Joy are consistent with Runco's works (1986, 1993), and Miller and Sawyers' (1989) discoveries on creative characteristics. They all discovered that creative individuals were outgoing, willing to try the difficult, cheerful, friendly, imaginative and energetic. Joy's cheerful, easy-going, friendly personality traits also contributed to the development of her open attitude; moreover, Joy's curiosity, sense of humor, and attraction to complexity and novelty enhanced her abilities of free association and idea incubation. These findings are similar to those noted by Barron (1968), Torrance (1962) and Welsh (1975).

Joy's open-minded attitude emerged in various aspects. She thought that everyone could be her teacher since they must have some special expertise in some particular fields if not in design. She believed students could always gain new knowledge from teachers although the teachers might not have appropriate instructional approaches. While working with groups, Joy always provided the most ideas to the team, and she could accept other teammates' thoughts. Joy thought everyone's opinions were valuable, and if she could not apply an idea immediately, she could incubate on it and get other new applicable ideas. To see, to listen, to communicate, to incubate, and to create became her way to free her mind, release her creativity, and, most importantly, to be creative. Joy's open attitudes toward people and to new ideas contributed to her creativity, and this finding supports Helson's (1998) work, that

> Openness is manifested in a rich fantasy life, aesthetic sensitivity, awareness of inner feelings, need for variety in actions, intellectual curiosity, and liberal

> value systems. Measures of openness show much higher and more consistent relations to measures of originality and creativity . . . (p. 368)

Kalki's creative characteristics are similar to those described by Torrance (1962), including acceptance of disorder, energeticness, persistence, assertiveness, unconventionality, independence, fault finding, sensitivity, and the ability to accept the making of mistakes. Additionally, Kalki would also be a perfect model of a creative person according to Miller and Sawyer's findings (1989)—interests in many things, questions, artistic, willing to change, willing to try the difficult, willingness to disagree with teachers, imaginative, expressive, inventive, and good at designing things. Kalki's creativity and hardworking attitude have made him a highly successful student in the department of industrial design.

The creativity characteristics observed in Aurora have been recognized as early as the 1960s. A positive correlation between intelligence and creativity has been suggested by numerous researchers (Barron, 1969; Darwin, 1964; Gruber, Terrelle & Werthenuer, 1963), and the quality of logic and reasoning have been stressed in many recent studies as well (Johnson-Laird, 1998). According to Darwin (1964), creative people who reach high levels of achievement, with the exception of scientists, are not in the extremely intelligent group but are in the upper half of the intelligence distribution. The creative individual has the ability to think, question, probe, hypothesize, and wonder. Aurora's high achievement in academia provided her more opportunities to receive higher education and stimulate her higher level thinking skills, which facilitated her creativity.

Aurora's type of creativity was not the same as Kalki's or Joy's creativity. Aurora is a typical "good and hardworking student" in Taiwanese society today. She

complied with teachers' and parents' advice, put lots of effort in her studies, and reached high achievement in each schooling period. Aurora received plenty of training in logical thinking skills and analytical ability, and these higher level thinking skills let her see and evaluate things from different angles; thus, Aurora always gave different suggestions in group discussions.

We could see many important Eastern creative characteristics in Aurora, such as intuition, endurance, hardworking attitude, and intelligence. These creative characteristics contributed to Aurora's open mind and flexibility, which signifies an active adaptability in any given environment (Yao, 1988). Although her creativity was not completely like the conventional definitions of creativity in the Western world, Aurora's outstanding performance in the professional realm has become a model of a successful creative person in industrial design.

Carpenter had the highest crafting ability in the class, and he could visualize his creative ideas by making very fine wooden models. Based on his superior spatiality, his design products were the most suitable and applicable to the mass production line. Bernbach (1993) stressed the importance and the relationship between creativity and discipline and explained how disciplined creativity reflected on products. He noted that the creative person has harnessed his imagination. He has disciplined it so that every thought, every idea, every word he puts down, every line he draws, every light and shadow in every photograph makes more vivid, more believable, more persuasive the product advantage. Additionally, Barbara (1979) also pointed out that creative people may be described as having certain attributes including self-discipline and independent working preference. These suggestions may help explain why Carpenter was creative.

Carpenter's creativity is a sample of disciplined creativity. On one hand, Carpenter's creativity developed by continuously practicing creating three-dimensional models; meanwhile, his creative ability developed gradually. On the other hand, Carpenter realized his lack of theoretical design knowledge, so he started to study design philosophy and developed his aesthetic concepts. Obviously, Carpenter's highly motivated creative characteristics manifested in his studying in the design field; moreover, his learning motivation has become one of the essential factors contributing to his creativity.

Clark (1979) also attempted to synthesize various theories of creativity and placed them within four dimensions: thinking, intuition, feeling, and sensing. She noted that, in general, creative individuals may be described as having the following rational attributes: self-discipline, independent, often anti-authoritarian. The findings from the interview and observations to Carpenter are consistent with Clark's theory.

Similar Creative Characteristics

Although the four participants showed significant distinguishable creative thinking styles and design skills, they also demonstrated the following creative characteristics similar in quality: 1) Leadership, 2) Willing to change and enthusiasm for invention and design 3) Hardworking attitude and high motivation, 4) Having broad interests, and 5) the ability to see things differently than others.

Leadership

According to Simonton (1988), organizational leadership roles impose a number of demands that make leaders' creative efforts a particularly complex phenomenon. To begin, leaders must solve problems in real group settings where time is

short and demands are many. As a result, leaders must generate solutions to multiple, rapidly emerging problems using shortcuts and general heuristics. Mumford and Connelly (1998) had also highlighted how creativity was related to leadership, and how creativity facilitated creative individuals' ability to manage people. As illustrated in the preceding chapter, the participants in this study demonstrated strong leadership qualities. They especially expressed their leadership while they were formulating a workable implementation plan and communicating this plan to other classmates.

Through analyzing the interview and observation data, we can find that the four creative interviewees' leadership abilities contributed to several creative characteristics. Joy's easy-going personality and leadership style were evidenced when she described how she facilitated collaboration amongst her peers. Kalki's leadership emerged every time (when) the class discussed how a problem could be solved by designing a product or establishing a working system; Kalki always had many ideas, and each idea was considered valuable and highly practical. Aurora and Carpenter's leadership could be found when a group discussed several ideas or made decisions. They did not have too many words to say in the beginning, but Aurora and Carpenter would always summarize and analyze everyone's opinion and give an applicable and optimal suggestion in the end of the discussion. All this evidence makes it clear that Joy's friendly and thoughtful attitude supported her leadership, Kalki's outstanding verbal ability and communication skills let him easily convince the class to accept his suggestions, and Aurora and Carpenter's sharp mind and logical thinking skills allowed them to lead groups with successful meetings.

Recent studies indicate that leadership is not a crucial determinant of group performance if the task is structured, goals are clear, members of the group are cohesive, and group members have the requisite expertise (Mumford, & Connely, 1998). However, research also suggests that leadership counts when groups confront turmoil, ambiguity, and change (Paulus, 1998). In conclusion, the four participants' creative qualities and leadership enable them to motivate each group member to contribute effectively to the group, and direct the group discussion through chaos to order. In design education, group discussions often involve ambiguity and change when discussing a new idea for product designs. Therefore, the quality of leadership would be especially important in this field.

