INVESTIGATION OF THE EFFECTS OF GROUP COMPOSITION AND CONFERENCE STRUCTURE ON GROUP CREATIVITY AND INDIVIDUAL PERCEPTIONS OF TRANSACTIONAL DISTANCE IN UNIVERSITY STUDENTS

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ABSTRACT

The main purpose of this study was to investigate online collaborative activities based on the differences of individual students, to enhance creativity in small groups and reduce transactional distance (TD) in an online learning environment. The relationships among gender, thinking styles, individual creative ability and group creativity were also explored.

Both experimental and survey data were collected to provide a rich understanding of the related issues. Different grouping and structuring strategies were developed and manipulated in this work. The 3 x 3 factorial quasi-experimental design employed a pretest-posttest comparison group, with two independent variables: thinking styles and conference structure. The dependent variables were group creativity and student perceptions of transactional distance.

One hundred and thirty-eight second year students from three intact classes at Southern Taiwan University were selected as the participants for the main study. Four research instruments were used to collect data: the Thinking Styles Inventory (TSI), the Abbreviated Torrance Test for Adults (ATTA), the Creative Product Semantic Scale (CPSS), and the individual's perceptions of transactional distance questionnaire.

The findings confirmed that male students tended to prefer the legislative thinking style more than the female ones. There was no significant difference between male and female students in the overall creative ability. However, the male students had significantly higher creative ability with regard to originality. The findings also supported Sternberg's argument that ability is different from style. In addition, this study found that there was no significant association between the average group member creative ability and the overall group creative performance.

As for the test results for the influences of the two proposed factors in terms of group composition and conference structure on group creativity, no significant differences were found for these two factors or their interaction on group creativity. In addition, group composition and conference structure had no significant interaction effect on any dimension of transactional distance, but two main effects were significant. Group composition had a significant effect on the learner autonomy dimension of transactional distance. The level of conference structure had a significant effect on individual perceptions of interaction, conference structure and interface transactional distance. Moreover, in the context of the present study, using synchronous online conferencing, a high degree of TD - interaction was associated with a high degree of TD - conference structure, TD - learner autonomy and TD - interface.

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Chapter 1: INTRODUCTION

Based on the differences among individual students, the main purpose of this study was to investigate the effectiveness of group composition and conference structure on group creativity and individual perceptions of transactional distance in an online learning environment. The relationships among gender, thinking styles, individual creative ability and group creativity were also explored. Chapter 1 provides an overview of this study, and is organized into six sections: (1) research background, (2) research objectives and theoretical foundation, (3) research questions and hypotheses, (4) significance of the study, (5) organization of the thesis, and (6) chapter summary.

1.1. Background

1.1.1 Education to foster creative human resources

The information industry has grown enormously in recent decades, which has in turn attracted attention from governments across the world with regard to how to increase their global competitiveness in the new knowledge-driven economy of the 21st century. Gurin (1995) stated that to maintain a competitive edge, corporations need people who are communicators and problem solvers with higher-order thinking skills. It is the essential goal of education to prepare a child to move to adulthood and to promote both learning and the attainment of life skills, and training in higher-order

thinking skills is of particular importance. The traditional view of education expects the teacher to take full control of student learning, and considers teaching and learning as a process in which the teacher stands and delivers the content, while students sit (often passively in developing countries) and receive. However, this approach minimizes individual diversity and focuses on basic rote learning, which could be deemed inadequate for the demands of the real world, which require people to use higher-order thinking skills to solve complex problems. Learners should thus be treated as proactive participants in learning, "actively seeking ways to analyze, question, interpret, and understanding their ever-changing environment" (Newby et al., 2006, p.12). Bruer (1993) also indicted that learners must surpass the rote, factual level to begin to think critically and creatively. However, creativity represents a multi dimensional and diffuse construct (Mumford & Gustafson, 1988), and it is rarely defined in the professional literature. Plucker et al. (2004) performed a content analysis of creativity articles appearing in refereed journals but found that of the 90 selected articles, only 34 (38%) explicitly defined what creativity was. A synthesized definition of creativity, proposed by Plucker et al. (2004) by identifying several reoccurring, constituent elements from their creativity study, was adopted in this study: "Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as

defined within a social context" (p.90). This definition of creativity draws attention to questions of not only who and what is creative, but also where are creative experiences made. In other words, to understand creativity, one cannot simply focus on the individual. Instead, as advocated by Gardner (1994), "one must broaden one's focus to include a study of the area in which that creative individual works and the procedures by which judgments of originality and quality are rendered" (p.146). This definition contains four facets of creativity: person, process, product, and press/place. The designation of the 4 Ps was originally proposed by Rhodes (1961), who wrote that "The word creativity is a noun naming the phenomenon in which a person communicates a new concept (which is the product). Mental activity (or mental process) is implicit in the definition, and of course no one could conceive of a person living or operating in a vacuum, so the term press is also implicit" (p. 305).

Since the late 1990s, creativity in education has increasingly been viewed as globally relevant (Craft, 2005). Creativity is related to intelligence and academic ability (Kaufman et al., 2008), and a survey of distinguished graduate faculty members conducted by Enright and Gitomer (1989) found that creativity is considered as one of the most important competencies for success in graduate school. Reich (2001) wrote that many of the jobs being created by the new economy depend on creativity, seen as based on out-of-the-box thinking, originality and flair. Thus one of

the important missions of higher education is the cultivation of creativity (Pascarella & Terenzini, 1991). To deal with this, institutions of higher education have been exploring ways to improve the quality of their curricula to advance students' creativity through innovative uses of technology, and particularly the Internet (Bonk & Sugar, 1998; Kanuka, 2005). Online learning has many advantages, such as bringing one learning module to a larger group of learners, providing opportunities for increased interaction between and among teachers and learners, and achieving flexibility learning in time and space (Kanuka, 2005; Kirschner & Van Bruggen, 2004). Course experiences that move students beyond narrowly-focused content and technical training (Shute, 1979) to educational activities that develop creative thinking (Roach, 1986) are recommended, and creative education is also in line with student-centered learning, which is one of the presumptions for online learning. Based on research findings (Zhang & Sternberg, 2006), students from three different cultures, Hong Kong, the United States and China, preferred teaching styles that provided them with opportunities to increase their creative thinking and level of cognitive complexity, and their ability to work collaboratively with others. Therefore, educational reform policies that implement online learning, also known as e-learning, to foster talents, especially the enhancement of creativity based on intellectual capital, have become a global trend (Lee & Tsai, 2004; Ministry of Education of the R.O.C., 2006).

1.1.2 Distance education and technology

Technology has allowed people to access, organize, analyze and exchange information in greater volume and detail, and at a much faster pace than before. Such developments have influenced educators in making changes to teaching and learning, both theoretically and practically. One of the significant results has been the emergence of distance education, which in recent years has evolved into e-learning (Saba, 2008). Based on different pedagogical and technological perspectives, a variety of definitions of distance education have been presented by leading scholars in this field since the 1960's (e.g., Dohmen, 1967; Peters, 1973; Moore, 1973; Holmberg, 1977; Garrison & Shale, 1987; Barker et al., 1989; Moore, 1990; Portway & Lane, 1997). Since the turn of the century, interactive computer-based technologies have become well-developed and widely implemented, and the new possibilities thus opened up have lead to new definitions of distance education (e.g., Mehrotra et Al., 2001; Picciano, 2001; Peters, 2003; Saba, 2003). In this study, distance education will be used to refer to a formal educational system from which individuals learn in a nontraditional environment through a variety of media with a freedom of choice related to space, time, pace, medium, evaluation and curriculum chosen. Originally, distance education was conceived as a supplementary or complementary to traditional face-to-face education, but later evolved into an alternative and almost parallel means

of education. The rapid development of electronic communication technologies in recent decades has enhanced the efficiency of educational communications, particularly with regard to the level of accuracy and speed of feedback that can now be achieved (Schlosser & Simonson, 2006). These changes have been clearly seen in the rapid growth in the number of students enrolling in and the number of institutions or universities adding education at a distance to their curriculum (Allen & Seaman, 2010). It is also evident in the growing body of literature on distance education and related topics (e.g., Edmundson, 2007; Jarvis, 2002; Luppicini, 2007; Meyer, 2002; Moore, 2007; Murphy, 2004; Syed, 2009).

The U.S. Department of Education found most institutions offering distance education have chosen the Internet as the medium, with this kind of approach generally called e-learning (Carnevale, 2001). Terms synonymous with e-learning, as reported by Davidson and Elliot (2007), include online learning, web-based instruction, online classes, Internet courses and virtual learning. The advent of the Internet combined with computer-mediated communications (CMC), the term given to any use of the computer as a device for mediating communication between people (Newby et al., 2006), has increased the potential for interaction and collaborative work among students, and consequently has had an impact on the distance instructional design, allowing the adoption of a wide range of technology-based

activities, either asynchronous or synchronous. Asynchronous activities in which students proceed at their own pace use technologies such as blogs, wikis, and discussion boards; while synchronous activities involve the exchange of ideas and information with one or more participants during the same period of time. A typical example of the latter is text-based synchronous computer conferencing, where participants in different locations at the same time type messages to each other that are posted on electronic discussion groups. With the increasing implementation of online course management tools, such as Blackboard, FirstClass, and WebCT, more and more schools have access to sophisticated online discussion tools (Landis et al., 2007). Love (2002) stated that more work is needed to understand how computer conferencing differs from face-to-face meetings, and to develop valid and reliable tools for qualifying behaviour (Love, 2002).

Technology has always had an inseparable relationship with distance education, because it overcomes the transactional distance between teacher and learner (Bates, 1993). However, distance education is not only about the distribution of course materials (Anderson, 2004). In this context, what matters is to understand "what is available, when and why it should be used, how it is effectively adapted, integrated, evaluated, and adjusted" (Newby et al, 2006, p.15). According to Garrison and Anderson (2003), educational technology is defined as "those tools used in formal

educational practice to disseminate, illustrate, communicate, or immerse learners and teachers in activities purposively designed to include learning" (p.34), and this technology "directly affects the display, the interaction, the cost, and the design of educational outcomes" (p.32). Distance education technologies can be differentiated into those that primarily allow one-way communication (e.g. course units, videotapes, television, and radio) or two-way communication (e.g. telephone tutoring, e–mail, audio or videoconferencing, and computer conferencing). Two-way technologies enable not only interaction between teachers and learners, but among learners themselves as well (Sumner, 2000), and thus we need to consider whether the use of educational technology simply makes individualized learning (basically one-way communication) more efficient, or if it can also enhance collaborative learning (basically two-way communication).

It is important to recognize that the use of a range of educational technologies does not automatically enhance the quality of teaching and learning. Although technology alone may have the potential to create new learning experiences and increase learning opportunities which significantly impact on distance education, Taylor (1995) pointed out that what matters is the quality of the instructional message, rather than any inherent characteristics of the instructional medium used. As noted by Clark (1983), technologies are:

> "mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (p 445).

Therefore, while it is certainly important to understand technology itself, it is perhaps even more important to have an understanding of the related pedagogical, social and communication factors. Administrators and educators should thus consider using well-grounded pedagogical principles and strategies to guide the technological use of course materials in building distance programs, and there is a need to analyze the factors related to program and student success when distance teaching and learning is adopted.

1.1.3 Emergence of theories of distance education

Over the last three decades, a number of theoretical frameworks from different perspectives and traditions have been proposed with an attempt to encompass the whole field of distance education (Amundsen, 1995). Broadly speaking, they can be grouped into the following categories (Keegan, 1996): autonomy and independence of the learner, industrialization of teaching, and interaction and communication. Theories of autonomy and independence focus on the essential component of the independence of the learner and the enhancement of opportunities for adaptation to individual differences; the main concern of the theory of industrialization is how distance

education functions and is organized, along with a focus on structural issues (e.g. industrialization) and how these influence the teaching and learning process. Theories of interaction and communication emphasize that interaction and communication are central to the concept of distance education (Saba, 2003). More specific frameworks are presented by:

(1) Otto Peters (1983, 1989, 1998) – a comparison of distance education and the industrial process;

(2) Michael Moore (1972, 1973, 1980, 1989) – a theory of transactional distance and learner autonomy;

(3) Börje Holmberg (1983, 1985, 1986, 1989) – a theory of teaching in distance education;

(4) Desmond Keegan (1986, 1990) – a theory of reintegration of the teaching and learning acts;

(5) D. Randy Garrison (1985, 1989) – a theory of communication and learner control; and

(6) John Verduin and Thomas Clark (1991) – a three-dimensional theory of distance education.

Amundsen (1995) analyzed these theories with regard to their possible positions in the evolution of theory in distance education, a summary of which can be seen in Table 1.

All of these theoretical approaches have made a valuable contribution to the understanding of the experiences and practices of distance education. Because the very nature of distance education is different from traditional education, it is important for educators to make good use of the findings of the theoretical-based research and decide which technological application is best suited to raising the quality of distance learning programs to meet the ever increasing and diversified educational needs and demands of today's information society.

Table 1: A comparison of theoretical perspectives on distance education (from Amundsen, 1995, p.71)

Framework	Central concepts	Primary focus	Apparent influence
Peters *The industrial model*	• Industrial • Post-industrial	Match between societal principles and values	• Cultural sociology
Moore *Transactional distance theory*	• Transactional distance (Dialogue, structure) and • learner autonomy	Perceived needs and desires of the adult learner	• Independent study
Holmberg *Theory of teaching in distance education*	• Learner autonomy • Non-contiguous communication • Guided didactic conversation	Promotion of learning through personal and conversational methods	• Humanist approach to education
Keegan *Theory of reintegration of teaching and learning act*	• Reintegration of teaching and learning acts	Recreation of interpersonal components of face-to-face teaching	• Framework of traditional pedagogue
Garrison (Shale, Baynton) *A theory of communication and learner control*	• Educational transaction • Learner control • Communication	Facilitation of the educational transaction	• Communication Theory • Principles of adult education
Verduin & Clark *A three-dimensional theory of distance education*	• Dialogue • Support • Structure • Specialized competence • General competence • Self-directedness	Requirements of both the learning task and learner	• Principles of adult education • Structure of knowledge

1.1.4 A paradigm shift for distance teaching and learning

The range and accessibility of communications technology with the potential to improve the quality of higher education has dramatically expanded in the past years (Taylor, 1995). Based on communication technologies used, Taylor (2001) noted that the technological evolution of distance education towards online learning can be seen to have occurred in five generations:

(1) the correspondence model based on print technology;

(2) the multimedia model based on print, audio and video technologies;

(3) the telelearning model based on applications of telecommunications technologies to provide opportunities for synchronous communication;

(4) the flexible learning model based on online delivery via the Internet; and

(5) the intelligent flexible learning model which incorporates the use of automated response systems and intelligent object databases in the context of Internet – based delivery.

The features of each generation relevant to the quality of teaching and learning are summarized in Table 2. This evolution illustrates how the focus has shifted from self-directed learning towards opportunities for communication and collaboration, and how educational technology has evolved from correspondence to the Internet.

Table 2: Generations of distance education – A conceptual Framework (from Taylor, 2001, p.3)

Models of Distance Education and Associated Delivery Technologies	Characteristics of Delivery Technologies				
	Flexibility			Highly Refined Materials	Advanced Interactive Delivery
	Time	Place	Pace		
FIRST GENERATION - The Correspondence Model					
• Print	Yes	Yes	Yes	Yes	No
SECOND GENERATION - The Multimedia Model					
• Print	Yes	Yes	Yes	Yes	No
• Audiotape	Yes	Yes	Yes	Yes	No
• Videotape	Yes	Yes	Yes	Yes	No
• Computer-based learning (e.g. CML/CAL/IMM)	Yes	Yes	Yes	Yes	Yes
• Interactive video (disk and tape)	Yes	Yes	Yes	Yes	Yes
THIRD GENERATION - The Telelearning Model					
• Audio teleconferencing	No	No	No	No	Yes
• Videoconferencing	No	No	No	No	Yes
• Audiographic Communication	No	No	No	Yes	Yes
• Broadcast TV/Radio and Audio teleconferencing	No	No	No	Yes	Yes
FOURTH GENERATION - The Flexible Learning Model					
• Interactive multimedia (IMM) online	Yes	Yes	Yes	Yes	Yes
• Internet-based access to WWW resources	Yes	Yes	Yes	Yes	Yes
• Computer mediated communication	Yes	Yes	Yes	Yes	Yes
FIFTH GENERATION - The Intelligent Flexible Learning Model					
• Interactive multimedia (IMM) online	Yes	Yes	Yes	Yes	Yes
• Internet-based access to WWW resources	Yes	Yes	Yes	Yes	Yes
• Computer mediated communication, using automated response systems	Yes	Yes	Yes	Yes	Yes
• Campus portal access to institutional processes and resources	Yes	Yes	Yes	Yes	Yes

The advantages of distance learning are both flexibility and independence, and its powerful capacity for interaction and communication. Distance education was initially designed to enable learners to study in their own places, away from the campus of the educational institution in which they were enrolled. Such learners, usually in an

individualized learning context, have more flexibility and responsibility to arrange their own learning schedule than in traditional education, which is constrained by fairly rigid timetables (Evans & Nation, 1996). A very important aspect of distance education is that teachers and learners do not need to be co-present for teaching and learning to occur, and distance learners are thus expected to undertake private study. Since the late twentieth century, distance education has entered into its post-modern development phase (Saba, 2007), and with the development of various online applications (such as MSN Messenger, blogs, wikis, twitter, MySpace, YouTube, Facebook, and social bookmarking) and modern communication technologies (such as mobile phones, and Wi-Fi), individual learners have been empowered with a high level of control over their own learning process. However, a learner is also a social being, and makes progress through a series of interactions within his/her learning context (Kang & Gyorke, 2008). There is a growing literature (e.g., Anderson & Kanuka, 1997; Hughes et al., 2002; Brown, 2001; Carabajal et al., 2003; Curtis & Lawson, 2001) addressing the significance of technology-enhanced collaborative learning, and the more that communication technology has advanced, the greater the possibility for interactivity. Nipper argued that "learning- although a very *personal* matter- must never be an *individual* matter- one learns best by and with others" (1989, p.66). Collaborative learning cannot happen in isolation, but instead exists in the

context of a group with two-way communication. Nipper (1989) contended that the more communication there is with and among the learners, the more noise there is in the system, with this noise being the sound of people coming together to learn.

Nowadays, educators might need to think about how to create a collaborative, contextual and constructivist online learning environment without sacrificing the independence and autonomy of learners. The best strategy might be designing online activities using computer conferencing, "the practice of people at distant sites, each with a computer, exchanging text and graphic messages and participating in meetings together" (retrieved from MediaDictionary.com), and this approach will be discussed in the next section.

1.2. Research objectives

Strategies for an online group discussion have a significant impact on the quality of collaborative learning. Online collaborative learning environments have the potential to support teaching and learning relying on social interaction between group members (Kreijns et al., 2004). For equal participation among group members, collaboration can be promoted by structuring the collaborative process or by different grouping methods to promote the emergence of productive interaction (Hakkinen, 2004). Research also shows that various conditions, such as group composition, task

structure, and individual characteristics, influence the efficacy of collaborative learning (Schellens et al., 2005). In this study, it is therefore critical to investigate how collaborative activities can be implemented using appropriate strategies, i.e. the most suitable group composition and conference structure, to increase students' motivation to contribute diverse perspectives via computer conferencing.

In relation to group composition, the most commonly mentioned factor is group size, which should not be either too large or too small, and the use of small groups, no more than 8, in online/distance education courses is preferred (Kumar, 2005). In addition to group size, some studies emphasize heterogeneous groups, whereas others support homogeneous ones. According to Sternberg (1988, 1990, 1997), the best way of grouping lies in each single group containing students with different thinking styles which bring forth better cooperative results. He argued that teachers should create a learning environment in which students with different thinking styles can capitalize on their strengths and compensate for their weaknesses of thinking and learning, and therefore proposed the theory of mental self-government to assist teachers to enhance the effectiveness of teaching and learning (see further discussion in Section 2.4.1.2). Thinking style refers to personal preferences, not abilities. Sternberg also contended that although someone might have creative ability, they may not enjoy coming up with novel ideals challenging prevailing view points (Sternberg & Lubart, 1995). Or

conversely, that while someone might not be creative, they may prefer generating unorthodox ideas (Sternberg & Zhang, 2005). However, in Zhang's (1999) cross-cultural study of the relationships between thinking styles and a number of student characteristics, she identified that legislative and liberal styles are creativity-relevant styles. Therefore, the complex relationships between people's willingness and their creative ability need to be further investigated. In addition, the validity of grouping people with different thinking styles is merely a theoretical assumption, and whether it actually leads to better cooperative results is still awaiting verification (Lee & Tsai, 2004).

Although the development of online courses emphasizing collaborative learning has shown positive effects on educational reform, the absence of nonverbal cues increases the transactional distance between the participants, in terms of psychological and communications gaps, when the teaching and learning acts are separated (Stein et al. 2005). Instructors can lessen transactional distance by developing dialogue and structures that match learners' needs and abilities (Kanuka et al., 2002). According to Moore's theory of transactional distance, which is viewed by many researchers as a basic analytical framework for understanding distance teaching and learning, there is "the physical distance that leads to a communications gap, a psychological space of potential misunderstandings between the behaviors of

instructors and those of the learners that has to be bridged by special teaching techniques" (Moore & Kearsley, 1996, p.224). Transactional distance is influenced by three basic factors: structure, dialogue and learner autonomy.