Willing to Change and Enthusiastic to Innovation and Design

Like many inventors and designers, each of the participants had a strong desire to change the world. They felt that there was so much inconvenience surrounding the living environment. People complain about the inappropriate height of an office desk causing their wrist injuries or shoulder aches while operating computers. Workers often have occupational injuries because of an unsafe environment or dangerous working actions. To my four participants, there were too many things that needed to be designed in order to provide a better physical and psychological environment for human beings. Despite their different thinking styles and problem solving skills, they were all addicted to invention. They were not afraid of changes; contrarily, they lead the conceptual revolutions and made progress.

This finding reflects many scholars' work in relevant research. Scholars have suggested that creative achievers are highly dedicated to their work (Gardner 1988, 1999; Langley & Jones, 1988; Perkins, 1988), and creative people's extraordinary high level of

energy appears as enthusiasm, driving absorption, passionate interest, and an unwillingness to give up. The creative participants were highly energetic, enthusiastic, intensely absorbed in their pursuits, endowed with vivid imagination, and strongly sensual. Moreover, these creative characteristics have also been recognized by Dabrowski (1967).

Hardworking Attitude and High Motivation

The participants' enthusiastic personality traits connected to the other two creative characteristics, which were hardworking attitude and being highly motivated. Certainly, they all worked very hard not only on their schoolwork, but also in their student activity clubs. These four participants were all highly enthusiastic in their hobbies. In addition to schoolwork, Aurora's dedication to her clubs, Carpenter's patient practicing of design skills, Kalki's accumulating practical design ability, and Joy's maintaining quality interpersonal relationships were all impressive to the faculty and students in the industrial design department. It was also remarkable that even though they were busy, they still could appropriately manage their time and have fulfilling lives.

Many creativity theorists stated that a creative individual also possesses the following traits accompanied by creative behaviors: passion (Bruner, 1962), devotion (Henle, 1962) and persistence (Newell, Shaw, & Simon, 1962). Experts also agreed that creativity means fulfilling more positive, higher-order needs (Gedo, 1983), and having a healthy desire to master one's environment (Cagelosi & Schaefer, 1992). Additionally, both intrinsic and extrinsic motivation have become indispensable factors of a creative achiever. The findings of this study are consistent with these findings and also suggest that creative students would be highly motivated if instructors could develop appropriate

curriculum content that stimulated their curiosity; moreover, their creativity would be unleashed and enhanced.

The four participants would unleash their energy in their design work and innovation; moreover, creative individuals' highly energetic working attitude provides them more chances to practice their skills and enhance their abilities. Research suggests that creative people tend to be self-disciplined in matters concerning work, with a high degree of drive and motivation and a concern with achieving excellence (Campbell & Willis, 1978; Csikszentmihalyi, 1988, 1996; Glover, 1980).

Having Broad Interests

Joy, Kalki, Aurora and Carpenter were all very curious about many things. Although strong curiosity was one of the essential characteristics successful students in the industrial design department, not all students had such broad interests like they did. Most design students only focused on a few things that were related to their designing interests; however, my four participants were attracted to different types of products in a variety of subject areas.

Joy and Aurora were interested in all kinds of electric and communication products in the design area. Besides, Joy loved jogging, hiking, swimming, camping, and doing aerobics while Aurora was addicted to academia such as discovering how to teach students talented in art and design areas and facilitating students' study in school. Kalki would rather go outdoors to search for his inspiration in the woods instead of looking for existing products because he thought that the existing design did not give new ideas, and sometimes blocked the designer's imagination. Kalki also loved painting, planting, and observing wildlife since he thought these hobbies were beneficial to developing his

intuition and purifying his mind for doing better design. Carpenter's furniture design was outstanding in the design department, and he was also good at kitchenware and handy tools design. Because his design interests were more directly related to human beings, he believed that more knowledge from psychology, sociology and communication skills would be helpful; thus, he devoted lots of effort to learning these theoretical concepts.

When they were asked why they had so many interests, they provided me the following common perspectives: 1) Different things could help trigger broad ideas, 2) You would never know what you would need for next design project, thus you had better develop broader interests in order to help yourself adapt to a new situation, 3) Having various interests and a sense of different products could help associate with one another while you incubated a new idea for a new design, 4) Different ideas and concepts could facilitate our imagination and enhance our creativity, and 5)Variety was just more fun than a single knowledge area.

These findings are associated with experts' assertion that creative people show their high curiosity in a variety of things (Stokes, 1999; Torrance, 1962; Wallace, 1986), and creative individuals preferred smudgy, complex, asymmetrical drawings over simple and balanced ones (Barron, 1968; Welsh, 1975). These four creative participants' broad interests allow them to discover this world and satisfy their attractions to novelty and curiosity. They not only tended to be interested in new products and new ideas, but they also have the ability to discover new meanings or usages among existing things. In addition, these qualities facilitate their development of design skills, enhance their creativity, and successfully reach higher achievement.

Learning Styles

According to Gregorc (1985), learning styles, from a phenomenological viewpoint, consist of distinctive and observable behaviors that provide clues about the mediation abilities of individuals. People, through their characteristic set of behaviors, reveal to us how their minds relate to the world and how they learn. Additionally, these characteristics reflect specific mind qualities that persist even though goals and content many change. Gregorc stated that mind-qualities emerge as dualities, including abstract and concrete perception, sequential and random ordering, deductive and inductive processing, and separative and associative relationships. Although everyone has all of these qualities, most people also have innate tendencies that "tip" toward one aspect of a duality rather than the other. By taking Gregorc's definitions of learning styles, and based on my observation and interviews, I found my participants' individual mind-qualities and learning styles. In this section, I address more on these findings.

Joy: Concrete-Random Learner (CR)

The concrete random learning preference is characterized by an experimental attitude and accompanying behavior. Just like Gregorc's definition, Joy got the gist of ideas quickly and demonstrated the ability to make intuitive leaps in exploring unstructured problem-solving experiences. Joy was also familiar with utilizing the trial-and-error approach to acquiring information. On the other hand, she did not like cut-and-dry procedures that denied her opportunities to find answers in her own way. Additionally, she also performed outstandingly in small groups.

Kalki: Abstract-Random Learner (AR)

Kalki's learning style almost perfectly fit Gregorc's definition of an abstract-random learner (AR). Kalki's noticeable attention to human behavior and the capacity to sense and interpret "vibrations" constituted his AR characteristics. Kalki preferred to receive information in an unstructured manner, and therefore, he liked group discussions, activities which involved multi-sensory experiences, and a busy environment.

Aurora: Abstract-Sequential Learner (AS)

According to Gregorc (1985), abstract-sequential (AS) learning preference is characterized by excellent decoding abilities with written, verbal, and image symbols. AS learners have a wealth of conceptual "pictures" in their minds against which they match what they read, hear, or see in graphic and pictorial form. They possess and like to use reading, listening, and visual translation skills. A symbol or picture is worth a thousand words to them. Aurora's performance and learning preference matched this definition. Additionally, Aurora preferred a presentation that had substance, was rational, and was sequential in nature; moreover, she also stressed that she learned better from authorities and through vicarious experiences.