> "The first of these, derived from analysis of curricula, is described as the teaching–learning program's "structure"; the second, derived from analysis of communication between teachers and learners, is the "dialogue" in the program. The third describes the roles of the learners, in terms of the extent to which they exercise degrees of "autonomy" in deciding what to learn, how to learn, and how much to learn" (Moore, 2007, p.90).

Moore (1990) stated that the extent of dialogue, level of structure and degree of learner autonomy naturally varies from program to program, and has called for more empirical studies to test the interrelationships among these in various teaching–learning situations. In addition, an increasing number of researchers have also noted the need to reconsider how such variables operate in the contexts of spontaneous communication and web-based learning environments (e.g., Chen & Willits, 1999; Chen, Y. -J., 2001a, 2001b; Jung, 2001; Stein et al., 2005).

If online distance learning is to be successful, in addition to assessing learning outcomes and achievements, it is necessary to make the online experience of learners satisfying. Based on the foregoing discussion, it is essential for educators to guide remote students to be creative and learn collaboratively with others, as well as to

reduce transactional distance, in an online learning environment (Lee & Tsai, 2004; Zhang, 2006). Theoretical and empirical research has contributed conceptual insights and practical guidance about the complexities of distance education, and has developed methods to enhance the distance teaching–learning environment (Chen & Willits, 1999). Unfortunately, in the online collaborative learning environment, in terms of computer conferencing, very few studies have focused on the promotion of creativity. Moreover, with regard to fostering creativity, research into the impact of grouping by thinking styles and conference structuring based on transactional distance theory has not yet been undertaken. In addition, the impact of small group activities on transactional distance via synchronous computer conferencing has yet to claim much attention from researchers. These issues are thus topics worthy of further investigation. One main concern of the current research is to investigate effective online collaborative activities using synchronous computer conferencing to enhance creativity in small groups. Another concern is about transactional distance, which in this study is defined as the perceptions of the learners toward the online experience. In this regard, it is a considerable challenge to develop authentic and effective collaborative activities connecting distance learners to reduce transactional distance in an online learning environment.

Thinking style and transactional distance theories provided the speculative basis

for this study. The research framework and analytical matrix in this study incorporate the following two dimensions: group composition and conference structure. The theoretical foundation of group composition in the current research design is based on thinking styles as defined in Sternberg's theory of mental self-government. On the other, the latter is based on transactional distance theory to structure synchronous computer conferencing, while transactional distance is also used to measure the users' online experiences in terms of perceptions of synchronous computer conferencing. A critical look at the literature will provide insights into how and why learning theory and Internet technology are integrated in this study. These will be further discussed in chapter 2, which contains a review of the related literature.

To sum up, the objectives of this research are to:

(1) investigate the relationship between thinking styles and creative ability;

(2) uncover the relationships among thinking styles, group composition, individual creative ability and group creativity;

(3) explore the effects of group composition and conference structure on group creativity;

(4) explore the effects of group composition and conference structure on

transactional distance;

(5) examine the relationships among the various dimensions of transactional distance.

1.3. Research questions and hypotheses

The main purpose of this study was to investigate the effects of online collaborative activities based on the differences of individual students, in order to enhance the creativity expressed in small groups and reduce transactional distance in an online learning environment. This research closely examined three levels of effects: group composition, conference structure and the interactions between them. In this study, the participating students' thinking styles served as the grouping criteria. Based on the scores of the TSI, they were assigned to homogeneous (executive thinking style, legislative thinking style, judicial thinking style) and heterogeneous (mixed thinking styles of the former three) groups. In addition, based on the creative thinking skills strategies examined in this work, the structures used for the computer conferencing had three levels: high, low and no structures. The following questions and hypotheses were formulated in relation to the research aims:

Question 1: Are there any relationships among gender, thinking styles and creative ability?

Hypothesis 1.1: There are differences between male and female students in thinking styles.

Hypothesis 1.2: There are differences between male and female students in creative ability.

Hypothesis 1.3: There is an association between individual creative ability and thinking styles.

Question 2: Is individual creative ability related to the overall group creative performance?

Hypothesis 2: The average of group member creative ability is correlated with the overall group creative performance.

Question 3: Do group composition and conference structure have an effect on group creativity, and do group composition and conference structure interact?

Hypothesis 3.1: There is a difference between the types of group composition with regard to group creativity.

Hypothesis 3.2: There is a difference between the levels of conference structure with regard to group creativity.

Hypothesis 3.3: There is an interaction of group composition and conference structure with regard to group creativity.

Question 4: Do group composition and conference structure have an effect on individual perceptions of transactional distance, and do group composition and conference structure interact?

Hypothesis 4.1: There is a difference between the types of group composition with regard to individual perceptions of transactional distance.

Hypothesis 4.2: There is a difference between the levels of conference structure with regard to individual perceptions of transactional distance.

Hypothesis 4.3: There is an interaction of group composition and conference structure with regard to individual perceptions of transactional distance.

Question 5: What are the relationships among the dimensions of interaction distance?

Hypothesis 5: The dimensions of interaction distance are intercorrelated.

There are two main dependent variables: group creativity and individual perceptions of transactional distance. On the one hand, group creativity was assessed by an evaluation sheet adapting the Creative Product Semantic Scale. Drawing on the definition of creativity proposed by Plucker et al. (2004, see Section 1.1.1), the criteria of a perceptible outcome was specified, because without observable and measurable evidence of performance, it is difficult to determine whether creativity has occurred. Group creativity was thus assessed by the group task, which was to create a blog via synchronous online discussions. Creativity judgments are often made quickly and intuitively (Cooper & Kleinschmidt, 1986), and it is possible that intuition on the basis of long and valuable experience may have internalized important criteria for judgment. However, Besemer and O'Quin (1999) stated that "current needs for accountability and objectivity require more explicitness in the statement of review criteria and standards of judgment" (p.287). On the other hand, transactional distance was investigated by a self-developed questionnaire survey. All the research instruments are described in greater detail in Section 3.2.

1.4. Significance of the study

As potential future leaders, students should prepare themselves to meet diversity and challenges in a dynamic world. Significantly, Child (1986) warned that the survival of advanced industrialized economies would be threatened without the continued emergence of creative people. Published by the International Society for Technology and Education (ISTE), the 2008 National Educational Technology Standards for Teachers entitled "NETS for Teachers 2008" raised expectations with regard to the use of existing and emerging digital tools and resources to provide students with cross-cultural learning experiences. The five new major goals for teachers are as follows:

(1). Facilitate and Inspire Student Learning and Creativity

(2). Design and Develop Digital-Age Learning Experiences and Assessments

(3). Model Digital-Age Work and Learning

(4). Promote and Model Digital Citizenship and Responsibility

(5). Engage in Professional Growth and Leadership

These goals embrace a constructivist philosophy and pedagogy, and provide a framework for educators to use as they transition schools from the Industrial to Digital Age. They cover some essential principles, such as creative and innovative thinking, collaborative processes, and building a learning community, that are in line with the fundamental concepts underpinning this study.

Nowadays, the use of computer-mediated communication is placing greater focus on collaborative learning. It is a challenge for the teacher to create an environment that not only emphasizes the importance of learner autonomy, but also ensures a high level of interaction and dialogue. However, just placing students in groups and assigning them tasks could never ensure that the group members will successfully carry out effective collaborative learning behaviors. Student perceptions of authority in a collaborative learning environment seem to affect their willingness to raise new ideas and discuss their various perspectives. According to the literature and the researcher's experience, students often want the teacher to provide explanations and solutions for the problems they have. Moreover, students want the teacher to take the lead in every discussion and provide feedback for each of their responses. Therefore, it is important for the teacher to design collaborative activities using appropriate strategies, i.e., good grouping and structuring, to increase students' motivation to contribute their ideas to such activities. Both researchers and practitioners have thus examined issues related to how group composition and task structure influence collaboration outcomes.

In relation to group composition, some studies emphasize heterogeneous groups, whereas others support homogeneous ones. According to Sternberg, the best way of grouping lies in each group containing students with different thinking styles, as this

brings forth better cooperative results. In contrast, some researchers indicate that a higher level of perceived individual differences among group members may have negative effects on both emotional reactions and cognitive processes.

In relation to task structure, according to Moore's theory, the relationship between dialogue and structure is immutable, and it is impossible to achieve high levels of both at the same time. He contended that greater transactional distance occurs when an educational program has more structure and less dialogue. However, as the Internet has become more widely applied, some researchers argue that a program can be both highly structured and highly interactive, and thus transactional distance can be reduced. Moreover, some also argue that without structured activities and guidance the use of a collaborative e-learning context may result in lower levels of knowledge construction.

By postulating new concepts and drawing in new factors to expand the idea of thinking styles and transactional distance, this study aims to uncover whether grouping and structuring in synchronous computer conferencing are related to group creative outcomes and individual perceptions of transactional distance. The main contribution of this research is that the findings enrich the growing body of knowledge about online collaborative group learning. Specifically, this study

examines the arguments underlying Sternberg's thinking styles and Moore's transactional distance. In addition, the findings and analysis presented in this work may lead to the development of better online strategies and guidance for group discussion activities, thus encouraging and promoting group creativity, as well as reducing the participants' perceptions of transactional distance.

1.5 Organization of the thesis

Chapter 1 details the background, objectives and research questions that examine the proposed effects of group composition and conference structure on group creativity and individual perceptions of transactional distance in university students. Chapter 2 provides a review of existing literature related to distance education, theory of transactional distance, theory of mental self-government, and the integration of learning theory and Internet technology. Chapter 3 details the methodology, research design, research instruments, the pilot and main studies, and data collection and analysis. Chapter 4 reports the reliabilities and validities of the research instruments in the main study and presents and an in-depth analysis of the collected data. Based on the results and findings, Chapter 5 presents a discussion of the results of this work, as well as the related conclusions, implications, and recommendations.

1.6 Summary

The theoretical framework for this study is derived from Sternberg's theory of mental self-government and Moore's theory of transactional distance. Chapter 1 provided an overview of the research project centered upon the factors influencing the group creativity and individual perceptions of transactional distance. The contexts, conceptual framework and rationale for the study were stated, with the research questions and hypotheses that the researcher had chosen to investigate. Information concerning the objectives and potential significance of findings of this experimental study was also discussed. The chapter concluded with a brief description concerning the organization of future chapters.

Chapter 2: REVIEW OF THE LITERATURE

The goal of this chapter is to review the concepts, themes, assumptions and principles that underpin the conceptual and theoretical framework of the current study. It will first cover the development and application of technology for distance education. Secondly, it will closely examine Michael Moore's theory of transactional distance. Finally, it will present the theoretical underpinnings of the current author's approach to design online learning activities and the desired learning outcomes.

2.1. An overview of distance education

Distance education, subsuming a number of exiting terms that have previously been used to describe education taking place in a nontraditional environment such as correspondence study, home study, independent study, external study, distance teaching and distance learning (Keegan, 1996), has been defined and practiced differently all over the world. The developments of various forms of distance education have been associated with the dominant technology of the time (Garrison, 1996), and this form of education has embraced technologies such as print, radio, telephone, television, audio and videotapes, and computer-based learning packages, interactive video (disc, tape), teleconferencing, the Internet and computer communications networks. Based on the communication technologies used, a number

of scholars have noted that technological evolution of distance education towards online learning can be shown to have occurred in three generations (Garrison, 1985; Nipper, 1989). The first generation began with the advances of the postal service early in the nineteenth century; second generation with the development of the telephone network during the first half of the twentieth century; and the third generation began with the creation of networks of computers during the last half of the twentieth century (Garrison & Archer, 2000). Some authors (e.g., Lauzon & Moore, 1989; Taylor, 1995) have proposed that there is a fourth generation, which refers to the use of the Internet. Moreover, Taylor (2001) has proposed the existence of a fifth generation based on the future exploitation of new technologies. A developmental overview will be outline in the following parts.

The first generation: Correspondence study

Initially distance education was established in the form of correspondence study, and the medium was written or printed materials delivered through the mail. By the end of the nineteenth century it expanded when new printing techniques, cheap and reliable postal services and an efficient transportation system made possible the production and distribution of teaching materials in large quantities to sparsely populated areas (Nipper, 1989).

The second generation: Multimedia learning

The second generation of distance learning deliberately integrated the use of highly-developed and refined teaching and learning resources, such as printed study guides and selected readings, with broadcast media, audio and video tapes, multimedia devices and computer–based course materials, to make up the student's learning package (Taylor, 1995).

The third generation: Telelearning

When making the move from the first and second generations to the third, the key element in the conceptual development of distance learning has been as a social process, and thus the greater opportunity for communication between the teachers and learners, and among the learners themselves (Nipper, 1989). The third generation makes use of two-way communication via telecommunications technologies such as audio teleconferencing, audiographic communication systems, video conferencing and broadcast television/radio with attendant audio-teleconferencing (Taylor, 1995).

The fourth generation: Internet and computer mediated teaching/learning

It is commonly agreed that courses in this generation allow high levels of interaction between learners and teachers and amongst learners, as mediated by computers

(Bates, 1994; Garrison, 1996; Rumble, 2001). According to Taylor (2001), the fourth generation is based on online delivery, supporting a learning process that is interactive, non-linear and collaborative. Online learning not only provides distance learners with greater flexibility, but also enables additional advantages such as instructor-learner, learner-learner, instructor-content, learner-instructor and instructor-instructor interaction, and access to external resources through the World Wide Web (WWW). By making possible short turnaround in instructor/tutor interaction, online learning has diminished the main weakness of delayed communication that was seen in the previous generations of distance learning.

The fifth generation: Intelligent flexible learning

The fifth generation of distance education is already emerging based on the further exploitation of new technologies (Taylor, 2001). This fifth generation adds artificial intelligence to the Internet, so that it can be navigated and processed by both human and nonhuman intelligent agents. For example, nonhuman agents can use automated responses to frequently asked questions and provide integrated access to resources and services via portals (Garrison & Anderson, 2003).

In summary, distance educators are challenged by the emerging technologies mentioned above when designing distance programs. A review of the various

generations of distance education provides clear evidence of a paradigm shift in recent years, with the focus shifting from self-directed learning toward more opportunities for communication and collaboration, and how educational technology has evolved from the postal system to the Internet. Pioneering distance education scholars, such as Garrison (2003), Moore (2007), Holmberg (2007), and Peters (2007) have acknowledged that the use of Internet is transforming distance education, and in their recent works most of them have attempted to extend their early theories in view of the application of online learning. Today there are online courses offered by countless public and private organizations worldwide at almost every level of education. Teaching and learning at a distance needs theories to guide the complex practice of a rational process. In the following sections, the focus will be on theory of transactional distance, in an attempt to better explain the research issues and questions that have been formulated and tested in the current study.

2.2. Examination of the theory of transactional distance

Moore (1972, 1973, 1983, 1986, 1993, 2007) developed and refined the theory of transactional distance, and was one of the first scholars that attempted to explore distance education from a transactional point of view. Moore's theory has been tested in many studies, with mixed results, and although many aspects have been criticized

as confusing and inconsistent, the concept of transactional distance has contributed to further theory development and guided much empirical research in distance education (Amundsen, 1995; Saba, 2008). The following sections will provide a detailed discussion of the theory of transactional distance.

2.2.1 Significance of theory of transactional distance

The theory of independent learning and teaching (1973) was first proposed by Michael G. Moore, and soon became known as the "theory of transactional distance" (Moore, 1980). It was an attempt to establish the identity of a previously unrecognized field of educational research, and was the first American theory to define distance education in pedagogical terms. By 1970, as long as the practice of distance education was defined solely by the technology in America, the few research questions generated were also stated as studies of the technology. At that time almost all educational research questions were grounded in an assumption that contiguous situations, referring to teachers and learners working in the same time and place, are essential for good learning and teaching, and such researchers thus failed to recognize the broader dimensions of education, arguing that distance education did not exist as a field of research and study (Moore & Kearsley, 1996). Some people even viewed distance institutions as offering no teaching activities, but instead working only to develop

learning materials, and thus more properly classified as businesses rather than educational institutions (Keegan, 1996). Moore (1973) challenged this prejudice, and stated:

> "Learning and instruction do take place in other situations. Millions of learners, particularly adults, do not learn in classrooms, never meet or speak directly to their teachers and learn from teachers with whom they have no personal acquaintance at all as contrasted to contiguous teaching-learning, theirs is a distant learning and teaching situation" (p.664).

The historical significance of transactional distance theory is that it identified and convincingly described teaching and learning that did take place outside of classrooms. Moore (1973) asserted that distance education is a system that consists of three sub-systems, including a learner, teacher and method of communication. These subsystems have distinguishing characteristics different from other forms of education in learning, teaching and communication. Moore (1993) indicated that the purpose of his distance education theory was to summarize the different relationships among and between the variables that make up transactional distance, especially the behaviours of teachers and learners.

2.2.2 Theoretical concepts

As already mentioned, Moore (1973, p.672) identified distance education as a system consisting of three sub-systems:

a. “autonomous learners engaged in learning events”;
b. “distance teachers preparing programs of instruction for transmission through communication media”; and
c. “communication media systems to bring teaching programs to learners in response to learners’ demands”.

The critical points and the development of the concepts of transactional distance theory derived from the relationships of these sub-systems will be illustrated in the next sections.

2.2.2.1 Two initial dimensions

Moore’s original theory on distance education considered two dimensions, distance and learner autonomy.

(A). Dimension of distance

Moore’s focus was on all independent learning carried outside the school environment. He examined more than two thousand programs including those on TV and radio, correspondence, programmed instruction, computer-assisted instruction, telephone, dial access audio tapes and independent learning on campus, and dichotomized them into two groups, called “individualized methods and programs” and

"non-individualized methods and programs". The former was defined as a method "which led to learners' controlling the rate of their progress in learning, and included programs demonstrating that characteristic". In contrast, the latter was defined as one "which provided learning experiences at a space that was beyond the learners' control" (Moore, 1972, p.78). A second round of analysis classified the programs into two subcategories, "dialogic" and "non-dialogic," based on whether the programs involved constructive interaction. "Dialogic" approaches involved a means of interaction between the learner and teacher, while "non-dialogic" ones involved interaction only with the content, but provided no communication with the teacher himself. Details of this classification system are shown in Table 3.

Table 3: Moore's original classification of programs (from Moore, 1972, p.78)

Individualized	*Dialogic*:	Independent learning on campus
		Correspondence
	Non-dialogic:	Programmed instruction
		Computer-assisted instruction
Non-individualized	*Dialogic*:	Telephone
	Non-dialogic:	Tape
		Radio
		Television

Later, Moore (1973) refined the variables from dichotomous to continuous. According to Moore (1972, 1973), distance is composed of two elements, dialogue and individualization, each of which could be measured. As measured by dialogue and

individualization, distance learning programs could be classified according to their relative distance from “most distance” to “least distance” and assigned a numerical ranking, as indicated in Figure 1. In the hierarchy, dialogue appears to be a more significant variable than individualization.

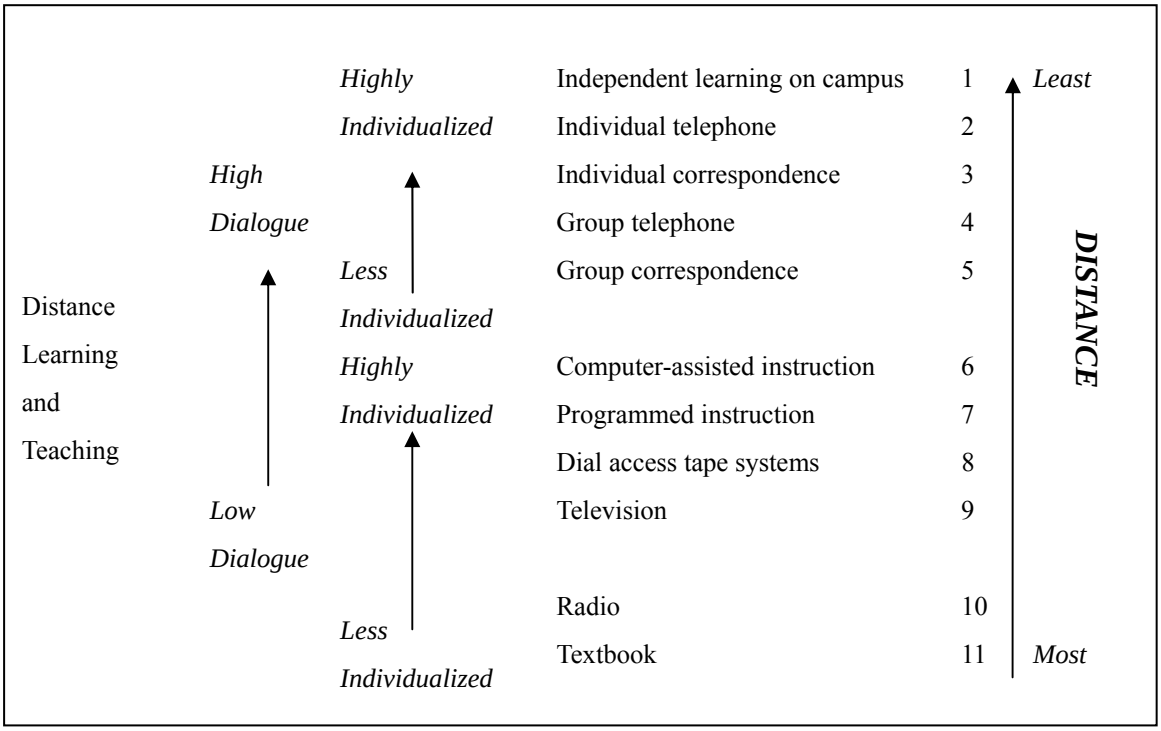

Figure 1: Distance learning and teaching methods classified by the dimension of distance (from Moore, 1973, p.674)

(B). Dimension of learner autonomy

The second part of transactional distance theory describes the dimension of learner autonomy, which depends on one's degree of control over one's own learning. Moore defined learner autonomy as “the will and ability to exercise powers of learning, to overcome obstacles for oneself, to try to do difficult learning tasks, and to resist

coercion" (1973, p.667). Moore identified the relationship between learners and teachers and where the control of each instructional process lies, and then gauged the degree of autonomy accorded the learner by answering to the following questions:

(1). Autonomy in setting of objectives: Is the selection of learning objectives in the program the responsibility of the learner or of the teacher?