Carpenter: Concrete-Sequential Learner (CS)

Gregorc described a concrete-sequential learner as a person characterized by the propensity to derive information through direct, hands-on experiences. CS learners exhibit extraordinary development through their five senses. They appreciate order and logical sequence of the if-then, premise-conclusion variety. CS learners prefer step-by-step directions when confronted with a learning situation. They not only look for

directions but they follow them. They like clearly ordered presentations and a quiet atmosphere. When observing Carpenter's performance in the class, I saw many obvious traits such as habitual, responsible and practical. His life seemed to have certain order, and never lost anything; his highly responsible personality earned instructors' and classmates' beliefs. In addition, Carpenter's individual working booth was one of the neatest desk in the design studio.

Eastern and Western Creative Characteristics in Design Departments

Throughout this study, we can see a variety of creative characteristics appearing to the four participants, and each participant demonstrates creativity in different ways. Joy and Kalki are more outgoing, talkative, active, and more like doers. In the cases of Joy and Kalki, we may notice that their creativity reflects the creative qualities emphasized in Western research, such as imaginative, artistic, sense of humor, questioning, and inventive. On the other hand, Aurora and Carpenter tended to unleash their logical thinking skills, analytical ability, and intuition to facilitate their creative work. Moreover, we can find that their creativity consists of Eastern personality qualities including intuition, metaphorical thinking style, endurance, logic, reasoning, intelligence, and hardworking attitude (Chen, & Yeh, 1994; Dunn, Zhang, & Ripple, 1988; Murphy, 1971; Oliver, 1993). All of them may express creativity differently, but they are all considered highly creative in the department of industrial design.

Traditionally, students, such as Kalki, and Carpenter, who have practical abilities to make models and express creative ideas may get more attention from the industrial design educators. Kalki's emphasis in Product Development and Design (PDD), and Carpenter's focus on Exhibition and Houseware Design (EHD) appropriately

evidence this viewpoint. However, the job contents of professional industrial design field have been changing along with the development of society (Chen, 1998). Today, industrial design is divided into several categories, and each sub-field needs people with different creative characteristics. Hence, Joy's learning in Design Administration and Management (DAM), and Aurora's researching in Applied Ergonomics on Industrial Design (AEID) are not surprising. In other words, any creative students interested in design, nowadays, can easily find a place that best fits their way of expressing their creativity in the department of industrial design.

It should be concluded, from what has been discussed above, that in the department of industrial design at NSUST in Taiwan, 1) Creative students share the following common creative characteristics: leadership, willingness to change, innovation, ability to design things, hardworking attitude, broad interests, motivation, open attitude, and questioning spirit; 2) Both Western and Eastern type of creative characteristics are recognized by instructors and students in the classroom; and 3) Creative students in different learning styles may dedicate their efforts to different aspects of design.

Perceptions of Creativity and Successful Creative People

The four participants of this study tended to view creativity as a process, ability, and type of energy. Kalki and Carpenter, the two who are masters at design and modeling skills, emphasized that in the industrial design realm, product is the most effective way to express a designer's creativity; moreover, the product must also be acceptable to the most people and applicable to the real world. On the other hand, although Joy and Aurora also agree with the importance of the creative product, they more asserted that everyone has creativity, and the creative product is only one of the

thousands of ways to demonstrate one's creativity. Joy and Aurora believed that despite the fact that some people are more creative than others, each individual's creativity can be enhanced by accepting appropriate training of divergent thinking skills and the creative process.

Since this study was conducted in an industrial design department, which is a physical product-driven professional field, the four participants all stated how design product could help designers express their thoughts and creativity. Meanwhile, they all admitted that due to the different levels of practical skill, not everyone can make models or have the ability to redesign an inappropriate product even though they have highly creative ideas. Hence, this finding may imply that, to the four creative individuals, in a non-product driven profession, creative activities may yield smart strategies or effective working schedules other than visible products.

Originality is one of the common factors appearing in the creative definitions of these four participants. They all highly value the original ideas of design products or design marketing strategies. In addition to a newly created product, they could also appreciate a new usage of the existing products. In the industrial design profession, products are divided into two categories, new creation and re-design. A new creation often means to create a product never existing or to apply a new technique or material; moreover, a re-design product often means to modify a minor function or change the shape of an existing product. These four participants believe that originality can be found in either category of design products, and creativity can always bring surprises and new concepts to most people.

It is noticeable that although Joy did not stress the acceptability to the most people while addressing her perception of creativity, she strongly emphasized that the result of creativity must not go against the law and the customs of a society. Both Joy's ethical concern and the other three participants' stress of acceptability of creativity support Chan (1996), Lam (1996) and Wu's (1996) research finding that people within Chinese culture believe creativity ought to involve some ethical standard. They all discover that, in a Chinese society including China, Hong Kong, Singapore, and Taiwan, creative individuals must dedicate to this world, and improve the lives of human beings. Lying on this definition, class clowns or talk show performers are often considered interesting, funny, but not necessarily creative.

The four participants are trained to be designers, and the job content of industrial design includes expressing creativity and promoting design products; therefore, these creative students have similar perceptions of being a successful creative person. In addition to the creative characteristics of their creativity definitions, they assert that creative people need the following qualities: self-awareness of creative ability, well-maintained interpersonal relationships, communication skills, and leadership.

Additionally, developing a personal design style is also an essential factor for Kalki and Carpenter as successful designers. This finding is a reflection of their outstanding design and modeling ability. Meanwhile, Joy's additional perception of successful creative people as being friendly and humble, and Aurora's emphasis at high E.Q. (Emotional Quotient) and listening to others are also reflective of their creative characteristics and personality traits.

To sum up the four participants' perceptions of creativity, we find that they believe: 1) Product is not essential to people who are not in a product-driven profession, 2) Creativity cannot be defined without moral concern, 3) The results of creativity must contain originality and novelty. 4) Creativity is an ability that can be nurtured and enhanced by receiving appropriate training. In addition, it should be concluded, from the discussions and findings above, that communication skills and interpersonal relationships are essential factors for being successful creative individuals. In order to enhance their creativity and facilitate creative students' ability to reach higher achievement, these findings ought to be applied in forming an effective learning environment and instructional approach, which is described in the next section.

Effective Learning Environments to Enhance Creativity in Industrial Design Departments

Although the four participates' personality characteristics and learning styles were different, they had similar responses when asked how they thought the environment, curriculum, and instructional approaches could better enhance their creativity. In this section, the findings are organized and discussed in two aspects to illustrate how the learning environment could facilitate students' learning and unleash their creativity. These aspects are: 1) Class climate and its physical environment, and 2) Curriculum content and instructional approaches.

Class Climate and Its Physical Environment

Due to the different learning styles, the class climates and physical environments that four participants required were not the same. While Joy thinks being in a big discussion group can better trigger her creative thinking, Kalki prefers to take a walk in the woods to incubate his new ideas alone. Meanwhile, Aurora would stay in her

semi-open working booth to analyze her data collection from the Internet and references, and Carpenter might join a small discussion group to listen to others' opinions. Although their requirement for learning environments were not the same, these four creative individuals shared similar opinions related to environmental concerns to enhance their creativity.

The findings of this study call attention to some important issues that departments of industrial design may want to consider in creating more effective learning environments. Due to different requirements, students may have discussion groups or isolated spaces accordingly. Some students need group discussion to stimulate their creativity or to gain feedback on their creative ideas from the others; whereas, the other students prefer to process their creative thinking alone. Instructors should recognize students' different needs in the physical environment, and provide them a suitable learning space to express their creativity. A traditional classroom with furniture arranged in "U" may help distribute lectures since students and the instructor can hold face to face discussions, and the instructor can also have a stage to get students' attention.

Flexible classroom furniture can better help students easily form a small group discussion when they need to. Obviously, group discussion can facilitate creative thinking strategies, such as brainstorming and lateral thinking approaches. In order to trigger students' divergent thinking ability, some group discussions should be allowed after a lecture in a class. Movable chairs with wheel casters would provide a great deal of flexibility and convenience for the students. Students can slide in and join a group discussion when they need more ideas, and they can also move away from the group when they need a private space to incubate their own design.

Open learning and discussion climate is also important to enhance students' creativity. All of these four participants strongly disagreed with some instructors' over-criticizing manner to students, and they all believed it was the main obstacle to enhancing creativity. This finding was consistent with the work of Chen and Yeh (1998). Although the instructors in this study may have wanted to prepare their students for the tough criticism that they would experience in future professional settings, the NSUST students did not appreciate their style of critiquing. Perhaps industrial design instructors need to maintain their high standards by delivering constructive criticism that highlights specifically where the students need to make improvement in their work as well as explaining the criteria they use to evaluate design products.

Additionally, an isolated room can provide privacy to those who need to be alone when incubating creative design ideas or who need a quiet place to work on in-depth thinking processes. Thus, the department may consider having study rooms or booths separated from the traditional classroom.

There are other components or variables that contribute to the environmental climate of an educational encounter. Physical environment, a major component, is concerned with ergonomics – the interaction of people with their physical and spatial environments. Some of the elements for consideration would be the arrangement of classroom seating as well as building characteristics such as lighting, ventilation, colorful decoration and appropriate temperature settings. The physical climate is important in the creation of a supportive learning environment; however, in most cases, it is not something you have to great deal of control over. Kalki made the clear point that he could learn in any circumstances, but he did care about the psychological climate. Therefore, it becomes

more important to provide college students, as adult learners, with a healthy psychosocial climate, which is something that is controllable.

The psychosocial climate is concerned with the psychological aspects as well as the cultural dimensions of the educational encounter. This includes the relationship among the learners, rapport and communication, opportunity for participation, values and belief systems which hold meaning for learners, expectations, and clarity of goals (Knowles, & Associates, 1984). If an effective transactional process is to occur, a climate that suggests mutual respect, collaboration, mutual trust, supportiveness, openness to challenge and criticism, risk taking, pleasure, and friendliness must be present. This essential climate will offer learners a secure environment to express their creativity.

According to Csikszentmihalyi (1988), one's creativity will emerge while one is in the "flow," where one's skills meet the challenge. By asking them to confront, scrutinize, and question the way they think and act, instructors can lead learners to solve tougher problems, develop higher abilities and enrich their creative experiences. Challenge and confrontation should be viewed as a natural progression within a transactional process and should lead to the development of creative thinking strategies.

Providing challenging interactions should have as its primary purpose the promotion of development of learners who can think critically and reflectively. Challenge is the most essential component necessary before an individual can develop alternative ways of thinking and acting (Egan, 1986). It begins with taking a stance of caring, attending, and listening to the learner while all along understanding how much the learners can emotionally take before such challenges become personally disturbing and threatening.

Group discussion was also suggested by all participants. They could recognize the benefit of group discussion although the size of the group that they required may vary. The finding that group discussion is beneficial to idea generation is similar to Paulus' theory (1988). Paulus pointed out that creativity requires that individuals take new or unusual approaches to problem, which is sometimes called a divergent style. This may require a somewhat random association of different domains, sets of knowledge, or ideas. Group interaction should be ideal for such a process. One can bring together people with diverse knowledge and skills and allow them to combine these in unique ways. Certainly such a group has a greater potential for developing unique conceptual combinations than individuals working in isolation.

Curriculum Content and Instructional Approaches

Like the old saying, "No one shoe can fit all," due to the various learning styles of the college students, it is not easy to create one teaching approach for all individuals. Each student has his or her own strengths, needs and learning preferences: Aurora and Carpenter prefer receiving some directions from the teacher, while Joy requires only a little hint of a new concept to facilitate her surfing on the Internet, and Kalki needs more ambiguity to let him better unleash his creativity. Therefore, instructors of these adult learners should try to understand the learning styles of each individual student, and then design appropriate instructional methods and environments to enhance students' learning and creativity.

Regarding the effective curriculum content, the creative design students want to learn both practical skills and theoretical knowledge. They believe that mastering design skills can better prepare them for their future careers in design professions, and

learning theoretical knowledge may help them develop a personal design philosophy and design style. Guest speakers may "bring fresh air" and the most up-to-date knowledge to the classroom, and students will benefit from their experiences as well. Thus, instructors may want to invite a variety of guests from different levels of the design profession, such as design managers, in-line designers, and marketing planners, to give speeches to students. Through the variety of contents of speeches, students may recognize their strengths in the industrial design area and have more opportunities to consult those experts to plan for their futures.

Integration and consistency are also essential factors when developing curriculum for these creative students in the department of industrial design. They highly suggest that instructors hold a faculty meeting to discuss the curriculum contents before delivering it to the students. These well-integrated courses would give students more opportunities to apply a new concept learned from a course to another and provide students with a better interdisciplinary learning climate to enhance creativity (Dowds, 1998).

Like all other college students, the creative students in this department also have their own backgrounds, learning styles, and work experiences. The facilitator cannot use only one method of instruction to teach all students. It is the multifaceted physiological, psychological, sociological, and developmental aspects of the adult learner that contribute to and make challenging and enriching the educational encounter. The various dimensions or characteristics of the adult learner are interrelated; thus one dimension of the individual is affected by every other dimension. Krupp (1982) suggests that to understand this multifaceted characterization is to understand the adult learner

from a holistic perspective. This seems most appropriate, especially when working with adults who have diverse reasons for participating, are at various stages in their adult development, and who possess a multitude of learning styles. Moreover, instructors have an opportunity to assist learners in developing learning strategies and unleashing their creative potential accordingly.

The findings of this study provide educators with important guidelines to develop or revise curriculum in design programs. Several issues should be taken into consideration when program planners develop curriculum for industrial design students.

Industrial design educators may want to consider introducing a variety of professional fields in their industrial design classrooms. For example, instructors in industrial design programs may want to introduce concepts from the following fields: computer technology, automotive technology, medical instruments, ergonomics, aircraft design, furniture, and consumer appliances. By doing so, students will have a better understanding of the entire realm of industrial design and be better prepared for their professional careers.

The findings of this study also indicate that providing learning style evaluation to students may help them understand their own learning styles in order better appreciate which type of instructional approaches are best suited to address their needs. Instructors in design programs would also benefit from conducting learning style evaluations of their students in order to provide a wider variety of instructional approaches.