(2). Autonomy in methods of study: Is the selection and use of resource persons, of bodies and other media, the decision of the teacher or the learner?

(3). Autonomy in evaluation: Are the decisions about the method of evaluation and criteria to be used made by the learner or the teacher?

After preparing such a system to order programs, Moore ranked them in positions from 1 to 8 on a continuum according to the kind and extent of autonomy the learner can exercise, as shown in Table 4.

Based on observations instead of empirical testing, Moore compared the two classifications of distance learning and teaching programs by the dimensions of distance and learner autonomy, and found that the situations of programs in the distance hierarchy and in the autonomy hierarchy were related: the more distance, the

more independence and the greater the learner autonomy.

Table 4: Distance Learning and Teaching methods classified by the Dimension of Learner Autonomy (from Moore, 1973, p.673)

	Establishment	*Execution*	*Evaluation*
1. complete autonomy (theoretical, most distance)	A	A	A
2. external agent judges progress	A	A	N
3. learner control over goals and evaluation: Programmed instruction	A	N	A
4. learner-set problem and goals only (unusual)	A	N	N
5. learner-set execution and evaluation (uncommon)	N	A	A
6. Learner-controlled evaluation only (most rare)	N	N	A
7. prescribed goals, external evaluation, student-controlled execution (most common)	N	A	N
8. complete lack of autonomy (theoretical, least distance)	N	N	N

Note. A=Autonomous; N=Non- Autonomous

2.2.2.2 Establishment and refinement of Moore's theory

Moore has continued to update his theory and terminology. The term "transactional distance" was first introduced and explained in the 1980s, although a comprehensive interpretation of the "theory of transactional distance" was not published until 1993. The concept of transaction, derived form Dewey and Bentley (1949) and developed by Boyd and Apps (1980), denotes "the interplay among the environment, the individuals and the patterns of behaviors in a situation" (Boyd & Apps, 1980, p.5) and was recontextualised by Moore to the distance education field (Kang & Gyorke, 2008). To clarify the concept of "transactional distance", Moore (1980) first outlined the development of the two major traditions for teaching-learning transactions in the

individual mode. One is the scholarly tradition, a tutorial model known as independent study on university campuses, in which “the instructor monitors the student’s practice of self-directed inquiry, through which the student acquires competence in study skills and the exercise of self-discipline” (p.17). In this tradition, independent study is a transaction between an individual student and a tutor who provides guidance and responds to the student’s assignments. The second tradition in independent study is known as telemathic study, designed for adults who live too far away to physically attend the institutions they are studying at, who are unable to find classes at convenient times, or who prefer to study at home for other reasons. Here, it should be noted that the term telemathic means “learning at a distance” (p.18).

Moore compared these two traditions of independent study and concluded that telemathic teaching is often less structured, less directed, and more attractive to the learner’s interests and concerns than collegiate independent study. Moreover, Moore pointed out an essential characteristic of all independent study is the physical separation of learners and teachers. Unlike face-to-face teaching, where teachers can communicate through words, performance, and non-verbal expressions, in independent study, both scholarly and telemathic modes, teachers communicate with students who are distanced in time and space. The extent of communication depends on the characteristics of the media employed.

> "Some educational transactional distances are more than the others; this distance is not a matter of geographic locations. The transactional distance is a function of two crucial variables in the learner-teacher transaction, which we have chosen to call *dialogue* and *structure* " (Moore, 1980, p.21).

Moore (1980) employed new terms and teaching methods, and further stated that transactional distance is a function of two sets of continuous variables, dialogue (D) and structure (S). Every program has more or less dialogue and structure, and it is the variation gives a particular program more or less transactional distance than another. Some elaborations of and new insights into the original concepts of transactional distance and its constructs are described, as follows:

(1). *Dialogue* describes two-way communication between student and teacher. Based on Moore's opinions, after a course is designed, dialogue is developed in the course of the interactions when the teacher gives the instruction and the students respond within the environment which is determined by the course structure. Although the concepts of dialogue and interaction are similar and sometimes are used synonymously, Moore emphasized that dialogue is helping, constructive, and positive exchanges in a teaching-learning relationship (Moore, 2007) and the direction of dialogue is toward to the improved understanding of the student.

The extent and quality of dialogue are influenced by numerous factors, such as

the teacher's personality, learner's personality, cultural and language differences, content area, academic level, student's communicative competence, and, overarching all of these, the structure of the course (Moore, 1993, 2007). For example, a teaching program using a potentially highly dialogic medium, like synchronous videoconferencing on the Internet, might be limited to the students asking factual questions of the teacher and receiving answers, thus seeing the role of learners as being to assimilate information by listening and taking notes. The medium of communication is another important variable affecting dialogue, and by manipulating, it is possible to increase dialogue and thus decrease transactional distance. For instance, highly interactive electronic teleconference media, including personal computers and teleconferencing, permit more dialogue than a recorded medium and thus bridge the transactional distance more efficiently.

(2). The greatest change in the view of the theory of transactional distance is that "structure" has replaced "individualization," and it is defined much more broadly than the learner being can control their rate of learning progress.

> "Structure expresses the rigidity or flexibility of the programme's educational objectives, teaching strategies, and evaluation methods. It describes the extent to which an education programme can accommodate or be responsive to each

learner's individual needs" (1993, p.26).

The definitions above are similar to how Moore described learner autonomy (1972, 1973), suggesting there is a direct and linear relationship between them (Stover, 2002). This more broadly defined term "structure" acts in the opposite direction to "individualization," which originally applied to pacing (Stover, 2002). Moore explained that a high level of structure means a low level of individualization. A distance program consists of elements such as objectives, content themes, presentations of information, case studies, pictorial and other illustration, activities and exercises, questions for discussion, projects, tests and so on which may be strictly specified by the course designer(s), leaving no room for deviations by the instructor or students. Such highly structured programs are inflexible and non-individualized, and give no choice to learners.

A recorded television program, for example, with every minute of time provided for and every piece of content predetermined, is highly structured and has no dialogue, no possibility of responding to input from the learners, and cannot deviate or vary to meet the needs of a particular individual. More distant courses have more tightly structured materials that provide all the anticipated guidance, direction and advice, but they cannot be modified for individual learners through dialogue with an instructor.

By comparison, other programs may have a looser structure in which student can choose different paths through the learning materials, or negotiate variations in the program with the instructor. For example, there can be teleconference courses in which the instructor can provide a wide range of alternative responses to students' questions and written submissions, or students may be allowed to progress at their own speed when viewing a CD-ROM or browsing a loosely determined set of web pages in a less structured program. In conclusion, a low-distance course will have a more open structure that supports individual interactions through which learners receive directions and guidance from a real instructor.

(3). Consistent with Moore's previous papers, *learner autonomy* describes a situation in which adult learners do not need guidance "in formulating their learning objectives, in identifying sources of information, and in measuring achievement" (Moore, 1980, p.23). He noted that an autonomous learner is both an instrumentally and emotionally independent individual. While the former has the abilities to act, solve problems, and persist in a given task without asking for instructions or help, the later possesses the abilities to act without needing reassurance, affection, or approval of others (Heathers, 1955). An autonomous learner is self-directed and self-reliant in learning, but non-autonomous learners need to develop an independent stance in educational transactions.

(4). *Transactional distance*: the most detailed definition of transactional distance was as follows:

> "The transaction that we call distance education occurs between teachers and learners in an environment having the special characteristic of separation of teachers from learners. This separation leads to special patterns of learner and teacher behaviours. It is the separation of learners and teachers that profoundly affects both teaching and learning. With separation there is a psychological and communications space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner. It is this psychological and communications space that is the transactional distance" (Moore, 1993, p.22).

In attempting to clarify the structural relationships among the concepts of transactional distance, Moore (2007) presented some visual representations of them, as shown below.

(I). Figure 2 shows how the variables of dialogue and structure interact to determine transactional distance in a simple two-dimensional graph. It shows that as dialogue increases, transactional distance decreases, and vice versa. In addition, as structure increase, transactional distance also increases, and vice versa.

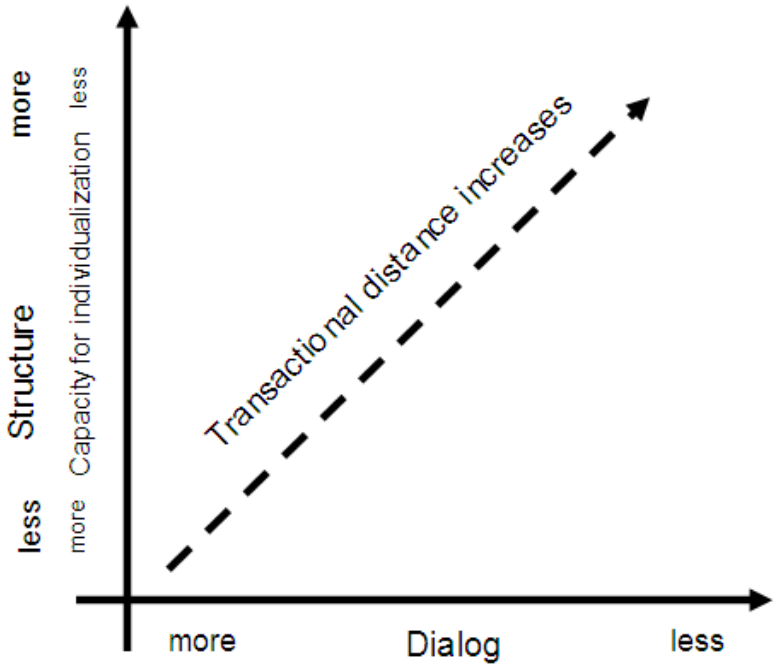

Figure 2: Relationship of dialogue, structure and transactional distance (from Moore, 2006, p.9)

(II). When by dialogue and structure are measured, distance programs can be classified according to their relative distance from “most distant” to “least distant”, as shown in Figure 3.

(III). Moore provided theoretical constructs for classifying distance programs by the dimension of learner autonomy. The three criteria are “Goal” (what to learn), “Execute” (how to learn) and “Evaluation” (how much to learn). Programs are classified on a range from AAA, meaning the learner have the full autonomy in deciding Goal, Execute and Evaluation, to NNN, meaning the learner have absolutely no freedom to make any decision about the learning program, and this is illustrated in Figure 4. Learners vary in their ability to exercise autonomy from course to course.

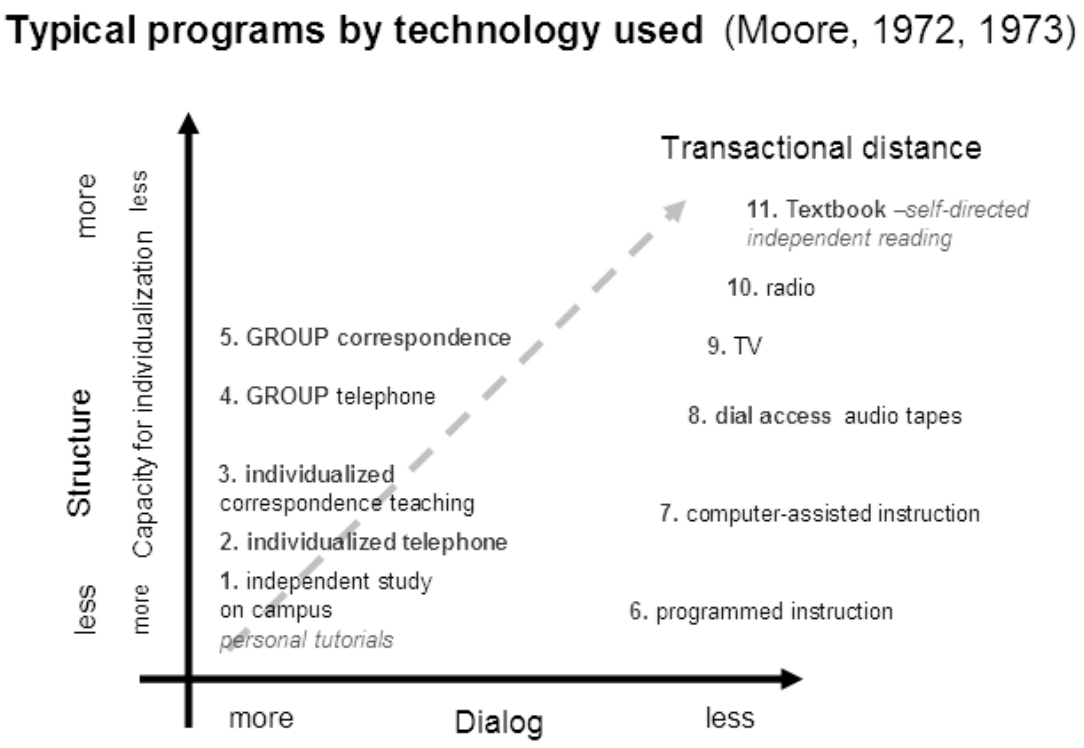

Figure 3: Moore's classification of distance programs (from Moore, 2006, p.10)

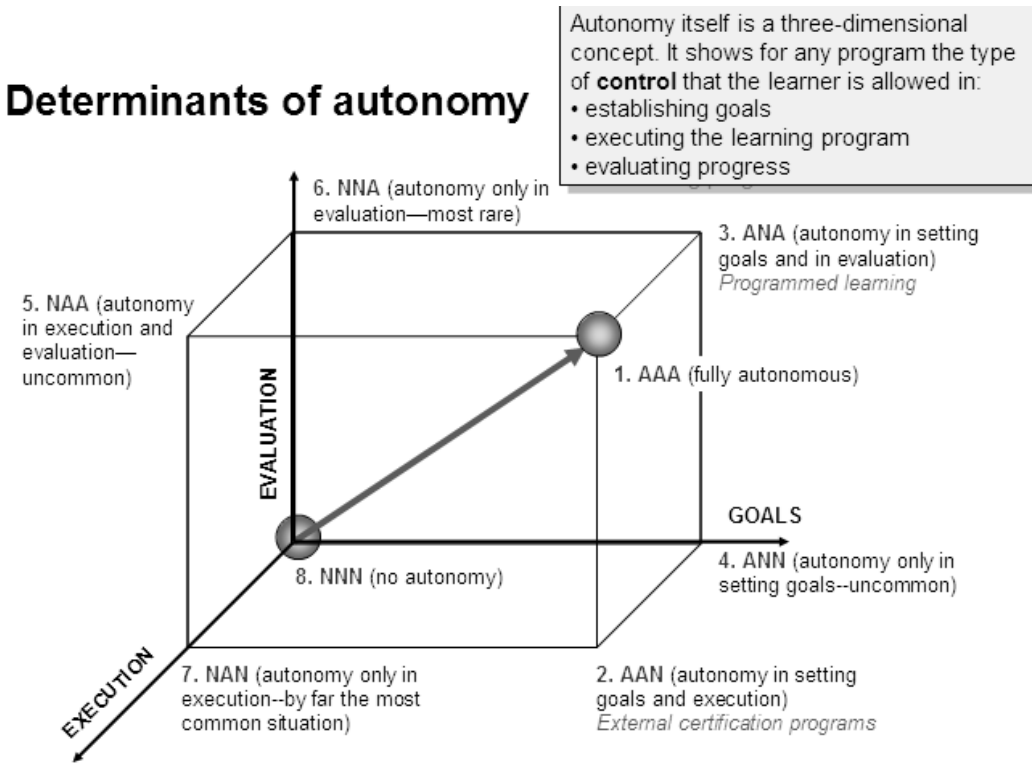

Figure 4: Dimensions of autonomy in distance teaching-learning programs (from Moore, 2006, p.13)

(VI). Moreover, transactional distance can be viewed as a 3D model. The relationship between learner autonomy and transactional distance is illustrated in Figure 5. As one steps away from the origin (dialog or structure), the steps also increase in height (autonomy). A course with little transactional distance that allows modifications to suit the needs, learning styles and pace of different individuals is more attractive to less autonomous learners who are less secure in managing their studies, while more autonomous learners are more comfortable with less dialogue. If there is minimal dialogue or structure in a program with high transactional distance, learners are forced to exercise more autonomy when making decisions about their own studies (Moore, 2006).

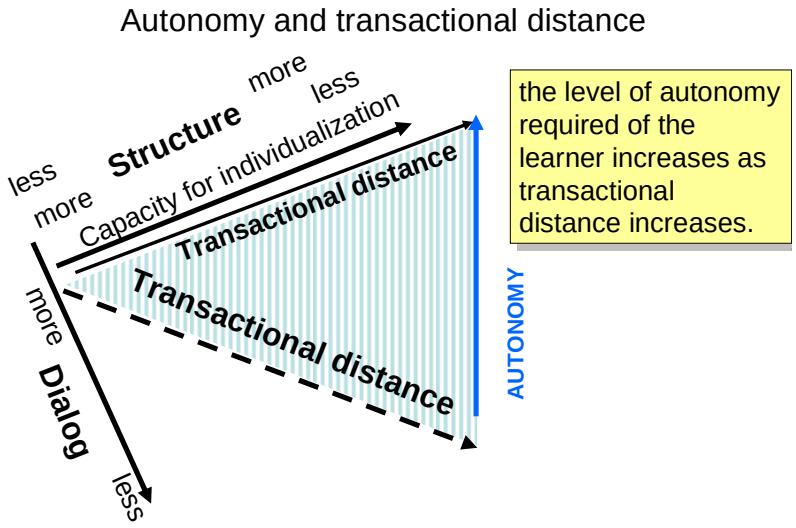

Figure 5: Relationship between autonomy and transactional distance (from Moore, 2006, p.12)

In spite of the criticism of its unclear operational definitions and interconnections among variables, problematic propositions and logical inconsistencies (see Section 5.3.1), the theory of transactional distance has been an extremely useful tool for analyzing and predicting teaching and learning behaviors (Stover, 2002), and thus has not only been widely cited in scholarly journals and conference proceedings, but also been extensively used as the theoretical foundation for empirical research (Bunker, 1998; Lee et al., 2005; Moore, 2007). The focus of the following section will be research that has applied the theory of transactional distance.

2.3. Applications of the theory of transactional distance

Moore's theory of transactional distance has inspired the generation of many hypotheses for research into the interactions among its variables of structure, dialogue, learner autonomy and transactional distance. Subsequently, a large amount of research has been carried out to validate or extend Moore's theory. Adapted from Kang and Gyorke's (2008), the various approaches may be classified into four groups: (1) Studies that focus on the verification of the validity of the theory, of its propositions, and of the relationships between the major constructs of the theory; (2) Studies that create or adapt from other researchers instruments to measure transactional distance and its relationship with learner satisfaction and learning outcomes; (3) Studies that

focus on individual constructs. Each construct is broken down into smaller units of analysis to evaluate its validity and effectiveness; and (4). Studies that attempt to expand the idea of transactional distance by postulating new concepts and bringing new factors into discussion. (See Kang & Gyorke, 2008 for details)

2.3.1 Reconsiderations of Moore's theory

With the turn of the century and the more widespread use of computers and the Internet, more and more researchers have noted there is a need to reconsider the propositions of transactional distance theory. Firstly, some studies (e.g. Chen, Y. -J., 2001a, 2001b; Jung, 2001; Shea et al., 2003; Stein et al., 2005; Kang & Gyorke, 2008; Murphy & Rodríguez-Manzanares, 2008; Benson & Samarawickrema, 2009) suggest several advances beyond the original concepts, expanding them to take into account more specific characteristics of new teaching and learning environments, such as the contexts of spontaneous communication and web-based learning. Moore and Kearsley (1996) noted that the structure, quantity and quality of dialogue between instructor and learner determine the level of success in distance education. Their conclusion is that transactional distance is lessened in courses with high levels of dialogue and little predetermined structure. Greater transactional distance occurs when an educational program has more structure and less dialogue. In line with Moore, researchers who favor a low task structuring approach argue that too much structure on a task

involving higher-order thinking skills is dysfunctional, because it impedes conceptually oriented interaction (Cohen, 1994). Besides, too much guidance may hinder learners' creativity, flexibility and ability to self-regulate and ultimately causing a loss of effectiveness of the learning process (Dillenbourg, 2002; Dillenbourg & Jermann, 2007). In contrast, researchers who promote a high task structuring approach contend that higher-order thinking occurs when learners are given structure and task specialization, because engagement in higher-level discussions leads to greater conceptual understanding, and thus they suggest that a clear structure is needed to foster cognitive processes and academic performance (e.g., Bell, 2005; Hewitt, 2005; Johnson & Johnson, 1989; Liu & Tsai, 2008). Moreover, some researchers argue that structured activities and guidance are especially important in the collaborative e-learning context (e.g., Bonk et al., 2004; Falchikov, 2001; Laurillard, 1998; Schellens & Valcke, 2005; De Smet et al., 2008). Due to difficulties in organizing large amounts of information, in structuring the discussion, and in developing a personal overview, online learning may result in lower levels of knowledge construction. For example, Brannon and Essex (2001) stated that it is necessary provide students with clear communication protocols and clear requirements for posting and reading discussion entries to prevent the potential pitfalls of online communication, such as a feeling of social disconnection. Garrison

and Cleveland-Innes (2005) pointed out that if students are to reach a high level of critical thinking and knowledge construction, the interaction or discourse must be structured and cohesive, and that "more online guidance, more structured discussion topics and considerable time devotion are required for instructors" (Wu & Hiltz, 2004, p.149).

Secondly, the theory of transactional distance needs to be reworded as external conditions of distance education have changed, particularly with the advances in delivery technologies (Jung, 2001). According to Moore's theory, the relationship between structure and dialogue is immutable, and it is impossible to achieve high levels of both simultaneously (Dron, 2005). Dialogue is originally limited to the message and response between the learner and teacher. However, as new technical support systems like the Internet are more widely applied, the structure of knowledge has changed from linear to nonlinear (Spiro et al., 1995). Notably, teleconferencing allows a new form of 'inter-learner' dialogue which occurs between learners and other learners, alone or in groups, with or without the real-time presence of an instructor (Gorsky & Caspi, 2005). This makes it more likely that a program can be highly structured and highly interactive, and thus transactional distance is reduced (Kanuka et al., 2002). For example, Shea et al. (2003) and Stein et al. (2005) have identified the central role of structure in student satisfaction and perceived learning in online

environments. The suggestion that high structure and high dialogue can reduce transactional distance was also supported by the latter study.

Based on the different arguments of the above studies, the relationships between the level of task structure and transactional distance need to be further examined. How and to what extent an online activity should be structured to foster the collaborative process is a crucial decision of the instructional designer.

2.3.2 Student perceptions of transactional distance

Moore argued that distance is determined by how and to what extent instructors, learners and the learning environment interact with one another. Where there is more interaction, there may be less distance, and vice versa. Moore identified transactional distance as a pedagogical phenomenon, not a geographical one. Transactional distance refers to any potential or existing misunderstandings which occur between the learner and the teacher, and is something that can only be experienced and perceived by the people involved, in different ways in different cultural and educational contexts (Kang & Gyorke, 2008).

Moore (1989) proposed that three types of interaction are essential to distance education: learner-instruction, learner-content, and learner-learner interactions.

(1) Learner-Content Interaction

> "the teacher must facilitate is the interaction the student has with the subject matter that is presented for study.", "Every learner has to construct his or her own knowledge through a process of personally accommodating information into previously existing cognitive structure." (Moore & Kearsley, 1996, p.140)

(2) Learner-Instructor Interaction

> "After the content has been presented […] the instructors assist the students in interacting with it", "Next they help the students' application of what they are learning.", "Finally, instructors provide counsel, support, and encouragement to each learner." (Moore & Kearsley, 1996, p.140)

(3) Learner-Learner Interaction

> "This is interlearner interaction, interaction between one learner and other learners. Two different kinds of interaction are included here; one is the interaction within groups and between groups that occurs in programs based on teleconferencing technologies. The other is learner-to-learner interaction in online settings where the individuals do not meet face-to-face." (Moore & Kearsley, 1996, p.141)

Nevertheless, as the context of distance education has evolved to the online environment, before the learner can successfully interact with the instructor, other learners or content, he/she needs to have enough technological proficiency to participate effectively in the electronic classroom (Hillman et al., 1994; Wagner, 1993). If the learner's experience is limited and (or) he/she is fearful of working with the technology, this can mitigate success in distance or online learning contexts. With the incorporation of computer conferencing into programs to support interaction,

Hillman et al. (1994) then added a fourth type, learner-interface, to Moore's three-part model of interaction:

(4) Learner-Interface Interaction: interaction between learner and the technological medium in order to interact with the content, instructor, and other learners.

Huang (2002) thus suggested that online course surveys need not only to evaluate the dimensions of interaction, structure and learner autonomy, but also to explore students' perceptions of the delivery system in term of its interface and ease of use.

The current study operationalized structure in synchronous computer conferencing to implement different creative thinking skills strategies. The effects of two variables, namely group composition and conference structure, on the transactional distance that learners perceive were investigated by a questionnaire survey. Transactional distance was measured by four dimensions in terms of interaction, structure, learner autonomy and interface. A detailed description of questionnaire design will be elaborated in Chapter 3.

2.4. Integration of learning theory and Internet technology

Planning is important to any learning activity, but it is arguably more important to distance education due to the separation of the learners and teacher. While a teacher is able to adjust activities in traditional classroom setting, those in distance education

must be thoroughly planned in advance to avoid leaving out critical components (Newby et al., 2006). In addition, the course goals and objectives, structures of the course, course activities and the number of students expected for the particular course will all determine how and what learning theory and technology will actually be applied (Heidt, 1989).

Taiwan is engaging in e-learning on a small scale, and the teachers taking care of online courses are directly responsible for their design, delivery, and evaluation. The author agrees with the collaborative constructivist perspective that interaction among learners is necessary in order to explore and build new knowledge, and for learning to be meaningful and of a high quality. Moreover, to plan a successful online course it is important to choose learning activities that best suit the learners' characteristics. More specifically, it is critical to design collaborative activities implementing appropriate strategies based on both the characteristics of the learners and the goal of the learning task, i.e. thinking styles and creative achievement. The following subsections will explain the rationale for the integration of learning theory and Internet technology for this study.

2.4.1 Integration of learning theory

As previously mentioned, practice is based on theory, which offers a set of consistent principles allowing teachers to select which technology will work best with specific

students and learning goals. However, some theories are more appropriate in some learning situations than others. Learning theories that best suit the current study include those related to collaborative learning, thinking styles and creative thinking strategies.

2.4.1.1 Constructivist collaborative learning

The ideas that make up constructivism were derived from Dewey, who argued that "education must be conceived as a continuous reconstruction of experience" (1897, p.91). Each individual has a unique set of experiences and knowledge construction is a process of making sensing of and interpreting experience. While some constructivist theories suggest that knowledge construction is a matter of individual interpretation, others theories consider it as a process of dialogue leading to shared interpretation (Newby et al., 2006). In the middle of the twentieth century, Vygotsky contended that knowledge is constructed through social collaboration (Driscoll, 2005). Collaborative learning can be defined as individuals actively constructing knowledge by working to solve realistic problems, usually in collaboration with others (Duffy et al., 2005). Dialogues with teachers or others provide learners with opportunities to explore different interpretations and then arrive at solutions to a problem.

The emergence of the third and subsequent generations of distance education

(Bates, 1991; Nipper, 1989; Taylor, 2001) has had a major effect on promoting the practice of collaborative learning. Nowadays, the use of computer-mediated communication places a great focus on building online communities of practice (Wenger et al., 2002). The sharing of views via computer conferencing might enable students to think beyond their egocentric views of the world, while fostering collaboration and enhanced interpersonal understanding (Bonk & Sugar, 1998). It is thus the responsibility of the teacher to provide students with a collaborative situation in which they have opportunities to construct "new and situationally-specific understandings by assembling prior knowledge from diverse sources" (Ertmer & Newby, 1993, p.63). Guidelines developed by the Instructional Communications Systems group at the University of Wisconsin-Madison for teachers in teleconferences suggest the creation of an environment that not only emphasizes the importance of the individual and which generates a feeling of group rapport, but also ensures a high level of interaction and dialogue (Moore & Kearsley, 1996).

Nevertheless, students' perceptions of authority in a collaborative learning environment seem to affect their willingness to raise new ideas and discuss diverse perspectives. Students often converge on representations that they associate with authority. Guzdial's (1998) study of students' collaborative learning in a Web-based environment found that students often want to hear from the teacher, who they feel is

supposed to provide explanations for the issues discussed as well as solutions for the problems being considered. Puntambekar (2006) also points out that students expect the instructor to take the lead in every discussion and to provide feedback on each of their responses. Therefore, it is critical to design collaborative activities implementing appropriate strategies, i.e. grouping and structuring, to increase students' motivation to contributing divergent perspectives via computer conferencing.

2.4.1.2 Group composition and thinking styles

Putting learners in a group and simply providing them with a relevant platform for communication and knowledge will not automatically lead to productive collaboration (Hakkinen, 2004; Puntambekar, 2006). Collaboration can be promoted by effective grouping to favor the emergence of productive discussion. Some studies emphasize the effectiveness of heterogeneous groups (Johnson et al., 1998; Nurrenbern, 1995; Slavin, 1995), whereas other studies support homogeneous ones (Felder et al., 1995; Rosser, 1997; Sandler et al., 1996). Heterogeneity of group members is a critical factor with regard to the level of collaborative discourse, although the research results on this issue are less conclusive.

According to Sternberg (1997), the best approach is when each single group mixes students with different thinking styles. We should thus consider students'

thinking styles as a critical grouping variable before conducting collaborative learning. Thinking styles, also called the theory of mental self-government, was proposed by Robert J. Sternberg (1988, 1994a, 1997), and refers to personal preferences, not abilities, in employing one's intelligence and competence when thinking or managing everyday activities. Abilities refer to what we can do, whereas styles refer to our preferred ways of using the abilities (Sternberg & Zhang, 2001). Sternberg (1997) noted that people choose styles which they are comfortable in processing information and dealing with tasks. An individual's preference may be different in different situations, and specific thinking styles are not regarded as good or bad in themselves, and they may be modified by time and demands. In other words, thinking styles are in part socialized. The question examined here is whether we can fit the styles to the demands of the collaborative environment, so that students can fully develop what they are good at. Moreover, it should be noted here that some research indicates that thinking styles are related to social factors, such as culture and gender (Messick, 1994).

Thinking styles and culture: Research shows that students from different cultural settings might be likely to develop their thinking styles based on the demands of their specific academic and cultural environments. For example, Cheung (2002) found that, in Hong Kong, students from allegedly low-ability secondary schools were more

legislative in their thinking than those from high-ability schools. Cheung explained that the schools with high-ability students tend to adopt traditional knowledge transmission teaching approaches, i.e., a more executive kind of education, to prepare their students for higher education entrance examination, and since they are satisfied with the students' achievements they are not encouraged to try new teaching strategies, like cultivating creativity or problem-solving abilities. In addition, Wu and Zhang (1999) found that in a sample from mainland Chinese universities, urban students scored significantly higher on the executive thinking style than suburban ones, and students from northern China demonstrated more legislative and judicial thinking styles than those from southern China.

Thinking styles and gender: The notion that males are expected to come up with new ideas and make rules and decisions, while females should only follow the resulting rules and execute the tasks they are give, not only exists within Chinese culture, but also in western societies. Even today, it is not surprising to find that young women are socialized into the executive role of doing what they are told (Zhang, 2006). Different levels of psychological differentiation between males and females are affected by different expectations and forms of socialization. In general, males are expected to be active and independent, while females are expected to be more obedient and adaptive (Vernon, 1972). Many studies have examined the relationship between intellectual

styles and gender in school settings, but have obtained inconsistent or even contradictory results (see Zhang and Sternberg, 2006 for details). The mixed findings of the relationships between styles and gender can be attributed to the various contexts in which the empirical studies were conducted (Severiens & Ten Dam, 1997). For example, Cheung (2002) found that male university students scored higher on the legislative and liberal thinking styles than their female counterparts among a mainland Chinese sample. Gender differences in thinking styles have also been commonly found in nonacademic settings, and there is evidence that a person's thinking styles can be changed (Zhang, 2006). Using the Kirton Adaption-Innovation Inventory (Kirton, 1976, see Section 4.1.2), many studies with samples drawn from the UK, the USA, Italy and Slovakia (e.g., Jacobson, 1993; Kirton, 1976; Kirton & Kubes, 1992; Prato Previde, 1984, 1991) found that females in general population are, on average, more adaptive, and males are, on average, more innovative. A number of studies (e.g., Hill et al., 2000; Kirton, 1994; Tullett, 1995) have shown that females who take up leadership positions are more innovative than their male counterparts.

The theory of mental self-government posits 13 thinking styles along five dimensions of mental self-government: functions (legislative, executive, and judicial thinking styles), forms (hierarchical, oligarchic, monarchic, and anarchic thinking styles), levels (global and local thinking styles), scopes (including internal and

external thinking styles), and leanings (liberal and conservative thinking styles) of the mental self-government. A brief description of each style with its characteristics and examples can be found in the Appendix A (for detail, see Sternberg, 1997). According to L. F. Zhang (2003a, p.623), the theory of mental self-government possesses the following characteristics: “First, the styles it specifies fall along five dimensions rather than one. Second, styles are perceived as falling along continua rather than as being dichotomous. Third, styles are not regarded as “good” or “bad” in themselves. The utility of a style for an individual interacts with the task the individual is performing and the situation in which the task is performed. Finally, the theory yields a profile of styles for each individual, rather than merely the identification of a single style”.

The theory has been operationalized through inventories, including the Thinking Styles Inventory (TSI; Sternberg & Wagner, 1992). The usefulness of the TSI has been assessed in the United States, the Philippines, Hong Kong and China (Zhang, 2010), and the results have been shown that the internal consistency, reliability and validity of TSI are generally sufficient (see description in the Methodology section, under instruments). However, intercorrelations among the 13 subscales within the thinking styles measure showed there may be some overlap. The first dimension including the legislative, executive and judicial thinking styles appeared to be the

most striking and robust among the scales in the inventory (Chen, C. -H., 2001). The function scale provided a good start point for examining the impact of thinking styles on performance. Based on the author's concern, the function of government was used as the principal theoretical foundation for forming the small groups in the current study.

Just as in government, there are three functions in mental self-government: legislative, executive and judicial, which roughly parallel three functional types of thinkers: creators, implementers, and evaluators. Their characteristics are as follows (Sternberg, 1999; Zhang & Stenberg, 2009a):

(a). Legislative Style

Legislative people like to do things their own way. They enjoy creating, formulating, and planning for resolving problems. Legislative people also prefer problems that are not prestructured, but rather that they can create their own rules.

(b). Executive Style

People with the executive style are implementers. They prefer problems that are given to them or clearly structured for them. Executive people also like to do things in a way that appears to follow a set of rules or guidelines and work within existing systems.

(C). Judicial Style

Judicial people prefer problems in which they can analyze and evaluate things- that is focusing attention on evaluating others and the structure and content of existing things and ideas.

In some studies on thinking styles (e.g., Zhang, 2000, 2001a, 2001b, 2002; Zhang & Sternberg, 1998), the legislative thinking style was positively related to the liberal one, whereas the executive thinking style was positively related to the conservative one. The former pair is thus thought to be more creativity-generating and complex, while the latter is perceived to be more norm-favoring and simplistic. Furthermore, drawing on empirical research data, Zhang and Sternberg (2005, 2006) proposed a threefold model of intellectual styles and classified the 13 thinking styles into three broad types: Type I, Type II and Type III styles (see Section 5.1.2 for details).

Moore & Kearsley (1996) noted that real or virtual groups can be used by course designers and instructors for generating content, especially when students can be organized into project teams and given responsibility for making presentations to their peers. Based on Sternberg's arguments, in this study it was reasonably predicted at the group level that the heterogeneous groups would produce better outcomes than the homogeneous ones. For example, when legislative, executive and judicial people work well together in a team, legislative people are capable of generating creative and

constructive ideas and then judicial people undertake the evaluation and selection procedures. Finally, executive people implement this structured task. During the cooperative process, group members have the opportunity not only to learn from one another about more effective thinking styles, but also learn how to tolerate differences among them, such as different values and ways of approaching a task and dealing with problems (Zhang, 2002). At the individual level, it was reasonably predicted that there is a difference between ability (how creative a person is) and style (how much a person likes to be creative).

2.4.1.3 Conference structure and creative thinking strategies

Creative thinking is both a process and an outcome that is achievable and needs to be practiced and reinforced, and computer conferencing provides opportunities for such collaboration and interaction among participants. Creativity itself has been defined in many contexts, and the common definition from Webster's is as follows: "Creativity is marked by the ability or power to create- to bring into existence, to invest with a new form, to produce through imaginative skill, to make or bring into existence something new". In addition, as noted above, some research indicates (e.g., Kharkhurin et al., 2008; Niu & Sternberg, 2003) that culture and gender have influences on creativity.

Creativity and culture: Two dimensions of the cultural dimensions theory developed by Hofstede (1980), individualism (IDV) and uncertainty avoidance, provide the most widely recognized explanation of cultural differences in studies of creativity. One dimension is collectivism versus individualism. The former is manifested in an emphasis on harmony, which may lead individuals to more conventional behaviors, whereas the latter is manifested in an emphasis on independence, which might more easily lead to unconventional and creative behaviors (Runco, 2007). Hofstede (1991) defined these dimensions as follows: "Individualism pertains to societies in which the ties between the individuals are loose: everyone is expected to look after himself or herself and his or her immediate family. Collectivism as its opposite pertains to societies in which people from birth onwards are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty" (p. 51). Traditionally, Asian societies are typical collectivist ones, and people value conformity rather than individuality. In American culture, a typically individualistic, people are encouraged to be more creative compared to those in a Chinese one (Niu & Sternberg, 2003). On Hofstede's (1980, 1993) country individualism index, Taiwan was ranked 41st out of 50 countries.

Some cross-cultural studies use uncertainty avoidance to explain the cultural influence on creativity (Kharkhurin et al., 2008). This cultural dimension measures a

country or culture's preference for strict laws and regulations over ambiguity and risk. Zandpour and Sadri (1996) defined uncertainty avoidance as ''the extent to which people feel threatened by ambiguous situations and have created beliefs and institutions in an attempt to avoid such uncertainty and ambiguity'' (p. 178). In other words, it reflects the extent to which members of a society attempt to cope with anxiety by minimizing uncertainty, doing so by establishing and enforcing formal rules for behavior (Hofstede, 1980). Uncertainty avoidance scores are the highest in Latin American countries, Southern and Eastern European, countries, including Germany, and Japan, while they are lower for countries with Anglo, Nordic, and Chinese cultures. On the uncertainty avoidance score rankings, Taiwan was ranked 26th out of 53 countries (Hofstede, 1991). Theoretically, in a society with high uncertainty avoidance, individuals with very divergent views and behaviors are treated as unusual or strange (Zandpour & Sadri, 1996), and tend to look for common responses, rather than original ideas. However, there is a great deal of within-group variation, such as there are Americans with the tendency to be more collectivist, and there are Chinese who are quite individualistic (Runco, 2007). Runco argued that "the East and the West both have something to offer creative efforts" (2007, p.266). The West encourages, rewards and expects individuality, and thus might make it easier for people to fulfill their creative potential. Nevertheless, individuals in the East are

typically more open to and in control of their emotions, and this is significant for creativity, because emotions are important in creative work (Runco, 1991). Moreover, nowadays governments in many countries around the world are promoting educational reforms which emphasize the importance of creativity and innovation. In addition, respect for originality is pervasive in both Western and Asian frames of thought, and creativity is thus inherent in all countries (Kharkhurin et al., 2008), although Runco (2007) noted that cultures cannot be directly compared, stating that "different cultures express creativity in different domains and behaviors" (p.267)

Creativity and gender: From Weiner's (2000) perspective, social-material developments, such as multiculturalism, globalism, feminism, and so on, have greatly accelerated the social-cultural transformations which have pushed people into a global and relativistic context, and continue to do so. As a result, the seeming certainty of traditional values has been undermined, as evidenced in the changes regarding people's understanding of creativity, especially in relation to gender differences. In the past, tasks associated with females, from parenting to housework, were not viewed by males as creative fields. In both Western and Asian societies, women were traditionally expected to do no more than fulfill their domestic duties, and thus many faced a struggle between neglecting these or creative potential (Nin, 1973). "To be "creative", a woman had to break into "male" fields. Therefore, the number of women

artist, writer, and composers whose work was publicly celebrated in the West before 1750 seems to be no more than a few score" (Weiner, 2000, p.222). Those females who succeeded in the traditional realms of male creativity were relegated to footnotes, assumed male names to get attention, or remained anonymous. Not until the late twentieth century did female scientists and innovators start to be recognized by historians, and before this the creative works of women were generally denigrated by men as "mere craft" (p.102), neither art nor science, and thus not valued. Today, however, "every aspect of our lives seems touched by change, and with each passing year, the intense change seems to increase….Many of the changes we witness have been propelled by innovation, and we need to be creative to cope with the changes" (Weiner, 2000, p.98). Since the number of males participating in these activities is rising, distinctions between male and female domains are fading, and cooking and childrearing are now more widely appreciated as being creative. Moreover, the stereotypical characteristics of women, such as being more emotional, open, and sensitive, have been highlighted by psychologists as indicative of creativity (e.g., May 1975; Adams, 1986; Chadwick & De Courtivron, 1993). Consequently, in the twentieth century, more and more women "have made their mark in traditionally creative domains like science, painting, music and writing" (Weiner, 2000, p.102) that were previously male, and men are increasingly sharing the burden of household

chores. However, “those responsibilities still fall disproportionately on women, greatly limiting their opportunities for creative expression” (Weiner, 2000, p.222).