The experiences of the four participants also indicate that other design students may benefit from group discussion, opportunities for independent study, training

in communication skills, logical thinking approaches, leadership education and training in aesthetics. University industrial design faculty may want to consider incorporating these instructional approaches in their degree programs to better address the educational needs of their students. In order to do so, they might want to consider a differentiated curriculum which would lead students to develop their expertise. Such an approach would be more individualized and would encourage students to explore different design options as well as encourage them to develop their own personal philosophy of industrial design.

Recommendations for Future Researchers

My experience in industrial design education and discipline in educational psychology were probably my most potent researcher qualities in that these characteristics of this profession enabled me to perceive their creativity and recognize their creative characteristics. However, these same characteristics were also weaknesses. While I was excited in finding those creative individuals, I might overlook the other people who were also creative, but did not perform well. Although I was trying to be open to examine their creative characteristics and creative activity, I probably had some bias against the creative type that I was not familiar with. Because some questions that a more sophisticated researcher might have asked still remain unanswered, this study does help lay the groundwork for future research.

This volume contains numerous observations of patterns and themes that surfaced and offers tentative explanations. Future research can corroborate their validity such as the question, “Are the findings from these respondents true for creative people in other design fields?” or “Are my explanations accurate or arbitrary?” Additionally, some

relevant concerns such as family issues have not been examined extensively in this research, and these areas may stimulate the curiosity of future researchers. The following hypotheses and research questions are examples of possible topics reflecting the findings in this study, which could be confirmed or investigated by future research.

1. How could we recognize ones' design potential in childhood?
2. What is the parents' role to enhance children's creativity?
3. How could parenting styles influence creative children's achievement?
4. Creative people are question askers. Is it more important to find questions than answers?
5. How can we design educational systems that encourage self-development, self-discovery, and the intrinsic wisdom of the inner voice to enhance creative development?
6. How do non-traditional instructional approaches such as guest speeches, and field trips enhance creative development?
7. How does group discussion influence creative development in industrial design students?
8. How does one's logical thinking skill influence one's creative achievement in industrial design program?
9. How do creative people demonstrate persistence, discipline, determination, endurance, and intelligence?
10. At some point early in their lives creative people turn inward because of some perceived adversity, and later as adults, they translate that internal

experience into creativity projecting it outwardly in the form of a creative project. How does this occur?

11. Due to the differences of discipline, people who are creative in other fields may not necessarily perform as creative in the professional field of industrial design. How can we explain this?
12. What does a creative underachiever look like in industrial design?
13. Why do some creative individuals not perform well in industrial design?
14. How can design educators reverse creative underachievement in this field?
15. How can educators develop effective curriculum to enhance students' creative ability and design skills in industrial design programs?

Summary

This study revealed creative characteristics of students majoring in industrial design, and their perceptions of creativity and creative achiever; furthermore, the participants' suggestions to learning environments and instructional approaches that can better enhance students' creativity were also generalized in this study. Regarding creative characteristics, while they expressed various individual personalities, the 4 participants demonstrated some similar creative characteristics: 1) leadership, 2) willingness to change and enthusiasm for invention and design, 3) hardworking attitude and high motivation, 4) having broad interests, and 5) the ability to see things differently than others. Additionally, both Western and Eastern views of creative characteristics were recognized in this study.

To these four creative design students, there is no universal definition to describe creativity; they tend to view creativity as a process, ability and type of energy. Although they are flexible in defining creativity, they feel some moral concern should be involved to define a successful creative individual. Additionally, this study also finds that personal design style, communication skill, and interpersonal relationships play an essential role to a creative individual's achievement in an industrial design department. Therefore, I would suggest that instructors in design programs work toward enhancing these abilities in their students to prepare them for future success in their design careers.

Open and encouraging classroom climates were mentioned by all of the participants in this study when discussing the design of effective environments to enhance creativity. Students' will learn better and generate more creative design ideas in comfortable classrooms with supportive climates free of strict criticism. Both psychological and physical environments should provide challenges and encouragement to students so that students will be motivated to learn and develop their creativity.

To conclude, most university professors in industrial design programs have been trained as designers, and have not been trained to teach highly creative students. In addition, instructors of industrial design have not been trained to recognize students' strengths and individual needs. If industrial design programs are to be successful, we need to better understand the creative personalities and characteristics of industrial design students. Once we better understand these perceptions, we will be able to develop industrial design programs that enhance their creative talents and likelihood of being successful. With this knowledge, educators will be able to create psychologically safe

environments with appropriate curriculum and instructional approaches to nurture creativity in industrial designers.

Afterword

A large number of studies have been conducted on creativity; however, limited research has examined creativity in the field of industrial design. In addition, what seems to be lacking is knowledge of how to enhance students' creativity by establishing appropriate instructional approaches and curriculum in industrial design programs. I hope the results of this study will stimulate ideas for future research and be beneficial to industrial design education. Should you be interested in contacting me regarding further research in this area, please find my personal contact information in Appendix F. If you have any comments, suggestions, or questions, I would be willing to share my experiences and assist you in thinking about your research.

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APPENDIX A

IRB APPROVAL

The University of Georgia
Office of The Vice President for Research
DHHS Assurance ID No. : M1047

Institutional Review Board
Human Subjects Office
606A Graduate Studies Research Center
Athens, Georgia 30602-7411
(706) 542-6514; 542-3199
Fax No. (706) 542-5638

APPROVAL FORM

Date Proposal Received: 2002-01-04 **Project Number:** H2002-10488-0

Name	Title	SS Number	Dept/Phone	Address	Email
Mr. Chin-Hsiang Lin	MI		Educational Psychology Aderhold Hall	110 Rogers Road #n112 Athens GA 30605 (706) 543-6714	clin@coe.uga.edu
Dr. Thomas P. Hebert	CO		Educational Psychology 323 Aderhold Hall +7143 542-3678		thebert@coe.uga.edu

Title of Study: A Study of the Creative Charactersitcs and Personality Traits of College Students in an Industrial Design Department

45 CFR 46 Category: Administrative 2 Modifications Required for Approval and Date Completed:

Approved : 2002-01-30 Begin date : 2002-01-30 Expiration date : 2002-04-15

NOTE: Any research conducted before the approval date or after the end data collection date shown above is not covered by IRB approval, and cannot be retroactively approved.

Number Assigned by Sponsored Programs: **Funding Agency:**

Form 310 Provided: No

Your human subjects study has been approved as indicated under IRB action above.

Please be aware that it is your responsibility to inform the IRB . . .
. . . of any adverse events or unanticipated risks to the subjects or others within 24 to 72 hours; . .
. . . of any significant changes or additions to your study and obtain approval of them before they are put into effect; . . .
. . . that you need to extend the approval period beyond the expiration date shown above; . . .
. . . that you have completed your data collection as approved, within the approval period shown above, so that your file may be closed.

For additional information regarding your responsibilities as an investigtor refer to the IRB Guidelines.
For your convenience in obtaining approval of changes, extending the approval period, or closing your file, we are providing you with a blue Researcher Request form. Detach this blue form, complete it as appropriate, sign and date it, then return it to the IRB office. Keep this original approval form for your records.