In addition to considerations of cultural and gender differences, in order to support the co-construction of knowledge to increase group creativity through discourse via computer conferencing, an effective online learning teacher should also inspire students’ desire to contribute to the discussion. However, there has been controversy concerning structure (see section 2.3.1). The strategies of instruction to foster creativity need to be finely balanced between free, unstructured activities, and controlled, structured ones (Wheeler et al. 2002). The Department for Education and Employment publication ‘All Our Futures’ (DfEE, 1999) considers both freedom and control as important elements in creativity, but recognizes “…the mutual dependence of freedom and control at the heart of the creative process” (ibid, p.38).

There are many types of instructional strategy to enhance creative thought, among which brainstorming and Six Thinking Hats role play are the most frequently implemented. Brainstorming encourages every group member to generate ideas without role assignment, while Six Thinking Hats role play assigns every group member a specific thinking mode, and is thus highly-structured. Comparing the structure of group discussions, brainstorming is less structured than Six Thinking Hats

role plays. Incorporated with the theory of transactional distance, brainstorming and Six Thinking Hats are manipulated as two levels of the conference structure variable in this study, to find out if there are any different outcomes with regard to promoting creativity and perceptions of transactional distance. Adopting experimental research, the author established a comparison group with no limitation on conference structure. Therefore, the relationships between the level of structure, group creativity and transactional distance need to be further examined.

(a). Brainstorming

In one of the earliest attempts to develop a structured approach to the enhancement of creativity, Osborn found that conventional business meetings were inhibiting the creation of new ideas, and therefore developed the technique of brainstorming to stimulate people's thinking to solve problems creatively. He described brainstorming as a conference technique by which a group attempts to find solution(s) for a specific problem by amassing all the ideas spontaneously by its members (Osborn, 1953). The rules that Osborn came up with are (1) suspend judgment: no criticism of ideas, (2) quantity: go for large quantities of ideas, (3) cross-fertilize: build on each others ideas and (4) free-wheel: encourage wild and exaggerated ideas. Since it is very unlikely to think up the perfect solution at the first time, Osborn recommends first getting as many ideas as possible and then going back to examine them afterward, as quantity

produces quality.

(b). Six Thinking Hats

Six Thinking Hats is the title and subject of a book by Edward de Bono, published in 1985. de Bono's concern is not with theory, but with practice. Based on personal experience, de Bono (2000) found that in group discussion argument is inefficient, ineffective and slow as it was never designed to be constructive. Associated with the idea of parallel thinking, Six Thinking Hats provides a means for individuals and organizations to think more effectively, and a way to plan thinking processes in a focused, detailed and cohesive way.

The human brain thinks in a number of distinct directions, and de Bono identifies six distinct states that can be "sensitised" by the brain. In the Six Hats technique, wearing a particular color of hat requires the student to engage in a certain mode of thinking (Starko, 1995). By mentally wearing and switching "hats", participants can easily focus or redirect thoughts, the conversation, or the meeting. Six distinct states are identified and assigned a color (retrieved from http://www.debonogroup.com/six_thinking_hats.php):

(1). *White hat* (Blank sheet, Information): it calls for information known or needed.

(2). *Red hat* (Fire, Emotion): it signifies feelings, hunches and intuition. When using this hat you can express emotions and feelings and share fears, likes, dislikes, loves, and hates.

(3). *Yellow hat* (Sun, Good point judgment): symbolizes brightness and optimism. Under this hat you explore the positives and probe for value and benefit.

(4). *Black hat* (Judge's robe, Bad point judgment): It is judgment- the devil's advocate or why something may not work. Spot the difficulties and dangers; where things might go wrong.

(5). *Green hat* (Plant, Creativity): It focuses on creativity; the possibilities, alternatives, and new ideas. It's an opportunity to express new concepts and new perceptions.

(6). *Blue hat* (Sky, Thinking): The Blue Hat is used to manage the thinking process. It's the control mechanism that ensures the Six Thinking Hats guidelines are observed.

Regarding the learners' characteristics, Sternberg (1997) contended that learners are generally more engaged and motivated when the learning context is compatible with their cognitive style when processing information. It is not surprising certain kinds of cognitive styles and strategies are mitigated in online learning contexts, while others

flourish (Friend & Cole, 1990; Kozma, 1991; Lynch, 2001). When considering the interaction of thinking styles and conference structure, it has been postulated that students with legislated thinking style using the Six Hats method (the highest structured) and students with executive thinking style in the comparison group (not structured) will perceive more transactional distance and negative online experiences. On the other hand, legislative students in the comparison group and executive students using the Six Hats method will perceive less transactional distance and more positive online experiences.

2.4.2 Integration of Internet technology

With regard to the e-learning environment, Benson and Samarawickrema (2009) contended that it is necessary to consider the specific implications of the range of contexts in which learning might take place. Internet applications to enhance the learning process in higher education are becoming increasingly popular. The current research is focused on the communication application of the Internet to enhance learning experience. Communication with other individuals and groups, the basis of collaborative learning group work, allows for exchange of ideas, insights, and cultures (Newby et al., 2006). Anderson (2004) presented a diagram to show different media's capacity to support independence and interaction (see Figure 6). We can see that,

compared to other forms, computer conferencing is the best option for high interaction and independence of time and distance.

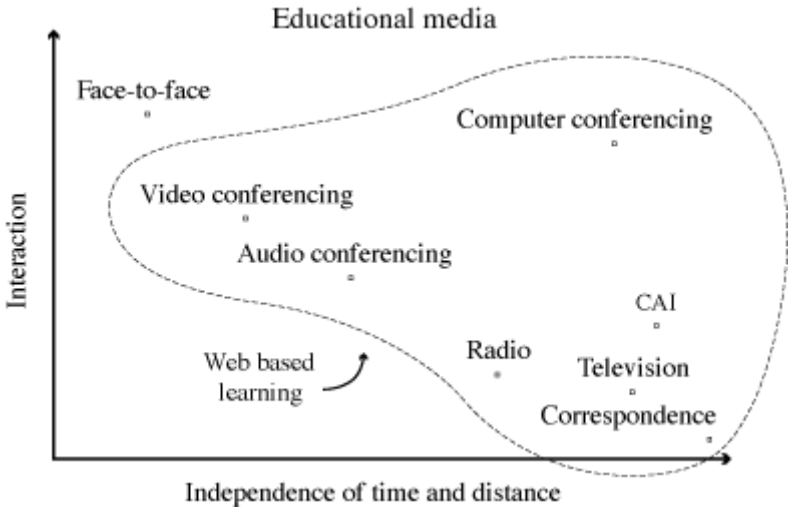

Figure 6: Attributes of educational media (from Anderson, 2004, p.45)

Many online classes use computer conferencing. Despite the geographical distance among the participants, "students and the instructor can carry out classroom discussions, dialogue and debate" (Yildiz & Chang, 2003). Computer conferencing can be divided into synchronous and asynchronous modes. In synchronous communications all participants in different places are online at the same time, while asynchronous communications occurs without time constraints.

In this research, synchronous online discussions that require real-time online participation are the major concern. Synchronous computer conferencing was chosen and live chat group discussion was employed for completing the group task. The

strength of using computer conferencing includes not only its capability to enhance communication among learners for sharing ideas and files, but also that participants can individually access online information from a variety of resources very quickly at the same time. One of the reasons for choosing the synchronous mode is that synchronous communication allowing immediate feedback provides motivation to distance learners. Mason (1998, p.31) stated that online synchronous modes "focus the energy of the group, providing motivation to distance learners to keep up with their peers and continue with their studies", "such participation in presentation also reinforces or enhances motivation, including self-direction". It is expected that employing online synchronous group discussions will raise the participants' contributions to discourse and reduce the dropout rate. Another consideration is that the synchronous mode is more appropriate for achieving a more fruitful conversation, when participants get together and stimulate the generation of creative ideas in real time. Since both brainstorming and the Six Hats method which are highly effective techniques for maximizing a group's creative potential are thus better used in a synchronous mode.

2.5 Summary

After reviewing the literature on the evolution of distance teaching and learning, various strategies for increasing students' creativity and reducing their transactional

distance when using synchronous computer conferencing as the medium in an online learning environment have been proposed by the author. Grounded on Moore's theory of transactional distance and Sternberg' thinking styles to design online collaborative learning activities and then measure the outcomes, the research framework and analytical matrix in this study have the following two dimensions as independent variables, group composition and conference structure. This study aims to uncover:

(i) the relationships between gender, thinking styles, group composition and both individual and group creativity;

(ii) whether grouping and structuring in synchronous computer conferencing have different effects on the two dependent variables in terms of the creativity of the group project, and student perceptions of transactional distance.

The next chapter provides details regarding the research design. It will present the methods and procedures used to empirically investigate the research questions and hypotheses of this study. In addition, the methods of data collection, data analysis, reliability and validity are also discussed.

Chapter 3: METHODOLOGY

This section describes the methodology chosen for this quantitative study. The target population for this work was full-time university students in Taiwan. Students from the researcher's teaching university, which is located in the southern part of Taiwan, served as the non-random convenience sample in this study. This research examined the proposed effects of group composition and conference structure on group creativity and individual perceptions of transactional distance. The scope of this research was restricted to: (1) the use of only the legislative, executive and judicial thinking styles, not all 13 subscales of thinking styles, as seen in either homogeneous or heterogeneous groups, and (2) the use of only two strategies, namely Brainstorming and Six Thinking Hats, to organize the conference structure. This chapter provides further details of the specific research methods employed, research procedures, the operationalization of the key variables, the development of the research instruments and a personal development questionnaire for gathering data, along with the analysis techniques. A graphic representation of this research project is depicted in Figure 7.

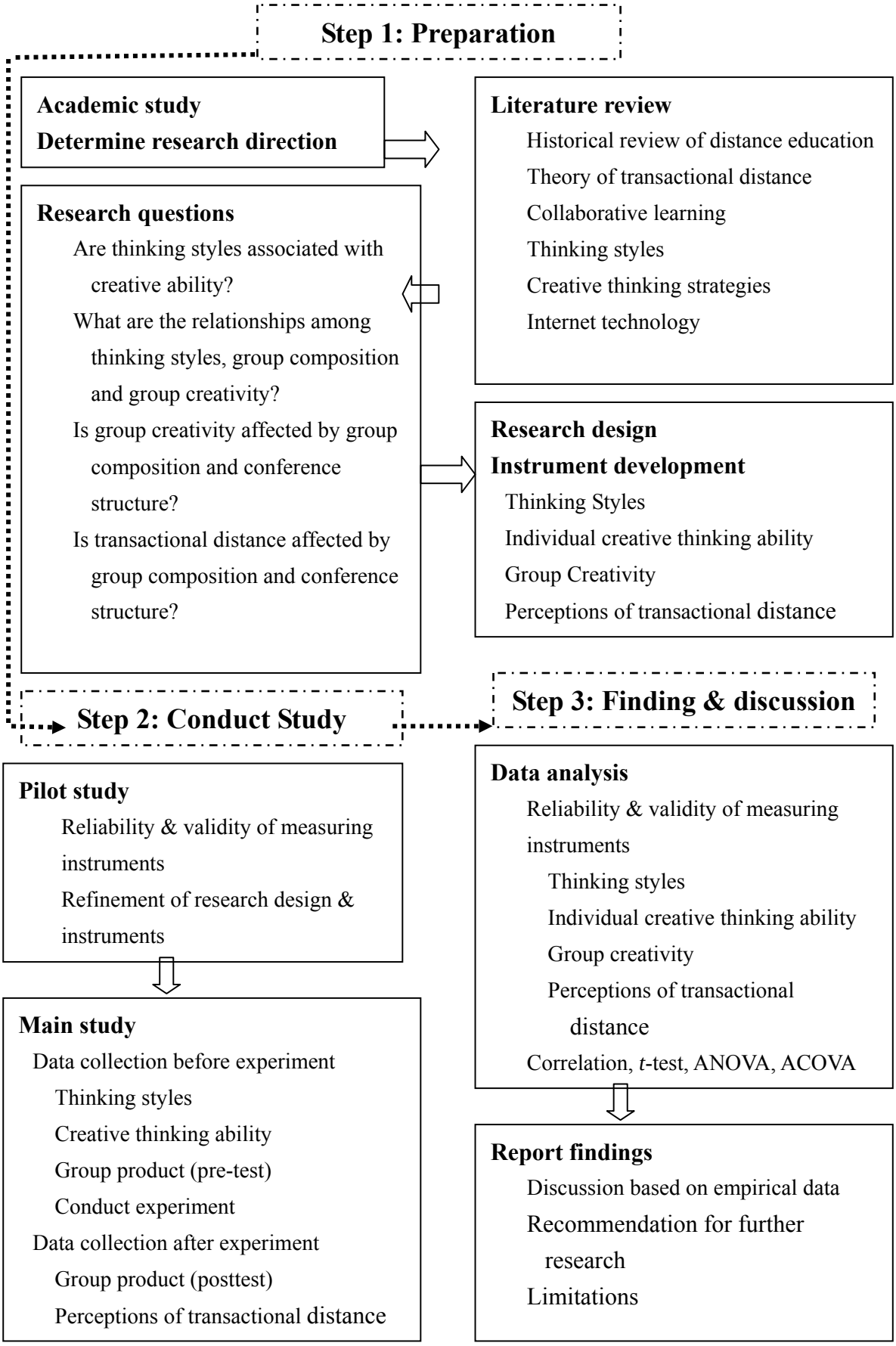

Figure 7: Graphic representation of this research project

3.1. Research design

Only a few studies compare group composition and conference structure with regard to the specific creative thinking strategies adopted, or analyze their effects on group creativity and transactional distance in synchronous computer conferencing. The research aims of this thesis were thus to investigate the relationships among thinking styles and creative thinking ability, and to test whether grouping and structuring in synchronous computer conferencing have different effects on the creativity of the group assignment and student perceptions of transactional distance. The appropriate approach to examine a research problem depends on what is being investigated (Silverman, 2001). As Blaxter et al. (2001, p.59) stated "different kinds of research approaches provide different kinds of knowledge about the phenomena under study". In this study, a mixed research design was used to examine the research questions through analysis and interpretation of the data gathered. The reasons for adopting various specific approaches in the present research will be described in the following sections.

3.1.1 Methods

A quantitative research method is most appropriate when a study seeks explanations and predictions that can be generalized to other participants, settings, and times, and which aims to establish, confirm, or validate relationships (Leedy & Ormrod, 2005).

In addition to experiments which choose subjects for treatment conditions, Creswell (2003) suggested that quantitative approach following a mixed approach should also include surveys that are calibrated to ensure validity and reliability to form generalizations. Therefore, the research strategies of experiment and survey for data collection were used in the present study.

I. *Experiment design*: An experimental approach is the most powerful method for examining a causal hypothesis, namely whether a specific intervention produces certain outcomes. The four-step procedure of experimental research is: (1) randomly assign subjects to control and experimental groups; (2) provide a treatment or intervention (the independent variable) to the experimental group; (3) provide no treatment or intervention to the control group; and (4) compare the outcomes (the dependent variable) for the control and experimental groups. By controlling the independent variables, the major advantage of an experimental research design is that it "enables the researcher to determine who receives the treatment, when it starts, what it consists of, and how much of it is administered" (Vogt, 2007, p.100). True experimental design is defined by a manipulation coupled with random assignment of subjects to groups (Suter, 2006), with all participants having an equal and independent chance of being assigned to each group. The purpose of random assignment is to try to equate groups over extraneous variables, and ensure that any differences are due to

chance. However, in social research, especially in natural school settings, researchers are usually unable to employ random assignment of participants to control and experimental groups. Instead, they commonly use a quasi-experiment design, using pre-existing groups such as classes, and then randomly assign treatments to these non-randomly assigned groups. In quasi-experiments, the control group is often called a comparison group (Vogt, 2007). Because the researcher was interested in making comparisons as well as identifying cause-and-effect relationships, a quasi-experimental approach was adopted in this work. Nevertheless, the lack of random assignment means that it is necessary to make considerable efforts to determine the comparability of the comparison and experimental groups. The author thus tried to ensure the experimental and comparison groups were as similar as possible in the real study.

Sometimes a change in an experimental group which could mistakenly be attributed to the treatment may due to extraneous influences, and consequently it is difficult to interpret the effects caused by the treatment itself. To avoid misinterpretation, the use of a comparison (untreated) group is vital to allow the researcher to discover relationships among variables (Suter, 2006). In addition, the use of a pretest allows for the assessment of change, with the results functioning as each group's baseline.

Based on the thinking styles proposed in Sternberg's mental self-government theory and Moore's theory of transactional distance, different grouping and structuring strategies were developed and manipulated in this study. In addition to exploring the separate main effects of group composition and conference structure on group creativity and individual perceptions of transactional distance, the researcher was also interested in understanding if there was an interaction effect (i.e., a joint effect of independent variables). The 3 x 3 factorial quasi-experimental design employing a pretest-posttest comparison group, with thinking styles being a measured (i.e. naturally occurring) factor and conference structure being a manipulated factor, is outlined in Figure 8 and Table 5.

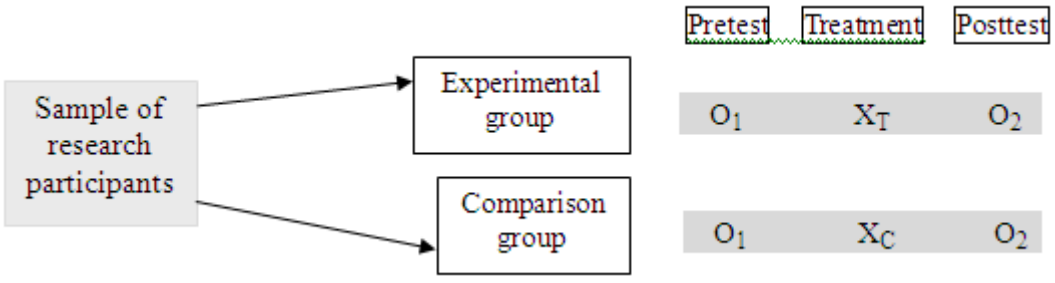

Figure 8: Pretest-posttest comparison-group design in which X_T represents the treatment condition, and Xc represents the comparison or no treatment condition, and O_1 and O_2 represent the pretest and posttest assessment of the dependent variable.

Table 5: Framework of factorial quasi-experimental design

		Conference Structure		
		High	***Low***	***No***
Group composition		Class A Experimental group 1 Strategy: Six Thinking Hats	Class B Experimental group 2 Strategy: Brainstorming	Class C Comparison group Strategy: None
	Homogeneou	Legislative groups/ Executive groups/ Judicial groups	Legislative groups/ Executive groups/ Judicial groups	Legislative groups/ Executive groups/ Judicial groups
	Heterogeneous	Mixed groups	Mixed groups	Mixed groups

Note. This table is explained in Section 3.1.2

II. *Survey design*: A questionnaire survey provides a numerical description of a certain segment of a population. Questionnaires are thus valuable tools that can be used to gather information about a group's characteristics, motives, attitudes, preferences and demographic composition (Gay et al., 2009). As a quantitative approach, questionnaires typically have close-ended questions grouped in specific response categories. Questions are often scaled, allowing the researcher to quickly tabulate and analyze results statistically (Creswell, 2003; Dressler, 1999; Jackson, 1988). However, if all the questions and all the possible answers are determined in advance, the element of discovery is much reduced, as it is impossible to know what lies behind the responses selected or what answers the respondents might have given had they been free to answer as they wished (Gillham, 2000). To overcome the limitation of

close-ended questions, open-ended questions are often used, and these have the following strengths (Bauer & Gaskell, 2000; Gantley et al., 1999; Gillhan, 2000; Kumar, 2005): (1) open-ended questions avoid imposing the researcher's perspective on respondents; (2) respondents will comfortably come up with open responses that express their opinions about a particular subjects; (3) open-ended questions allow for free-ranging, unexpected answers in the respondents' own words. (4) As open-ended questions allow respondents to express themselves freely, they virtually eliminate the possibility of predetermined item bias. And (5) open-ended questions can provide vivid examples for inclusion in a report on the survey. Therefore, in addition to using a survey questionnaire with close-ended questions to provide a broad picture of students' perceptions on transactional distance, the present research also adopted a qualitative approach with open-ended questions to cover the same ground in more depth.

3.1.2 Operationalization of key variables

The primary purpose of this study was to investigate the relationships between thinking styles and creative thinking ability, and examine whether group composition and conference structure affect group creativity and student perceptions of transactional distance. There are two major types of independent variables applicable

to the research questions. First, there are attribute variables, which measure the preexisting characteristics of the research participants. The attribute variables in this study include thinking styles and creative thinking ability. If thinking styles are significantly related to creative thinking ability, then creative thinking ability would serve as a control variable. Second, there are manipulated variables, and these reflect a presumed cause and set up the conditions for comparison (Suter, 2006). In this study, the manipulated variables are group composition (homogeneous and heterogeneous) and conference structure (no, low and high). Moreover, the dependent variables reflect the presumed effects of the manipulation of the independent variables (Suter, 2006), and these are the measured outcomes. In this study, the dependent variables are group creativity and student perceptions of transactional distance. All of the variables are defined below.

(A). Independent variables

1 *Thinking styles*: these are based on the test scores of the Sternberg-Wagner Thinking Styles Inventory (TSI), with higher averaged scores indicating a greater tendency to use the evaluated thinking style. See Section 3.2.1 for further details.

2 *Creative thinking ability*: this refers to the test scores of the Abbreviated Torrance Test for Adults (ATTA). The independent variable in this study is the overall

creative performance, the Creative Index. The four sub-scores of the four creative abilities including fluency, originality, elaboration, and flexibility are also tested and analyzed. See Section 3.2.2 for further details.

3 *Group composition*: in this study, the participating students' thinking styles served as the grouping criteria. Based on the scores of the TSI, they were assigned to homogeneous (executive thinking style, legislative thinking style, judicial thinking style) and heterogeneous (mixed thinking styles of the former three) groups. In this research, when the scores of the legislative, executive or judicial thinking styles were equal for an individual, the results of the group assignment for the individual were evaluated by his/her profile of all the TSI scores (see Section 2.4.1.2).

4 *Conference structure*: Based on the creative thinking skills strategies examined in this work, the structures used for the computer conferencing had three levels: high and low structures for two separate experimental classes and no structure for one comparison class, as explained below.

(i). A high-structured conference used the Six Thinking Hats approach. In this method, different color hats represent different thinking modes, and

group members were required to think according to the color assigned to them during the group conference. A student assigned as a white hat focused on the information base, a red hat dealt with hunches and emotions, a green hat signaled energy for creative proposals and alternatives, a black hat was for judgment and preventing dangerous actions, a yellow hat represented sunshine and optimism, while a blue hat oversaw the whole process.

(ii). A low-structured conference used the brainstorming approach which allowed group members to communicate any idea, however strange or wild, to the rest of the group without any evaluation of it in the idea generation phase. All ideas thus produced were then examined in the subsequent evaluation phase.

(iii). An unstructured conference did not use any creative thinking skills strategies. Group members were not given guidance and felt free to speak whenever they wanted to.

(B). Dependent variables

Group creativity: refers to the scores for the group websites, as determined by the combination of sub-scales from the CPSS.

Individual perceptions of transactional distance: refers to the results of a self-developed questionnaire.

3.1.3 Research questions and hypotheses

Overall, the proposed framework (see Table 5) describes the interaction between group composition and conference structure. Based on the research questions, the following hypotheses were generated, and each of these was tested in an attempt to understand the relationships among the variables and to answer the following research questions:

***Question 1**: Are there any relationships among gender, thinking styles and creative ability*?

Hypothesis 1.1

Ho: There are no differences between male and female students in thinking styles.

Ha: There are differences between male and female students in thinking styles.

Hypothesis 1.2

Ho: There are no differences between male and female students in creative ability.

Ha: There are differences between male and female students in creative ability.

Hypothesis 1.3

Ho: There is no association between individual creative ability and thinking styles.

Ha: There is an association between individual creative ability and thinking styles.

Question 2: *Is individual creative ability related to the overall group creative performance?*

Hypothesis 2

Ho: The average of group member creative ability is not correlated with the overall group creative performance.

Ha: The average of group member creative ability is correlated with the overall group creative performance.

Question 3: *Do group composition and conference structure have an effect on group creativity, and do group composition and conference structure interact?*

Hypothesis 3.1

Ho: There is no difference between the types of group composition with regard to group creativity.

Ha: There is a difference between the types of group composition with regard to group creativity.

Hypothesis 3.2

Ho: There is no difference between the levels of conference structure with regard to group creativity.

Ha: There is a difference between the levels of conference structure with regard to group creativity.

Hypothesis 3.3

Ho: There is no interaction of group composition and conference structure with regard to group creativity.

Ha: There is an interaction of group composition and conference structure with regard to group creativity.

Question 4*: Do group composition and conference structure have an effect on individual perceptions of transactional distance, and do group composition and conference structure interact?*

Hypothesis 4.1

Ho: There is no difference between the levels of group composition with regard to individual perceptions of transactional distance.

Ha: There is a difference between the levels of group composition with regard to individual perceptions of transactional distance.

Hypothesis 4.2

Ho: There is no difference between the levels of conference structure with regard to individual perceptions of transactional distance.

Ha: There is a difference between the levels of conference structure with regard to

individual perceptions of transactional distance.

Hypothesis 4.3

Ho: There is no interaction of group composition and conference structure with regard to individual perceptions of transactional distance.

Ha: There is an interaction of group composition and conference structure with regard to individual perceptions of transactional distance.

Question 5: *What are the relationships among the dimensions of transactional distance?*

Hypothesis 5

Ho: The dimensions of interaction distance are not intercorrelated.

Ha: The dimensions of interaction distance are intercorrelated.

The entire research involved the following three phases. Phase 1: data collection instruments were developed, pretested and modified. Phase II: pilot research was conducted using an equivalent sample from the target population (university students). Phase III: the main study was conducted using modified research design and instruments. Each of the phases is further described in the following sections.

3.1.4 Informed consent and protection of privacy

To ensure that participation was voluntary, the purpose of the study was explained to the participants and they were informed about the related research ethics, and told that the data they provided would be kept confidential and not used for any other reason except for the execution of this study. Moreover, no individual respondent would be linked to any specific response. Informed consent forms (see Appendices B and F) were then provided and signed by the participants prior to running the tests and survey. Incomplete tests and questionnaires were not used in the study. All submissions of the data were only available to the researcher, and the results were coded and stored in Word, Excel and SPSS. The identity of participants as well as the data sets remained confidential. Participants were told that they could receive the results of the study upon request.

3.2. Phase I: Development of research instruments

Research conclusions derived from converging evidence are more credible than research findings which are based on only one source of evidence. This study adopted a mixed approach using both quasi-experimental and survey strategies. The two main criteria for a good research instrument are reliability and validity. Reliability represents the consistency of an instrument in measuring a given performance or

behavior under near-identical conditions, while validity is concerned with the degree to which an instrument actually measures what it purports to measure (Jaeger, 1990). The various types of data and collection methods are summarized in Table 6, and the processes of the instrument development along with the tests of instrument reliability and validity are described in more detail in the following subsections.

Table 6: Types of data collection and methods

Data	Methods
Thinking Styles	Using the Sternberg-Wagner Thinking Styles Inventory
Creative Ability	Using the Abbreviated Torrance Test for Adults (ATTA)
Group Creativity	Adapting the Creative Product Semantic Scale to develop an evaluation form
Perceptions of Transactional Distance	Using a self-developed questionnaire containing close- and open-ended questions

3.2.1 Measurement of thinking styles

An existing instrument was used in the present investigation, the Thinking Styles Inventory (TSI; Sternberg-Wagner, 1992), which is among the best of a number of standardized questionnaires that were developed to operationalize students' dispositions to adopted specific approaches to thinking. "Thus far, over 100 studies have been conducted on the theory of mental self-government, all lending strong support to it" (Zhang, 2010, p.594). The TSI, a self-report measure to assess general

thinking styles, consists of 13 subscales corresponding to the 13 thinking styles illustrated in Sternberg's mental self-government theory. The TSI consists of 104 items, eight for each of the 13 subscales, with no questions appearing in more than one subscale (Sternberg & Wagner, 1992). For each self descriptive sentence, the respondents were asked to rate themselves on a seven-point Likert scale, with 1 indicating that the statement does not at all describe the way they usually carry out tasks, and seven indicating that it describes it extremely well. Examples of items from the inventory are: "When faced with a problem, I use my own ideas and strategies to solve it" (legislative style); "When discussing or writing down ideas, I follow formal rules of presentation" (executive style); and "I enjoy work that involves analyzing, grading or comparing things" (judicial style). The TSI is presented in Appendix C.

Reliability and validity of the TSI. Zhang and Sternberg reported (2009a) that the usefulness of this inventory has been assessed with a variety of populations, including students, teachers, parents, and working adults from different walks of life. Moreover, it has also been validated in many studies in cross-cultural contexts, including the United States (e.g., Grigorenko & Sternberg, 1997; Sternberg & Grigorenko, 1995), Hong Kong (e.g., Zhang, 1999; Zhang & Sachs, 1997; Zhang & Sternberg, 1998), China (e.g., Zhang, 2001b; Zhang & Sachs, 1997), Spain (e.g.,

Cano-Garcia & Hughes, 2000), and more recently, Norway (e.g., Fjell & Walhovd, 2004), Korea (e.g., Park et al., 2005), Turkey (e.g., Fer, 2005), and the United Kingdom (Zhang & Higgins, 2008). Most of these studies have obtained reasonably good reliability and validity. Findings from studies carried out in Taiwan (e.g., Chen, C. -H., 2001; Chen, Y. -W., 2001; Chou, 2001; Chu, 2006; Weng, 2000) also largely supported the test's reliability and validity.

Normative data was collected for various age groups in Sternberg and Wagner's 1992 study. For a college sample, subscale reliabilities ranged from .42 to .88, with a median of .78. In another study with the TSI (Sternberg, 1997), Cronbach's alpha coefficients were generally satisfactory for the 13 scales reliabilities, ranging from .57 to .88, with a median of .82. Only one scale was in the .50s, two were in the .60s, and one was in the .70s, while the rest were in the .80s. The internal validity of the TSI was assessed through factor analysis, and the results in Sternberg (1994b) showed that the 13 subscales accounted for 77% of the variance in the data, and fitted to the five dimensions of the thinking styles described in the mental self-government theory. The TSI has also exhibited external validity, and this was examined by testing thinking styles not only against other inventories based on different theories of styles, such as the Myers-Briggs Type Indicators (Myers & McCaulley, 1985) and Bigg's (1992) Study Process Questionnaire, but also against

several variables that are predicted to be related to thinking styles, such as academic achievement, self-esteem, cognitive and psychological development and personality traits (see Zhang & Sternberg, 2006 for details). The results of these studies supported the argument that thinking styles are different from ability, and that the theory of self-mental government may bridge intelligence and personality. The results from these studies also showed that the Thinking Style Inventory is a reliable and valid instrument for examining thinking styles across cultures.

With the aim of developing an effective Chinese version for the main study, the researcher first searched the "Taiwan Theses and Dissertations Knowledge Value-Added System" and selected some Chinese versions translated from the original TSI. The researcher then consulted five English teachers, and each of them independently selected the most appropriate Chinese translation item by item according to the original English version. At the same time, they were asked to modify the Chinese translation if necessary. Based on their feedback, and being university lecturers of Chinese, the researcher and her colleague collaboratively refined this Chinese version of the instrument. This new Chinese version was then translated back into English again by another English teacher fluent in both languages. Finally, a discussion was hold between the researcher and the English teacher to confirm the face validity.

Test items were further sent to respondents to obtain suggestions for modification. Recruited from the target population, 10 students volunteered to test this new version. It was a self-report test in which respondents rated themselves on a seven-point scale, with "1" indicating that the statement does not describe them at all and "7" indicating that the statement characterized them extremely well. The researcher also added "8" indicating "don't understand the question" and "9" indicating "not sure". Based on feedback from these respondents, the final Chinese version of the TSI was created for the current study (see Appendix D). The next step was in the use of a pilot study to examine the appropriateness and stability of this Chinese version of the TSI for university students, and the results of these are presented in Section 3.3.5.

3.2.2 Measurement of creative thinking ability

Because the complex nature of creativity makes its evaluation difficult, there are a large number of tests that assess different components of it, and many different approaches have been adopted, including: (1) divergent thinking tests, (2) interest and attitude inventories, (3) personality inventories, (4) biographical inventories, (5) ratings by teachers, peers, and supervisors, (6) judgment of products, (7) self-reported creative activities and achievement, (8) eminence, and (9) other creativity assessment

procedures (Hocevar & Bachelor, 1989). It is generally agreed that the Torrance Tests of Creative Thinking (TTCT) - created by Torrance (1966, 1974, 1981, 1990) and used internationally despite their weakness with regard to construct validity- are by far the most influential and longest-running creativity assessment tests (Almeida et al., 2008; Amabile, 1996; Kaufman et al., 2008; Kim, 2006; Shaughnessy, 1995; Sternberg, 2006; Wechsler, 2006).

Torrance (1965, 1966, 1988) defined creative thinking as the ability to sense problems, make guesses, generate new ideas, and communicate the results (Wang, 2011), and the rationale behind the TTCT is described by Hakuta (1983, p.44) as follows: “For Torrance, creativity is closely identified with divergent productions and transformations with the ability to take different perspectives and different approaches to a given problem.” Over several decades the administration and scoring of this tool was refined by E. Paul Torrance and his associates, and the current TTCT is a set of standardized instruments including Verbal (thinking creatively with oral or written responses) and Figural tests (thinking creatively with pictures). Furthermore, there are two forms of each test, A and B, and each activity on the tests is based on research linking the required ability to creativity (Cramond et al., 2005; Torrance, 1966, 1974). Building on Guilford's (1950, 1967) structure-of-intellect model, the TTCT originally involved simple tests of divergent thinking (the quantity and quality of creative ideas

produced by the test taker) as well as in other problem-solving skills, which were scored based on the following four divergent abilities associated with creativity (Torrance, 1966, 1974, 1990): fluency (the number of relevant responses), flexibility (the number of different categories or shifts in responses), originality (the statistical rarity of responses) and elaboration (the number of details used to extend a response). A revision of the TTCT published in 1984 replaced the Flexibility scale from the figural test with “Resistance to Premature Closure” and “Abstractness of Titles”.

In the current research, creative thinking ability was tested with the Chinese version of the Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2002a) which is a standardized, shortened version of the TTCT. Since both the Verbal (45 minutes) and Figural (30 minutes) forms of the TTCT require considerable testing time, the ATTA is particularly time-efficient when administering it to adults. The ATTA consists of one verbal and two picture-drawing activities utilizing the same rationale as activities in the original TTCT, each taking three minutes (See Table 7 and Figures 9, 10 and 11), and the time needed to complete the Chinese version of the ATTA is also approximately 15 minutes.

Table7: The activities in the ATTA

Task 1: verbal activity The participants are asked the following question: "*Just suppose you could walk on air or fly without being in an airplane or similar vehicle. What problems might this create? List as many as you can.*" (1). The participants are given three minutes to list as many of these problems as they can.
Task 2: figural activity The participants are given a page on which there are two incomplete drawings. The participants are then told to use the incomplete figures to make some pictures that are unusual and interesting and to give each picture a title. (2). The participants are given three minutes to complete this task.
Task 3: figural activity The participants are given a page that contains 3x3 isosceles triangles. The participants are asked to make as many pictures as possible using these triangles. The participants are told that every picture should have a meaning and a title. (3). The participants are given three minutes to complete this task.

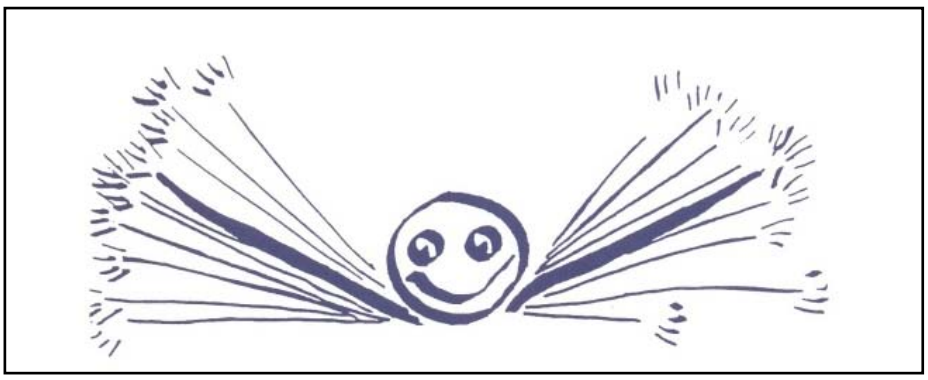

Figure 9: Task 1 of the ATTA

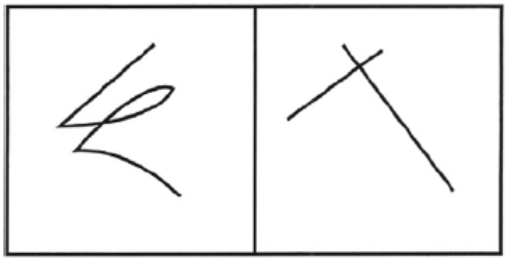

Figure 10: Task 2 of the ATTA

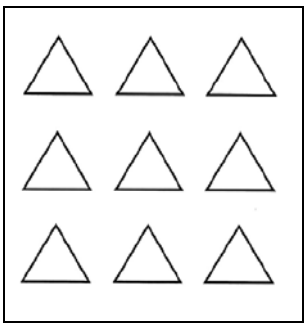

Figure 11: Task 3 of the ATTA

The ATTA provides substantial insight into the creative ability of adults by quantifying both verbal and figural creative strengths. It consists of four norm-referenced abilities in terms of fluency, originality, elaboration, and flexibility along with fifteen criterion-referenced creativity indicators. The first activity scales scores for fluency and originality. The second activity scales scores for fluency, originality and elaboration; and the third activity scales scores for all the four abilities. The test manual provides strict scoring criteria for each activity, and the operational definitions of the norm-referenced abilities are as below (Goff & Torrance, 2002b):

(1). Fluency

- For task 1, fluency is defined as the total number of different consequences or possibilities produced.
- For Tasks 2 and 3, fluency is defined as the number of objects or pictures made from the incomplete figure (Task 2) and triangles (Task 3).

(2). Originality

- For all tasks, originality is defined as the ability to produce uncommon or novel-original responses that do not appear on the list of common answers provided by the test manual.

(3). Elaboration

- For Tasks 2 and 3, elaboration is defined as the ability to embellish ideas with details.

(4). Flexibility

- For Tasks 3, flexibility is defined as the ability to process information or objects in non-traditional ways given the same stimulus, and involves switching from one conceptual field to another.

To assess the four measures on a comparable scoring scale, raw scores of fluency, originality, elaboration and flexibility are converted into four normalized standard scores with values of 11 through 19, and then summated to form the ATTA Creativity Ability score (range from 44 to 76). In addition, 15 more creativity indicators are evaluated to properly score the test. Each creativity indicator is scored on a three-point scale of 0 (if the indicator does not occur), 1 (if the indicator appears once), or 2 (if the indicator appears more than once). Verbal responses are assessed using the following five creativity indicators: (1) Richness and Colorfulness of Imagery, (2) Emotions/Feelings, (3) Future Orientation, (4) Humor: Conceptual Incongruity and (5) Provocative Questions. Figural responses are assessed using the following 10 creativity indicators: (1) Openness: Resistance to Premature Closure, (2) Unusual

Visualization, Different Perspective, (3) Movement and/or Sound, (4) Richness and/or Colorfulness of Imagery, (5) Abstractness of Titles, (6) Context: Environment for Object, Articulateness in Telling Story, (7) Combination/Synthesis of Two or More Figures, (8) Internal Visual Perspective, (9) Expressions of Feelings and (10) Emotions and Fantasy (Goff & Torrance, 2002b). The results from the verbal and figural responses are summated to establish criterion-referenced creativity indicators (range from zero to 30). Finally, the ATTA Creativity Ability score and the criterion-referenced creativity indicators are added together, giving the Creativity Index (CI, range from 44 to 106). In total, the seven-point scale of the CI represents the level of creative ability: 1 means minimal creativity and 7 indicates substantial creativity. In this study, one of the attribute variables used in the analysis is the overall creative ability in term of the Creativity Index (CI).

Reliability and validity of the ATTA. According to Goff and Torrance (2002a), evidence for ATTA's reliability and validity has been provided in a variety of studies (Chen, 2006; Goff & Torrance, 2002b; McCracken, 1997; McCann, 2005; Kim, 2006; Runco et al., 2006; Wechsler, 2006). The ATTA manual reports that inter-rater reliabilities of the ATTA in the initial form range from .95 to .99. The Kuder–Richardson reliability coefficient (KR21) for the total raw score with the creativity index is .90, while that of the raw score for the four creative abilities ranges

from 0.38 to 0.84. The Chinese version of the ATTA was released by Psychological Publishing in 2006. In consideration of the relevant regional and other factors, the standardized Chinese version sampled 627 adults in various occupations (male = 220; female = 407) covering ages from 18 to 57 to establish the norm in Taiwan. The Chinese version reported inter-rater reliabilities ranging from .31 to .98 ($p < .01$) and test-retest reliability ranging from .34 to .68 ($p <. 01$), and thus has acceptable stability. The external validity was supported by the correlation coefficients of .46 (verbal sections, $p <. 01$) and .37 (figural sections, $p <. 05$) between the Chinese version of the ATTA and the Problem Solving Creativity Test (2005, Ju). After filling out a research application form and conditional use agreement, the researcher purchased and received permission from the publisher to use the Chinese version of the ATTA.