Copy:
Dr. Randy W. Kamphaus
Dr. Bonnie Cramond

Christina A. Joseph, Ph.D.
Chairperson, Institutional Review Board

APPENDIX B

CONSENT FORM

English Version

Participant Consent Form

I agree to take part in a research study titled *A Study of the Creative Characteristics and Personality Traits of College Students in an Industrial Design Department in Taiwan*, which is being conducted by Chin-Hsiang Lin, Department of Educational Psychology, at the University of Georgia, (706)543-6714 under the direction of Dr. Thomas P. Hébert, Department of Educational Psychology, (706)542-3678. I do not have to take part in this study; I can stop taking part at any time without giving any reason, and without penalty. I can ask to have information associated with me returned to me, removed from the research records, or destroyed.

The following points have been explained to me:

1. The reason for the research is: to understand the creative characteristics and personality traits of students pursuing degrees in industrial design.
2. The benefits I may expect from it are: upon completion of the study, if I agree to be interviewed, the researcher will provide me with the results of the study, so I may better understand my creative characteristics and personality traits, and my strengths and curricular needs as a student of industrial design.
3. The procedures are as follows: The researcher will contact me to participate in two, one hour interviews to gain specific information about my early school experiences, family experiences, and university experiences which may contribute to my creativity. The data collected from these interviews wll be tape recorded and transcribed verbatim. The transcripts will analyzed and interpreted. To protect my confidentiality, the taped interviews will be labeled with a pseudonym. The original data will be destroyed once the research and the dissertation are completed. In addition, the researcher will also observe me in my design studio classroom for 3 class periods (4-6 hours total). The researcher will also review documents that I will provide him, which may include school records, my portfolio of my industrial design products and any design awards I have received.
4. No discomforts or stresses are foreseen; however, if I feel uncomfortable, I understand that I may withdraw myself from the study at any time without any penalty.
5. No risks are foreseen.
6. The results of this participation will be confidential and will not be released in any individually identifiable form without my prior consent, unless otherwise required by law. To ensure confidentiality, psyeudonyms will be given, and the names of the school insitutions and communities will be changed. Any publications resulting from this research will use pseudonyms.
7. The researcher will answer any further questions about the research, now or during the course of the project, and can be reached by telephone at (03)478-3438 (Taiwan) or by email clin@coe.uga.edu.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____ _____

Signature of the Researcher Date Signature of Participant Date

Please sign both copies of this form. Keep one and return the other the investigator.

For questions or problems about your rights please call or write: Dr. Christina A. Joseph, Human Subjects Office, University of Georgia, 606A Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411, USA; Telephone +1-706-542-6514; Email address: IRB@uga.edu

Chinese Version

受訪同意書

本人同意參與「台灣工業設計系學生之創造力與人格特質之研究」。本研究由喬治亞大學教育心理學系博士候選人林金祥 (03-478-3438) 主持，同系之教授 Thomas P. Hébert 博士 (+1-706-542-3768)所指導。本人並無義務負責此項研究計劃；同時，本人亦可依個人意願中止參與研究。本人有權詢問有關本研究計畫之內容與受訪步驟，也有權要求將不適當的受訪內容刪除或消毀。

此外，本人已明確了解以下各點：

1. 這個研究的目的是在了解在台灣的工業設設計系學生之創造力，以及其創造力特質。
2. 本人將可自此研究獲得以下益處：若本人完成所有訪談的過程，研究者將會提供本人研究結果，並更了解本人的創造力與人格特質，進而知道自己在設計課程上的優點與所需。
3. 本研究的實施程序如下：研究者將要求我參與至少兩次，每次一小時的訪談，以了解與我的創造力相關的各種經驗，包括：早期的學習經驗、家庭經驗、大學課程學習經驗。這些資料將會被錄音，並繕寫成逐字稿，然後翻譯成英文。研究者將依逐字稿分析與解釋。爲了保護我的隱私權，這些錄音的受訪內容將以匿名方式收藏。一旦研究與論文撰寫完成，原始資料亦將全數消毀。此外，研究者將觀察我的產品設計課 4-6 個小時，亦將瀏覽我所提供之任何書面資料、作品集、設計得獎紀錄。
4. 本研究不會爲本人帶來任何的不愉快或壓力；若我覺得不妥，我將可以退出研究並終止參與受訪，而不會受到任何處罰。
5. 本研究不會帶來任何風險。
6. 在符合法律範圍的約束之下，本人參與研究一事將會保持私密性，也不會在未經本人同意下提供給本人之外的人做任何比對或了解。爲了維護本人的隱私，所有關乎本人的紀錄將會以匿名處理，本人所就讀的學校名稱亦將改變。所有出版的研究結果或論文亦將以匿名做爲敘述。
7. 研究者在研究進行的任何時間，都有義務回答我所有的疑惑，本人可透過電話 (03-475-3959) 或電子郵件 clin@coe.uga.edu 與他取得連繫。

本人已了解上述各項研究相關重點，對於研究者的解釋亦感到滿意。同時，本人同意參與這項研究，並接受訪問。本人將收到此同意書之拷貝一份。

_____		_____	
研究者簽名	日期	參與研究者簽名	日期

請同時在兩份同意書上簽名：自行保留一份，並交回一份給研究者。

若有任何權益問題，您可以與喬治亞大學的 Human Subjects Office 之 Dr. Christina A. Joseph，由以下方式取得連繫：606A Boyd Graduate Studies Research Center, UGA, Athens, GA. 30602-7411, USA; 電話：+1-706-542-6514; 電子郵件：IRB@uga.edu

APPENDIX C

SAMPLE OF TRANSCRIPTION

	Original Chinese Transcription	English Translation
Kalki	哈哈……其實我很喜歡大自然，所以從小就喜花草的東西。或者應該說，我很喜歡欣賞美的東西，也喜歡去創造「美」，所以對於像畫畫、藝術創作的東西我也非常……怎麼講，就是很能吸引我就是了。在國中畢業時，我對自己做了一個實驗，看看究竟是一個星期不去碰花草比較難過，還是一個星期不去拿畫筆比較難過。實驗的結果是，我不能一個星期不去畫畫，所以我就決定進美工這一科。	Ha! Ha! . . . In fact, I love Mother Nature a lot, so I love plants since I was a child. Maybe I should say, I do appreciate any beauty, and like to create “beauty” as well. So I think like drawing, artworks are also……uh….can catch my eyes easily. After I graduated from junior high school, I had an experiment, and wanted to know which one I missed most: whether not touching my brush pen or watering my flowers. The result of the experiment was that I couldn’t stop drawing, so I decided to enroll to the department of fine arts.
Kalki	我覺得創造力是細緻的、具有豐富的變化，像雲、星星、海一樣，好像很具象，又很抽象。你看得到他，但又跟你看到的東西不一樣，你也可以去描述他，但他也不是像你講的。如果你硬要說一些科學的觀點，什麼水啊、空氣啊、光線折射，那就離他更遠了。	I think creativity is a sort of very fine thought with various possibility. It’s like cloud, stars, and seas, which is physically existing substance, and also an abstract concept. You can see it, but it’s not like what you see; you can describe it, but it’s not like what you say. If you insist that, from the scientific view, they are just conducted by some single elements, such as damp, air, and reflection of the light from other planets, then you are even far away off creativity.
Kalki	產品是表現設計師創意最好的一個方式。產品像是一棵樹，創造力像是肥料。你可以加不同的肥料給樹苗，那你肥料加越多，樹會長得更好。	I think a product is the best way to represent a designer’s creativity. A product is like a tree, and creativity is like fertilizer. You can add different, but appropriate fertilizer to a small tree, and it will grow better, if you fertilize it more.