3.2.3 Measurement of group creativity of products

There are two major approaches to measuring product creativity. One is the consensual assessment technique (CAT) proposed and tested by Amabile. According to Amabile (1983), “a product is creative to the extent that appropriate observers independently agree it is creative (p.31)”. Typically, “appropriate observers” are domain-specific experts. Based on the concept that creativity is understood when one sees it, and that no universal criterion exists, the CAT is a subjective judgment

independently assessed by expert judges (Horn & Salvendy, 2006). Based on general cultural values within a society, the CAT's assumption is that consistencies will underline the assessments of judges (Child, 1970), and the construct validity of this approach has been shown to have high inter-rater reliability (Horn & Salvendy, 2006). Specifically, studies of the CAT reported inter-rater reliabilities of .72 to .98 (e.g., Amabile, 1982; Baer, 1994; Brinkman, 1999; Chen et al., 2002), although the predict validity was not reported.

In addition to the subjective judgment of CAT, referenced to the Creative Product Analysis Matrix (CPAM; Besemer & Trefiger, 1981) and its measurement scale, the Creative Product Semantic Scale (CPSS; Besemer & O'Quin, 1986, 1987), a more objective approach to measuring creativity, was also employed in the current research. The CPAM is a three-dimensional model that relates to the three most important indicators of creativity in products (Besemer, 2000): (1) novelty, (2) resolution, and (3) elaboration and synthesis (or recently called style). The three dimensions are defined as follows:

> "Novelty considers newness in materials, processes, concepts, and methods of making the product. Resolution considers aspects of how well the product works or functions. Elaboration and Synthesis describes stylistic components of the product."

(Besemer & O'Quin, 1999, p.287)

The CPAM offers a big picture look at product characteristics, and it can be used in products of all kinds, such as works of art, new product ideas in manufacturing, or other artifacts of the creative process (Besemer, 1998, 2000). Based on the theoretical model of the CPAM, Besemer and O'Quin (1986, 1987) developed the Creative Product Semantic Scale (CPSS). This measurement tool is intended to be useable across domains as well as by non-expert judges, and was therefore created to provide a standardized procedure through which the results of the assessments of these dimensions would be valid and reliable (Besemer & O'Quin, 1993). The CPSS posits that by using a validated and reliable instrument, even people with no special training or expertise can make meaningful judgments about creative products using a quick-to-administer questionnaire. Besemer (2000, p.62) noted that "Raters do not have to have a design background; they can select a rating by asking themselves, "Is the product concept drawing more like this word, or more like that word?" Moreover, according to Besemer and O'Quin (1999, p.288), "The ability to use untrained judges in studies of creativity increases the generalizability of results to the natural environment and demystifies the notion of creativity in products". It is assumed that based on general cultural values within a society, consistencies will underlie the assessments of judges (Child, 1970).

The CPSS has been praised in a number of studies as the most appropriate method for assessing creativity in a broad range of products (Amabile, 1996; Davis, 1992; Dunbar, 1999; Hennessey, 1994; Plucker & Renzulli, 1999). Along lines of the CPAM model, the CPSS focuses on measuring how well the creative product is made, or how well it is executed, as well as its originality and appropriateness. Each of three dimensions (novelty, resolution, and elaboration and synthesis) is measured with several semantic pairs on a seven-point scale. The CPSS instrument has been developed and refinement through a number of empirical studies (e.g., Besemer, 1998; Besemer & O'Quin, 1986, 1987, 1993, 1999; O'Quin & Besemer, 1989, 1999), which have included testing the reliability of the items and scales, as well as a factor analysis. As a result, the items and subscales have undergone many changes and have been reduced in number to improve their reliability and to make them easier to administer (Besemer, 1998). In the shortest version, nine subscales make up these three dimensions: original and surprising for novelty; logical, useful, valuable, and understandable for resolution; organic, well-crafted, and elegant for elaboration and synthesis (see Appendix E for details).

Reliability and validity of the CPSS. Based on the data analysis and results in their various studies (Besemer, 1998; Besemer & O'Quin, 1986, 1987, 1999; O'Quin & Besemer, 1989, 1999), Besemer and O'Quin reported that the reliability and validity of

the CPSS instrument has been strongly supported. The CPSS has shown adequate internal reliability, with reported measures ranging from 0.69 to 0.91 (Horn & Salvendy, 2006). The three sub-scales of the CPSS can be used together or individually to fit the researcher's needs (Besemer & O'Quin, 1999) and O'Quin recommends using an abridged version of the CPSS, because that the longer instrument is very fatiguing for evaluators and not all subscales are applicable to all creative products (White & Smith, 2001).

In consideration of the large number of group assignments evaluated in the current research, the judging criteria for creativity should not be too complex, but rather in a simple form. Therefore, after consulting with experts in webpage design and instructors in creativity, a specified assessment form consisting of the nine-item Creative Product Semantic Scale was created to judge group creativity. Given a written introduction and instructions on the instrument, raters were asked to make global ratings (on a 7-point scale) on each of the nine subscales, namely, original, surprising, logical, useful, valuable, understandable, organic, well-crafted, and elegant. A higher score indicated higher levels of the various qualities, such as originality, value, organization and so on. The refinement of the instrument incurred several specific stages of testing and purification. In the first step the assessment form was initially tested on a group of 10 volunteer students to evaluate the clarity of the content and

instructions, and slight modifications were made based on the results of this. After the instrument was deemed to have adequate face validity, (see the Group Creativity Assessment Form in Appendices F and G), the next step of refinement was to verify its appropriateness and stability in the pilot study. This will be further discussed in the section on the pilot study (see Section 3.3.5).

3.2.4 Measurement of transactional distance

To assess effects of the independent variables, i.e. group composition and conference structure, on transactional distance, a questionnaire using both closed- and open-ended questions was created for this study. From a collaborative learning perspective, it is important to explore students' perceptions of transactional distance when implementing different types of group composition and different degrees of conference structure, and thus to provide an effective learning environment for distance learners. There is no static ratio of structure to dialogue that will fit every group discussion, and thus the balance of structure and dialogue should be taken into consideration during the design of an online activity. It was therefore necessary to develop a scale of measurement that could assess individual students' perceptions of transactional distance. For this, an extensive literature review was undertaken (see Section 2.2), and the instrument used to measure transactional distance in this study

was adapted from Huang (2000). Questionnaires used in previous studies on similar themes were also carefully consulted (Chen, 2001c; Kennedy, 2003; Shin, 2003; Yildiz & Chang, 2003; A. Zhang, 2003). As a result, in this study the questionnaire used to assess the respondents' perceptions of transactional distance (TD) composed of the following four dimensions: interaction, structure, learner autonomy and interface, which are defined in Table 8.

Table 8: Definitions of the four dimensions of transactional distance

Constructs	Definitions
TD – Interaction	The psychological or communicational distance learners perceive when they interact with group members and task content in the online activities.
TD – Conference structure	The psychological or communicational distance learners perceive related to the rigidity or flexibility of the organization and the delivery of group events and activities in the implementation of online conferencing
TD – Learner autonomy	The psychological or communicational distance learners perceive with regard to both independent and interdependent participation in online group activities, involving both the learner's ability to be self-directed and his or her preference or need for collaboration.
TD – Interface	The psychological or communicational distance learners perceive when they use the online communication tools for carrying out online group activities.

The eight scales of the above four dimensions are: (1) interaction is at three subscales of learner-to-instructor, learner-to-learner, and learner-to-content interaction; (2) structure is at two subscales of conference organization and materials delivery; (3)

learner autonomy is at two subscales of independent and interdependent; and (4) the last subscale is interface. Following the guidelines of good question design such as making them easy to respond to, interesting, brief and clear, keeping the whole questionnaire short, and if you will not use the information, do not ask for it (Gay et al., 2009), 38 closed items describing all the situations learners face in the process of computer conferencing were compiled to test transactional distance statistically. The entire questionnaire was composed of two parts: one part was related to the individual respondent's perceptions of transactional distance, while the other contained the demographic and general questions about gender, individual thinking styles, and group and task characteristics. This initial questionnaire instrument was composed of several different types of questions, as described below.

(I). *Likert Scale Questions*: Most of these items are prefaced with phrases such as 'I believe' or 'I feel' in order to capture a respondent's subjective state of mind. A five-point Likert scale was used in which '1' indicates strong disagreement with a statement and '5' indicates strong agreement. The researcher also added '8', indicating "don't know" (For consistency in data coding, the option '8' in an item across all instruments used in this study indicated that respondents did not know how to answer the question). The instrument as a whole controlled for any systematic responses biases in either agreeing or disagreeing with all of the items. To discourage

respondents from going down the list of items and marking all items with one rating, 20 of the 38 questions referred to positive aspects, and the other 18 to negative ones. Before the statistical analysis was conducted, the answers to the negative worded statements were reversely coded.

(II). *Open Ended Questions*: While close-ended questions limit the respondent to the set of alternatives being offered, open-ended ones allow them to express a wide range of opinions (Reja et al., 2003). However, answering open-ended questions is more demanding, and so in order to maintain their willingness to complete the questionnaire only five such questions were asked:

T1. Would you please provide comments on what (i.e. teacher/group members/content) you interacted with best and why?

T2. Would you please provide details of your experience with the online group work in this project, either positive or negative? What impressed you most and why? What disappointed you most and why?

T3. If you could suggest two things to improve learning autonomy, what would they be?

T4. What things can be done to improve the usability of computer conferencing?

T5. In general, do you have any another comments or suggestions about the online activities in this project?

(III). *Demographic Questions*: Nine demographic items were designed to elicit two types of information. The first was personal information such as gender, thinking style,

while the second were situational questions, such as internet accessibility and online experience.

The questionnaire instrument was first developed in the English language, which was then translated into Chinese by the researcher. With the help of an English teacher, the Chinese version was translated back to English. The following steps were taken to ensure the quality of the questionnaire instrument. Firstly, to enhance clarity, readability, and content validity, three reviewers who were experienced teachers in a distance education context were consulted with regard to the instrument's content coverage and the match between the items and the subscales being measured. They were asked to provide feedback as to whether any of the proposed items were in need of modification or were not appropriate and applicable to measure the intended constructs. All feedback received from the reviewers was carefully studied and considered, and the necessary changes to item wording and ordering were made. Next, a pre-test group of 10 second year undergraduates examined the questionnaire to ensure that it was understandable and acceptable. They were encouraged to make comments and give suggestions concerning the survey directions, recoding procedures, and specific items. A pilot version of the questionnaire specifically designed for this study to investigate transactional distance was then created (52 items in total, see Appendix H): Part I had five items to gather demographic information; Part II had 16

items about online interaction; Part III had 11 items about conference structure; Part VI had eight items about learner autonomy; Part V had seven items about the interface; and Part VI had five items about online learning preferences. Details of specific survey items are shown in Table 9.

Table 9: Variables and items on the pilot questionnaire

Variables	**Item on Survey**	
Demographic information	See Questions	D1, D2, D3, D4 and D5
Dimension Name/Scales of Transactional Distance		
Interaction/		
learner-to-instructor	See Questions	1a, 1b, 1c, 1d, 1e and 1f
learner-to-learner	See Questions	1g, 1h, 1i, 1j, 1k and 1l
learner-to-content	See Questions	1m, 1n and 1o
open question	See Questions	T1
Structure/		
conference organization	See Questions	2a, 2b, 2c, 2d, 2e and 2f
materials delivery	See Questions	2g, 2h, 2i and 2j
open question	See Questions	T2
Learner autonomy/		
independent	See Questions	3a, 3b, 3c and 3d
interdependent	See Questions	3e, 3f and 3g
open question	See Questions	T3
Interface	See Questions	4a, 4b, 4c, 4d, 4e, and 4f
open question	See Questions	T4
Online learning preferences	See Questions	5, 6, 7 and 8
open question	See Questions	T5

Subsequent revisions were undertaken to enhance the questionnaires appropriateness and stability, based on the results of the pilot study, which are presented in Section 3.3.5.2

3.3. Phase II: The pilot study

The purpose of a pilot research is to test, in a parallel situation, whether the research instrument is working as it was designed and to explore unexpected issues before undertaking the main study to ascertain the validity of measures. Moreover, it is to ensure the protection of the participants from harm. During the first semester of the academic year 2007-2008, a pilot study using an equivalent sample of the target population was conducted to test the design of the quasi-experiment and its administration, as well as the research instrument's reliability and validity.

3.3.1 Setting and participants

The pilot research was set up in a naturalistic higher education setting at Southern Taiwan University (STU). This pilot research used a convenience sample in which participants were randomly recruited from three classes composed of students enrolled in a course entitled 'Applied Chinese' provided by STU's General Education program. This subject domain is generic enough to all participants. This course is compulsory for all undergraduate students at STU in their second-year curriculum. All classes included in this sample utilized the online course management system, Blackboard. In addition to the weekly face-to-face sessions, the Blackboard discussion board was a required element for each group to engage in collaboration to complete group assignment of this two-credit course. 138 second-year undergraduates

from three intact classes took part in the pilot research (112 male and 26 female), with most of them aged between 21 and 22. Among the three classes which were taught by the researcher, two were from the College of Engineering and one from the College of Humanities and Social Sciences.

3.3.2 Grouping

The students' thinking styles served as the grouping factor. Originally, participants were anticipated to be divided into Executive Group, Legislative Group, Judicial Group, and Mixed Group, with the last group containing the thinking styles of the first three groups. However, there were very few participants who had the judicial thinking style in this sample. Therefore, according to the score distributions of the TSI, there were only legislative, executive and mixed groups for each class. Based on the scores of TSI, every student was assigned to one of the above-mentioned three groups. Each group had five to six members and there were 26 groups in total. The group distribution is presented in Table 10. Students were informed that grouping was designed to facilitate online group collaboration, and thus the completion of the group assignment, which was to design a website or blog. The students were told that the group assignment would be graded at the end of the semester, and all participants consented to take part in group computer conferencing.

Table 10: Group distribution of the pilot study

		Conference Structure		
		***High* (Six Thinking Hats)**	***Low* (Brainstorming)**	***No* (No treatment)**
Group composition		Experimental class 1 (majoring in Mechanical Engineering, n=46)	Experimental class 2 (majoring in Electrical Engineering, n=51)	Comparison class (majoring in Applied English, n=41)
	Homogeneous	Three Legislative groups/ Three Executive groups/	Four Legislative groups/ Four Executive groups/	Two Legislative groups/ Three Executive groups/
	Heterogeneou	Three Mixed groups	Two Mixed groups	Two Mixed groups

3.3.3 Research interface

In the pilot study, the medium used for group conferencing was Blackboard Academic Suite, an e-Education platform that enables users to post information and assignments, and to share their academic or social experiences. It has three key areas of utility, which are as a learning system, as a community system, and as a content system. The Discussion Board enables threaded and asynchronous discussions, and this was the primary collaboration tool for the pilot study. Figure 12 is a screenshot of the course creation tool that allowed instructors at Southern Taiwan University to develop their online courses, and Figure 13 is an image of group conference room which could only accessed by the assigned group, and allowed group members to post messages, exchange files and ideas, and send emails.

Figure 12: Image of Blackboard Academic Suite

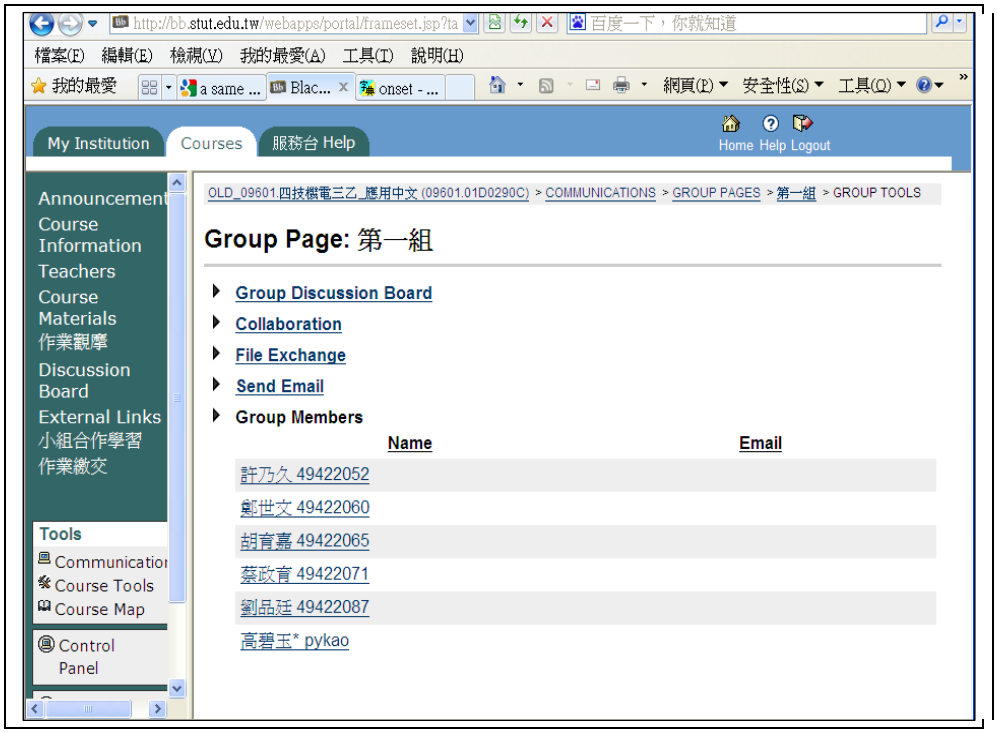

Figure 13: Image of an online group conference room

3.3.4 Procedure

An orientation was necessary so that the participants could become familiar with the online group activities, as none of the students had prior experience with computer conferencing using the strategies. In the pilot study, preliminary training was organized prior to the onset of the online discussions. Practice for online group discussions for each class was held in a computer lab during a two-hour session. The purpose of this preliminary training was to familiarize participants with the tasks, including the instructions and the practice trials. Guidelines and the conference procedures were provided for two experimental classes separately: one class for practicing Brainstorming and the other for practicing the Six Thinking Hats approaches. For the comparison class, no structure was provided for the group conference.

During the experimental period, the students were required to participate in six consecutive discussion themes scheduled by the researcher, with one week for each discussion, and the entire treatment lasted six weeks. Within the one-week time frame, students were flexible as to the time and place they chose to work on the asynchronous conferencing. After one week, a new discussion theme was presented and the previous themes were only accessible on a read-only basis. All themes were

set up to facilitate the completion of a group assignment, which was to create a website or blog. Generally, group members interacted via their group conference room to communicate plans, gain feedback and share discussion ideas following the conference structure prescribed by the researcher. Screenshots of examples of the conference structure and instructions for the two experimental classes and one comparison class are presented in Figures 14, 15 and 16. After the six consecutive group conferences, all the groups were required to provide the links to their websites, and these collaborative online outcomes were evaluated near the end of the semester.

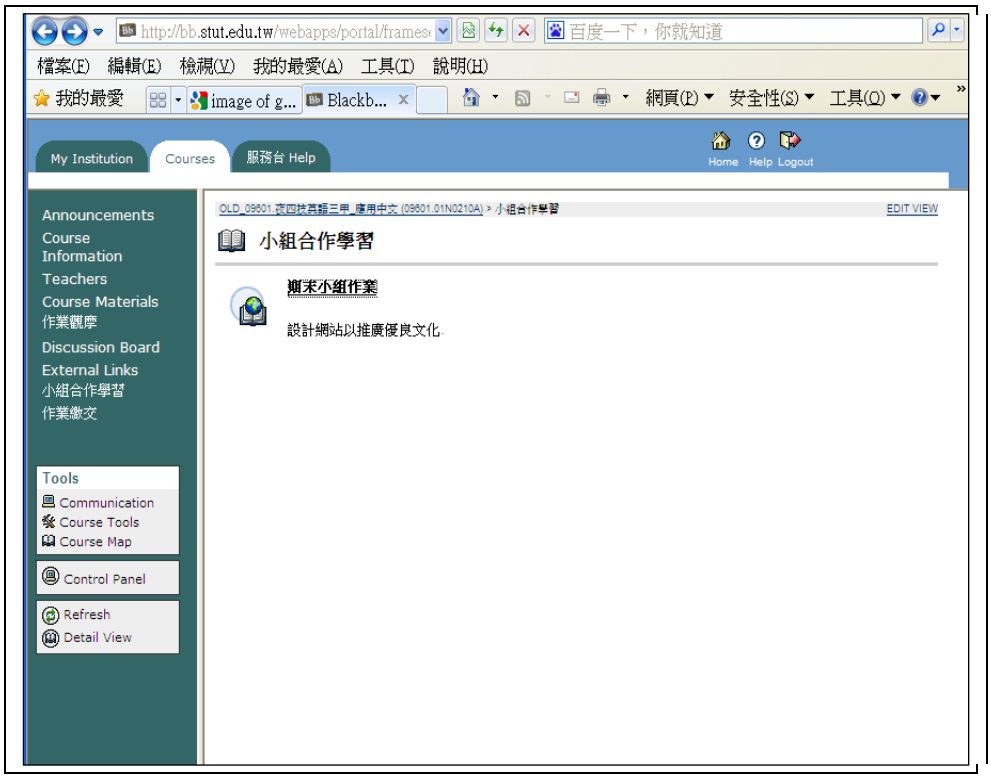

Figure 14: No conference structure for the comparison groups

Figure 15: Conference structure and instructions for the groups using Brainstorming

Figure 16: Conference structure and instructions for the groups using the Six Thinking Hats

3.3.5 Data collection and scoring

The author collected the research data in two time periods: one was at the beginning of the semester, when the students provided information about their thinking styles and creative thinking ability; the other was after experiment, when group creativity was evaluated and individual students' perceptions of transactional distance were investigated. The processes of data collection and scoring are described below.