Kalki	一個有創意的產品，是做出來你想不到的，但是你看到的時候就會覺得說，這是很妙的想法，很能認同。如果說做出來的自己覺得不錯，別人看到也很驚訝，但是卻無法接受，我想那大概只能算是藝術品，不能叫設計吧！所以從藝術的角度看，可能是創意，但就設計來看就鐵定不是！	A creative product is what you can't ever image, but you'll be amazed when you see it. However, if you make something you feel good, but other people can't accept it although they also feel amazed, I think it's only a piece of artwork, but not design. So, it may be a creative product from art's angle, but it's not from a designer!
Kalki	我…覺…得……有的老師太會罵人了，對於同學的創造力都不是很注意，其實還沒有了解學生的想法之前，都先否定學生的作品，我認爲這一點是比較不好的。很多同學從高中上來，對工業設計都會有一些想法，想去認識工業設計，透過老師的指導或課程等等，但其實他們不見得像我們美工科出身的同學一樣有底子，所以開始學的時候其實很吃力。如果在這個時候就對同學否定，其實對同學的自信心打擊很大，我認爲這不是一個好的教法。雖然有些老師也認爲，可能啦，認爲這樣子可以刺激學生的學習動機，我但還是認爲應該要了解學生的想法，也要欣賞一下學生的創造力，才會讓學生對工業設計產生更多的興趣，把設計做好。	I . . . think . . . Uh . . Some teachers are too critical, and they don't pay attention to students' creativity. As a matter of fact, they criticize students' products before they can try to understand their thoughts. Many students graduating from high school may have some thoughts about industrial design, and want to know industrial through receiving instructors' advise or the curriculum. However, they did not necessary have prior knowledge like us graduating from a fine arts department. So they often have a difficult time in the beginning. If teacher denies students' creativity, it will destroy students' confidence; I think it's not a good instructional approach. Although some teacher, probably, think it can stimulate students' learning motivation, I still believe they should try to understand students' thoughts and appreciate students' creativity so that students' will do better in industrial design.
Joy	啊，我以前在學校的時候不是學設計或是美工，所以她怎麼會覺得我在一上就要交出那麼好的作品？其實，我根本覺得她教的態度不是很好啦！也不喜歡她那種批評學生的方式。	You know, I was not a design or art major in [vocational senior high] school before, so how come she expected me to provide a nearly perfect product in my first semester? Basically, I didn't agree with

		her teaching attitude and her way of talking to students.
Joy	我覺得我不能只靠她一個人來學，對吧？那堂課又只有她一個人。如果我要學比較多的技巧，我想我應該再多找幾個老師，加強一下我自己 Sketch 的能力，因爲我在高中都沒學過。	I realized that I couldn't depend on her since she was the only instructor in the Basic Design course. If I wanted to learn better and [improve] my design concepts and skills, I must ask for help from other teachers to learn design and improve my sketching skills which I had never learned in high school.
Joy	我還記得以前跑老師的辦公室跑得很勤吶！一個一個找！我拿一樣的東西，就是那個設計課要做的東西給他們，要他們給點意見或什麼的，看要怎樣改善一下我的設計能力。	I remembered that I spent so much time running to several faculty offices one by one. I would bring the same design—my project from a class—[to different instructors], and ask for their opinion and consult with them on how I could improve my design.
Joy	啊就慢慢的也會發現我的能力有點進步啦！而且也比較了解設計是什麼東西，還有那個要求很嚴很嚴的老師要什麼。不過那段時間真的是喔，超痛苦！	Gradually, I felt that my ability increased little by little. Of course, I better understood what design really was and what that strict teacher's requirements were. Man! That was really a hard time for me.
	我不覺得我們應該不高興啊！我們活著的時候也不多，對吧！就算你能活到 100 歲，跟地球和宇宙比起來還是微不足道的。我覺得大家都應該高高興興的啊，傷心難過很浪費時間。就算有什麼不高興的，也不要太煩惱啦！反正去想也不見得解決要什麼東西。	I don't see any reason we can't be happy. Life is short. Even though you see some people as old as 100 years old, it's still nothing compared to the earth, the universe. I think people should be happy every day despite the troubles they face. We can't waste time being sad, and feeling sad won't help us solve problems.
	我很喜歡跟我朋友在一起，我覺得他們應該也是吧！我覺得大家在一起互相幫忙很好很好喔！以前剛進來的時候，我們都覺得很低落，有沒有？很多人都有一樣的感覺。因爲老師罵太兇了！我跟大家講，我們可以請那些美工	I love my friends, and I believe they would feel the same way. I like to be with my friends, and we help one another. Remember my frustration in the beginning of the first semester? Many students felt the same. So, I suggested to

	畢業的，有經驗的同學教其他人一些設計技巧。然後大家就覺得不錯，就這樣作了，我們都學得很高興，大家像一家人，好好喔！	the class to have the more experienced students help those who didn't know much about design to improve their designing skills. Everyone thought that was a good idea. So we started to work together, learn together, and have fun together. We were really like siblings in a whole big family.
	像他們就會告訴我怎樣做好設計，在我被罵的時候；他們有點經驗啊！是吧？我從他們那裡學到很多！所以吧，如果你相信日子好過，那日子就會好過了！	They were nice to me, talking to me when my products were criticized by the picky instructor. Additionally, they taught me how to improve my designing skills. See, I benefited from the big group of friends a lot. Life is good if you believe life is good.
	反正有時候他們就有很多奇怪的理由不想來幫忙。我想可能他們真的就不想做，是吧？那我也不想強迫他們，沒有用嘛！	Sometimes people had thousands of excuses for refusing to take responsibility. Maybe they weren't in the mood to do it at that particular moment. I think it's no use to force them to go any further.
	我是會聽看看他們到底有什麼事要幫，告訴他們這個工作很重要，一定要他們一起做。如果他們真的有麻煩，我會先幫忙他們解決問題，他們就會來了。不然我會告訴他們，「這次先不要來，下次要認真一點喔！」他們大概都會聽啦！就大家給一下方便啊。反正大家最後還是會來幫忙做事的。	I will always listen to them, see what they need help for, and then tell them why we have to finish the job. If they do have difficulties working with the class, I always try to help them to solve their personal issues, or tell them, "You can leave us this time, but you must work with us harder next time." Most of the time, they would listen, finally come back to the group and work with us together.
	我不知道別人這樣做有沒有效，我覺得很不錯啊！我不喜歡強迫別人，我會試看看去說服吧！還有幫他們解決私人的問題吧！	I don't know if this strategy works for others, but it works so well for me. I don't force, but I try to convince and try to help.

APPENDIX D

TRANSLATION APPROVAL FORM

From Dr. Chung L. Huang, Professor, Department of Agricultural and Applied Economics

College of Agricultural and Environmental Sciences
Department of Agricultural and Applied Economics

September 13, 2002

To: Chin-Hsiang Lin's Advisory Committee

Re: English Translation of Survey Results

Mr. Chin-Hsiang Lin has conducted personal interviews in Taiwan for his dissertation research. The interviews were conducted in Taiwanese/Chinese dialogue with respondents' answer recorded in Chinese. Chin-Hsiang provided me with a sample of his original Chinese transcription with English translation. Although I made a few editorial changes and suggestions for his consideration, I am satisfied and attesting that his English translation is truthful to the participants' responses and as accurate as to be expected.

If I can be of any further assistance, please do not hesitate to contact me. I can be reached by phone at 2-0747 or via email to chuang@agecon.uga.edu. Thank you.

Sincerely,

Chung L. Huang
Professor

From Hsiu-Ting Hung, Doctoral student, Department of Language Education

As a bilingual (Chinese and English) doctoral student, I completely agree on the translation and ensure its authenticity. My signature below indicates that I, Hsiu-Ting Hung, have discussed the translation with the researcher, Chin-Hsiang Lin, and both of us have reached full agreement.

Signature

September 3, 2002

Date

From Chang-Ya Hu, Doctoral Candidate, Department of Psychology

09, SEP, 2002

Dear Doctoral Committee members:

I am an international student from Taiwan. The purpose of this letter is to certify that Mr. Chin-Hsiang Lin's English translation of the interview accurately reflects the meanings of the dialogues. If you have any questions, please feel free to contact me.

Truly yours,

Chang-Ya Hu, M.S.
Doctoral Candidate
Applied Psychology Program
University of Georgia
Email: cyhu@uga.edu

APPENDIX E

INTERVIEW GUIDE – ENGLISH VERSION

I. Biographical Information

II. View of Self as a Creative Individual

1. How would you describe yourself? Please use 3 to 5 adjectives.
2. How do your classmates usually describe you?
3. You are nominated as one of the most creative students in your class. Why do you think they voted for you?
4. Tell me about your hobbies.
5. Why are these hobbies enjoyable to you?
6. How would you define creativity and creative characteristics?
7. Who would you consider creative, and why?

III. Early School Experiences:

8. Tell me about your early experiences in elementary school, middle school, and high school.
    - Would you tell me more about your successful and unsuccessful academic experiences?
    - What were your favorite and least favorite subjects at school? And what were not?
    - Explain why you like/dislike them?
    - Describe your school experiences in leadership?
    - How would you describe your leadership skill?

9. Please describe your interpersonal relationship with your classmates and teachers.
    - Please take a minute to recall your early school experiences, and describe your most influential teacher and how that person supported you as a student.
    - Tell me about your teamwork experiences in school.
    - Describe your learning style. How do you think you learn best?
    - Describe your preferences for working in a groups or working individually.
10. Describe your experiences with any private lessons in the areas of special talents (i.e. art, piano, dance, computers)?
    - How did these lessons influence you as a student?

IV. University Experiences in Industrial Design.

11. Tell me how you would define industrial design.
12. Explain why you decided to pursue a degree in industrial design.
13. Describe the most significant course in your industrial design program that has had influenced you as a design student.
14. Describe the most influential instructor in your industrial design program, and how that professor has influenced you as a design student.
15. Describe the most enjoyable or influential assignment in your industrial design program, and how those experiences have influenced you as a design student.
16. Describe what you think curriculum in industrial design program should be.

17. Are there any designers in your field whose work you admire? If so, explain why you admire them.
18. Tell me about your future academic or career plans, and how you intend to accomplish your goals.
19. Describe the classroom climate in which you work best.

* Follow-up questions will be generated from the responses of the participants.

INTERVIEW GUIDE – CHINESE VERSION

訪談概要

I. 基本資料：年齡／居住地／過去唸的學校

II. 對自己的創造力的看法

1. 請用三至五個形容詞形容你自己。
2. 就你所知，你的同學／朋友多半如何形容你？認爲你是一個怎麼樣的人？
3. 你是老師／同學所認爲是班上最具創造力的人。可不可以請你猜看看，爲什麼他們會提名你？
4. 你有哪些興趣？嗜好？
5. 爲什麼這些活動能夠吸引你？
6. 你怎麼看「創造力」？如何定義？
7. 就你所認識或知道的人裡，你認爲誰最有創意？爲什麼？

III. 早期在學的經驗

8. 說說看你在國小、國中及高中的學校經驗。
   - 請你回憶看看你在班上功課的表現，說說看最得意與最失意的經驗。
   - 你在學校裡最喜歡／最不喜歡的科目是什麼？爲什麼？
   - 談談看你在學校裡擔任重要幹部職務的經驗。
   - 你覺得你在領導統御方面的能力如何？

9. 描述一下你與同儕間／老師間的互動。
   - 用一分鐘的時間回想看看，過去的學習經驗裡，哪幾位老師影響你最多？在校時，那些老師又在你哪些方面給予啓發／幫助？
   - 說說看你在學校 Teamwork 經驗。
   - 你的學習方式是哪一種？（被動／主動；視覺／聽覺／觸覺；具象／抽象；遊戲規則／自由發揮）在什麼情況下，你的學習取有效率？
   - 你歡團隊工作還是獨立作業？爲什麼？
10. 你有沒有哪些才藝班的學習經驗？
    - 這些經驗對你在學業上以及現在的設計能力有沒有影響？

IV. 在工設系的學習經驗

11. 你自己如何定義「工業設計」？
12. 你爲什麼會想唸這個系？
13. 在工設系裡，有哪些科目影響你最深？爲什麼？這些科目對你創造力的啓發扮演什麼樣的角色？
14. 在系上有哪些老師影響你最大？爲什麼？他在你的創造力啓發上又扮演什麼樣的角色？
15. 在專業科目上，你喜歡哪些類型的作業？有哪些作業讓你印象最深？爲什麼？
16. 你認爲工業設計系的課程應該如何設計或做哪些改變？
17. 你最欣賞哪些設計師？爲什麼？
18. 你對自己在未來的學術上或專業工作上有什麼規劃？你打算如何達到這個目的？
19. 你認爲在哪一種教室環境下，最有助於你的學習？

APPENDIX F

VITA

Contact Info

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Education Background

1998-2002 Ph.D., Gifted and Creative Education Program,
Department of Educational Psychology,
University of Georgia, USA

1995-1997 M.S., Integration Design Program, Department of Industrial Design,
National Cheng Kung University, Taiwan
台灣・國立成功大學工業設計研究所整合設計組　畢業

1993-1995 B.S., Department of Industrial Design,
Hua Fan College of Humanity and Technology, Taiwan
台灣・華梵人文科技學院工業設計系畢業

1987-1992 Diploma, Department of Industrial Design,
Mingchi Institute of Technology, Taiwan
台灣・明志工業專科學校工業設計科畢業

1984-1987 Yang-mei Junior High School, Taiwan
台灣・桃園縣立楊梅國民中學畢業

1978-1984 Yang-mei Elementary School, Taiwan
台灣・桃園縣立楊梅國民小學畢業