3.3.5.1 Data collection and analysis before the experiment

(1). Thinking styles & Creative thinking ability

Before the start of the experiment, the informed consent form and two booklets (the Thinking Styles Inventory and the Abbreviated Torrance Test for Adults) were handed out, and then collected by the researcher from the three classes at the beginning of each regular class session, since both the TSI and the ATTA are suitable and easy for group administration. The purpose of the tests was explained, as well as what the data would be used for, and informed consent was obtained from all the participants. The TSI and the ATTA were then given to the participants and the sequences of the tasks were informed. The tests were administered when everyone was ready. Both tests were paper and pencil tests and were timed. Participants completed the self-report

scales of the Thinking Style Inventory first, with a short break to avoid fatigue effects, followed by the ATTA measure, which was administered strictly following the instructions in the ATTA manual (Chen, 2006). The instructions for each activity of the ATTA were read out aloud from the manual before the activity began. In the ATTA test, the participants were required to respond to each task in three minutes by presenting their ideas with texts or drawings. It took approximately 50 minutes to collect both types of data. The results of both tests were given to the individuals at the end of the classes. Confidentiality was assured and the names of the participants are not mentioned in the research.

(2). Scoring, reliability and validity of the TSI

All the 138 participants completed the TSI, which is a self-report questionnaire consisting of 104 items, eight for each of the 13 subscales (see Section 3.2.1). For each item, respondents were asked to rate themselves on a seven-point scale, with 1 denoting that the statement does not characterize them at all, and 7 that it characterizes them extremely well. The scores were determined by summing the numbers for each style, and then divide by eight, carrying the decimal to one place. This yielded a number between 1.0 and 7.0. This instrument evaluates each thinking style independently, and the results reveal a profile, not a total score, of the individual

(Sternberg, 2009). In the pilot study, both the reliability and validity of the Chinese TSI version developed by the researcher were tested.

The internal consistency of each of the 13 scales was estimated using Cronbach's alpha. The Cronbach's alpha coefficients for the pilot sample were .85 (legislative), .88 (executive), .88 (judicial), .68 (monarchic), .86 (hierarchic), .81 (oligarchic), .72 (anarchic), .83 (global), .64 (local), .89 (internal), .94 (external), .93 (liberal), and .91 (conservative). Only the alphas for the monarchic and local thinking styles were less than .70, which indicated minimally adequate reliability, the others were all above .70. Based on Zhang (2004), the lower scale reliabilities are usually obtained in three of the 13 styles: local, monarchic, and anarchic. Therefore, the results of the pilot data are comparable with those obtained in Zhang. Specifically, the Cronbach's alphas for the legislative, executive, and judicial thinking styles were all above .80, and these served as the grouping factors for the present research, having good internal consistency and suitability for the main study. Internal validity was investigated using a factor analysis. Visual inspection of eigenvalues with the scree test supported the possible extraction of four or five factors, although five factors were more consistent with the theory of mental self-government (refer to Section 2.1.4.2). A principal-axis factor analysis with an oblique rotation procedure resulted in five factors that accounted for 69.3% of the variance in the pilot data, demonstrating

the reasonable validity of the instrument.

In sum, this Chinese TSI version proved to have reasonably good reliability and validity for identifying the thinking styles of the individuals examined in this work.

(3). Scoring, reliability and validity of the ATTA

One hundred and thirty-three of the 138 participants completed all three tasks of the ATTA. The directions for administration are presented clearly and in detail in the Chinese version of the ATTA manual, as well as detailed scoring instructions (see Section 3.2.2). The participants' performances in the ATTA tests were scored by two independent raters, who were graduate students (one in College of Digital Design and one in College of Humanities and Social Sciences) and blind to the respondents' background information. To help establish inter-rater reliability, a rater training session was conducted during the pilot study. The same raters used in the pilot study were then used in the main one. They were required to carefully study the manual, practice and follow all the related instructions for the standardized scoring procedure. Five randomly selected tests from the participants were scored by both raters. Their ratings were inspected and compared, and disagreements on ratings were discussed and rules developed by the raters to increase consistency. Tasks were then rated independently, and this took approximately 20 minutes per respondent, per form.

Appendix L presents examples of the responses that were scored highest on originality, elaboration, and flexibility. Once the ratings from the two raters had been obtained, an inter-rater reliability analysis was conducted using Pearson product-moment correlations, resulting in coefficients ranging from .72 to .88 for the four creative abilities. A strong correlation ($r = .85$, $p < .05$) was also found between the ratings for the Creativity Index provided by both raters, providing evidence that they used the same rationale and their ratings were comparable. Using the mean scores of the raters, the pilot study also shows acceptable internal consistency reliability. The Cronbach's alpha coefficient for the total scaled norm-referenced score for the Creativity Index was .90, while that of the scaled score for the four creative abilities ranged from .45 to .65. These Cronbach's alphas of the pilot data are similar to the test-retest reliability of the Chinese version of the ATTA, which ranged from .34 to .68 (see Section 3.2.2).

In summary, the results of the pilot study indicated that both the TSI and the ATTA were reliable and valid instruments for assessing the constructs underlying their respective theories for a group of students from Southern Taiwan University. Therefore, the experimental procedures proceeded as designed.

3.3.5.2 Data collection and analysis after the experiment

(1). Group creativity assessment by expert judges

To evaluate group creativity using the CAT, two experts were recruited, both teachers from the Department of Information and Communication. These teachers were chosen because of their willingness to participate in the study, and because both had over 10 years experience of teaching creative web design. In order to reduce evaluation bias, they were blind to the condition of the participants' group work. The teacher raters were given links to all the groups' websites and were asked for their subjective judgments of the creative work with regard to Novelty, Resolution and Elaboration and Synthesis using a seven-point rating scale. Based on the analysis of the CAT data, the results pilot study confirmed that there was moderately high inter-rater reliability across the three scales (Pearson correlation coefficients ranging from 0.79 to 0.92) for the scores of creativity rating using the CAT.

(2). Group creativity assessment by student evaluators

After the experiment, an evaluation of group creativity using the CPSS was conducted. It is suggested that for factor analysis, a minimum of five respondents per variable (item) is required (Coakes et al., 2009). In order to conduct statistical tests to assess this instrument, the creativity of the group product was evaluated by 60 volunteer undergraduates (33 males and 27 females) recruited from the campus. They were majoring in engineering (N=22), science (N=15), and liberal arts (N=23) subjects. Referenced to the model of Creative Product Analysis Matrix and the Creative

Product Semantic Scale, the Chinese version of Group Creativity Assessment Booklet was given to each of the volunteer evaluators (see Appendix G). The original CPSS was used to analyze existing products, and this revised version was designed to assist people with no special training or expertise in evaluating the creativity of the group websites. Before the evaluators began the assessment, informed consent forms which described the study and instructions were provided to them, which they then signed. All the participants were required to complete the assessment based on the instructions and time was allowed for clarification of the directions by questions. The participants rated the group websites by giving a number ranging from 1 to 7 that best described each semantic item. For example, a group website was judged as to whether or not it was "Surprising," and a rating of "4" would indicate a neutral response, while "1" would indicate the strongest association with the negative aspect of that attribute, and "7" would indicate the strongest association with the positive aspect. Participants were instructed to be careful, but not spend too much time responding to each semantic scale. After receiving informed consent statements and instructions on the instrument, the participants completed the scale items by viewing all group websites by clicking the links provide to them. The order of the links was random to avoid bias from fatigue or comparison. The total time for assessment was about three hours, and data were collected anonymously.

(3). Scoring, reliability and validity of the CPSS

The data set collected from student evaluators was examined for missing data and normality. In the pilot study, out of the 60 completed assessment forms, 54 were chosen as valid and the remaining six were discarded due to unreliable evaluations. The data appeared to be normally distributed. Reliability analyses were conducted to check for the internal consistency of the judgments made by the student evaluators. Internal consistency reliability estimated (Crobach's alpha) for the measures of Novelty, Resolution, and Elaboration and Synthesis were computed for each of the group websites. All the Cronbach's alpha coefficients ranged from .70 to .85, and these high reliability coefficients were consistent with earlier studies conducted by Besemer and O'Quin (Besemer & O'Quin, 1986, 1987; O'Quin & Besemer 1989, 2006).

Due to the theoretical independence of the three dimensions, principle axis factor analysis with varimax rotation was conducted to examine the relationships among subscales separately for each group website. Three factors were requested, based on the fact that the items were designed to index three dimensions: novelty, resolution, and elaboration and synthesis. It was found that the highest loadings for one factor were those items that made up the dimension. This result provided a sufficient level of confidence that the items making up each dimension in this use of

the CPSS formed coherent subsets. The internal validity of a three-factor model of product creativity was thus confirmed using the pilot sample data.

(4). Students' perceptions of transactional distance

A pilot survey was conducted with the primary aim of observing how the preliminary questionnaire instrument worked with the pilot sample. The Chinese version of the transactional distance questionnaire was distributed (see Appendix I). To collect data that most accurately reflected the overall experience, students were given the paper-and-pencil questionnaires by the researcher during the normal class periods as soon as the experiment was finished. Students were given the opportunity to clarify any question they had about the questionnaire. The majority of participants finished responding to the questionnaire within 15 to 20 minutes. Anyone who was interested in knowing the results of the survey was asked to give an email address for the researcher to send them when the study had been completed.

(5). Scoring, reliability and validity of the questionnaire instrument

One hundred and thirty-eight questionnaires were distributed and 124 returned to the researcher, of which 120 were usable for data analyses. Three pairs of repeated questions were used to investigate internal consistency. For each pair of repeated questions (which were not arranged together), if a subject gave opposite answers (i.e.,

the difference between the two corresponding marked answers was more than 3), then the survey completed by this respondent was deemed invalid, and thus was eliminated. Out of 124 questionnaires returned, four were discarded due to unreliable responses, leaving 120 valid surveys, or 87% of the pilot sample size.

All the statistical analyses in this investigation were done using SPSS version 17. First, the data set was examined for missing data, which were then were imputed by mean substitution, and items were assembled into subscales. Recoding of reversed items was performed, so that higher scores meant higher ratings. Second, reliability analysis was used to examine the internal consistency among items. Third, exploratory factor analysis was used to investigate whether or not the transactional distance scales were consistent with the theoretical expectations.

Reliability analysis. The internal consistency of each of the eight scales was estimated with Cronbach's alphas. The Cronbach's alpha coefficients for the pilot sample were .42 (learner-to-instructor), .76 (learner-to-learner), .70 (learner-to-content), .86 (conference organization), .68 (materials delivery), .65 (independent), .67 (interdependent), and .75 (interface). The Cronbach's alpha coefficient for the total scaled score was .88. The following considerations were applied with regard to modifying or delete items (Leech et al., 2005): First, a coefficient alpha of .70 or

higher is expected in most social science research situations. However, in this study, a result above .65 was considered acceptable (DeVellis, 1991), due to the fact that there were only a handful of items in each subscale. A scale reliability of less than .65 was only obtained in the learner-to-instructor subscale (.42). The reason might be that the instructor did not interfere with the group conferences to avoid bias in the research outcomes, and thus the learner-to-instructor interaction subscale was considered not appropriate for measuring transactional distance in this study, and should be eliminated. Second, an item was considered as poor if the correlation between it and the total of the items in the subscale was negative or low (less than 30), or its deletion increased the Cronbach's alpha coefficient value (DeVellis, 1991). The item-total correlation was low for items 1j (.13), 1k (.27), 2d (.22), 3d (.27), 3e (.20), and 4d (.23). Further examination found that items 2d and 3e were related to the instructor, and item 1j was about group size. These were not the variables of interest, and thus were deleted. In addition, items 1k, 3d and 4d were modified.

Factor analysis. To examine the structure of transactional distance, construct validity was investigated using factorial analysis. Principal component analyses using a varimax rotation method and an eigenvalue greater than one as a cutoff point were run on each scale. For all scales, the underlying assumptions of factor analysis (Coakes et al., 2009) were met. The determinant was greater than .0001, the KMO measure was

greater than .60, and the Bartlett test was significant. In addition, the communality of each item was greater than .20. The learner-to-learner subscale resulted in a two-factor solution that accounted for 67% of the variance in the pilot data. It was found that Factor 1 was associated with communication distance, and Factor 2 was associated with psychological distance. A similar pattern of factor solution was noticed when run on the data for the conference organization and interface subscales. The other subscales all produced one-factor solutions. However, there was one problem with the analysis of the results, as some items were poorly correlated with other items in the same subscale (1k, 1l, 2e, 3d, 4d) that were written as reversed items. These items were thus revised to avoid ambiguities, vagueness, and confusion on the part of respondents.

Questionnaire refinement. Taking the results of the survey and experimental problems found in the pilot study (see the following subsection), refinements in both wording and organization were made in the process of finalizing the questionnaire instrument. Some changes on the subscales were made as follows:

~~(1). Learner-to-instructor~~	Questions	~~*1a, 1b, 1c, 1d, 1e and 1f*~~
(2). Learner-to-learner	Questions	1g, 1h, 1i,~~*1j*~~, *1k (revised)* and *1l(revised)*
(3). Learner-to-content	Questions	1m, 1n and 1o
(4). Conference organization	Questions	2a, 2b, 2c, ~~*2d*~~, 2e *(revised)*and 2f
(5). materials delivery	Questions	2g, 2h, 2i and 2j

(6). Independent Questions 3a, 3b, 3c and *3d (revised)*

(7). Interdependent Questions ~~*3e*~~, 3f and 3g

(8). Interface Questions 4a, 4b, 4c, *4d (revised)*, 4e, and 4f

The final questionnaire used in the main study had 43 items in total, as presented in Appendix J: Part 1 was comprised of five items on demographic information; Part 2 was comprised of nine items about online interaction; Part 3 was comprised of 10 items about conference structure; Part 4 was comprised of seven items about learner autonomy; Part 5 was comprised of seven items about interface; and Part 6 was comprised of four items about online learning preferences.

3.3.6 Refinements in research design

Examining the whole processes and results of the pilot study, the researcher made the following refinements for the main study:

(1). It was found that extremely few students belonged to the judicial thinking style group. So the researcher only had three categories for the independent variable "group composition," namely legislative, executive and mixed groups.

(2). The asynchronous approach made little contribution to generating many of ideas during the small group discussions. When adopting creative strategies such as Brainstorming and the Six Thinking Hats, it is better if the group members are thinking together at the same time. Therefore, asynchronous conferencing was

replaced by MSN Live Messenger, a real-time communication platform, in the main study.

(3). When using asynchronous conferencing, the teacher needs to reply to the students' questions, and this might act as an extraneous variable affecting the outcomes of group work, and therefore affect the research validity. However, by using MSN conferencing to improve research accuracy, only group members could enter their own chat rooms and join the discussions.

(4). It was found that some students were not skillful at creating website by themselves. To prevent technical bias, all groups were required to do group assignments by building blogs in the real study.

(5). It was also found that students majoring in different academic fields had different levels of Chinese language skills. To prevent language-skill bias, the experimental sample for the main study was chosen so that the individuals had similar academic backgrounds.

(6). In the pilot study, the research used a posttest experimental design. In the main study, a pretest-posttest comparison was used to provide a clearer measure of independent variable's effects than the posttest alone could provide.

3.4. Phase III: The main study

3.4.1 Setting and participants

The same as the pilot study, the main study was set up at Southern Taiwan University (STU). One hundred and thirty eight second year students from three intact classes of the College of Management were selected as the participants for the main study (38 male and 100 female, the majority were between 21 and 22 years old). They were enrolled in a compulsory course entitled 'Applied Chinese' in the second semester of the 2007 to 2008 academic year (from February 2008 to July 2008). The basic assumption in this study was that if students had similar academic backgrounds, then they would have similar levels of Chinese language skills. Table 11 shows the composition of the research sample. Group assignment was a formal component of this two-credit course.

Table 11: The composition of the research sample

Learning Field	Departments	Research group	Gender		N
			Male	Female	
College of management	Information Management	Control	22	20	42
	Leisure Management	Experimental	9	41	50
	International Business	Experimental	5	41	46
N			36	102	138

3.4.2 Grouping

The students' thinking styles served as the grouping factor. Based on the TSI scores, every student was assigned to one of the following groups: Executive, Legislative and Mixed (with no judicial group, as in the pilot study). The group distribution is presented in Table 12. Students were informed that grouping was designed to facilitate online group collaboration, and thus the completion of the group assignments which were to design two blogs. Group blogs were graded twice: once at the midterm and again at the end of the semester. All participants consented to use synchronous computer conferencing for the group discussions.

Table 12: Group distribution of the main study

		Conference Structure		
		***High* (Six Thinking Hats)**	***Low* (Brainstorming)**	***No* (No strategy)**
Group composition		Experimental class 1 (majoring in International Business)	Experimental class 2 (majoring in Leisure Management)	Comparison class (majoring in Information Management)
	Homoge	Three Legislative groups/ Five Executive groups/	Four Legislative groups/ Two Executive groups/	Five Legislative groups/ One Executive groups/
	Heterogeneo	One Mixed groups	Two Mixed groups	Two Mixed groups

3.4.3 Research interface

The group conference room on Blackboard was still set up for storing files, but the

function of the asynchronous “Group Discussion Board” was terminated, and this was replaced by synchronous communication using MSN Messenger. The synchronous conferencing process allowed group members to share ideas and information, and to collaborate at the same time from various locations. In the main study, the primary mode of group communication in synchronous conferencing was text-based, and all groups were required to upload the complete transcripts of the messages exchanged during each period of conferencing for the researcher to review the messages, and thus better understand the group interaction processes. Because it provides message logs, and the capability to share pictures, videos and other files while chatting, MSN Messenger was chosen as the synchronous communication medium. Figures 17, 18 and 19 are screenshots of the MSN group chat application.

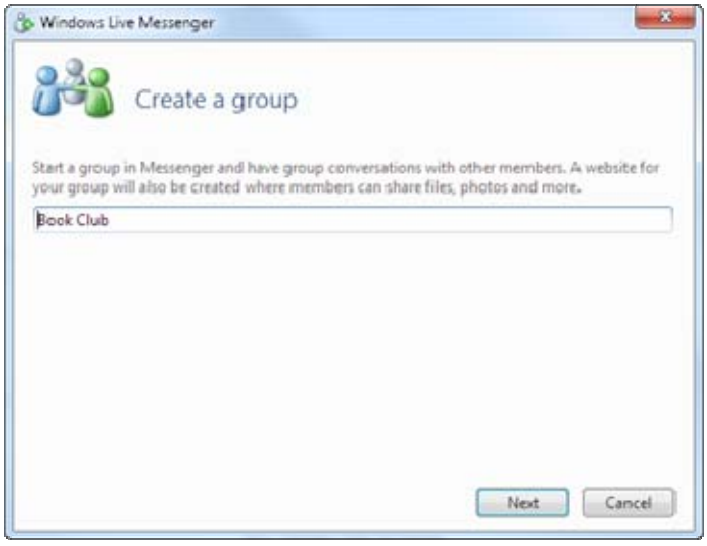

Figure 17: Create a group, retrieved from
http://gregsedwards.wordpress.com/category/computers-and-internet/

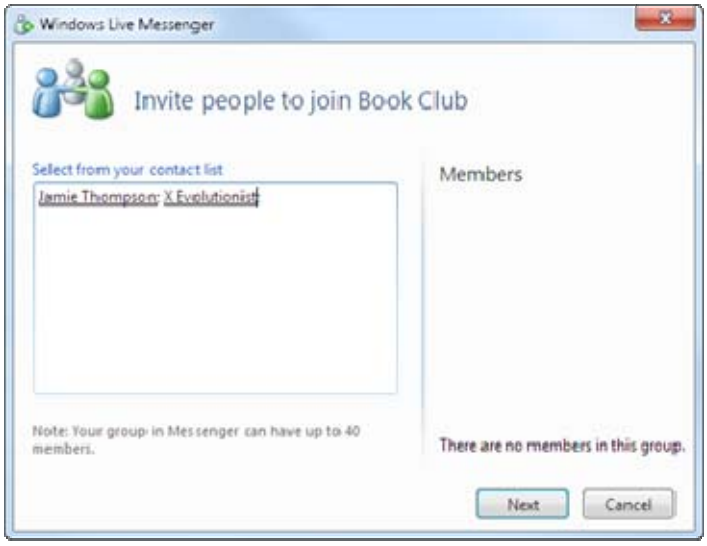

Figure 18: Invite people to join the group chat, retrieved from http://gregsedwards.wordpress.com/category/computers-and-internet/

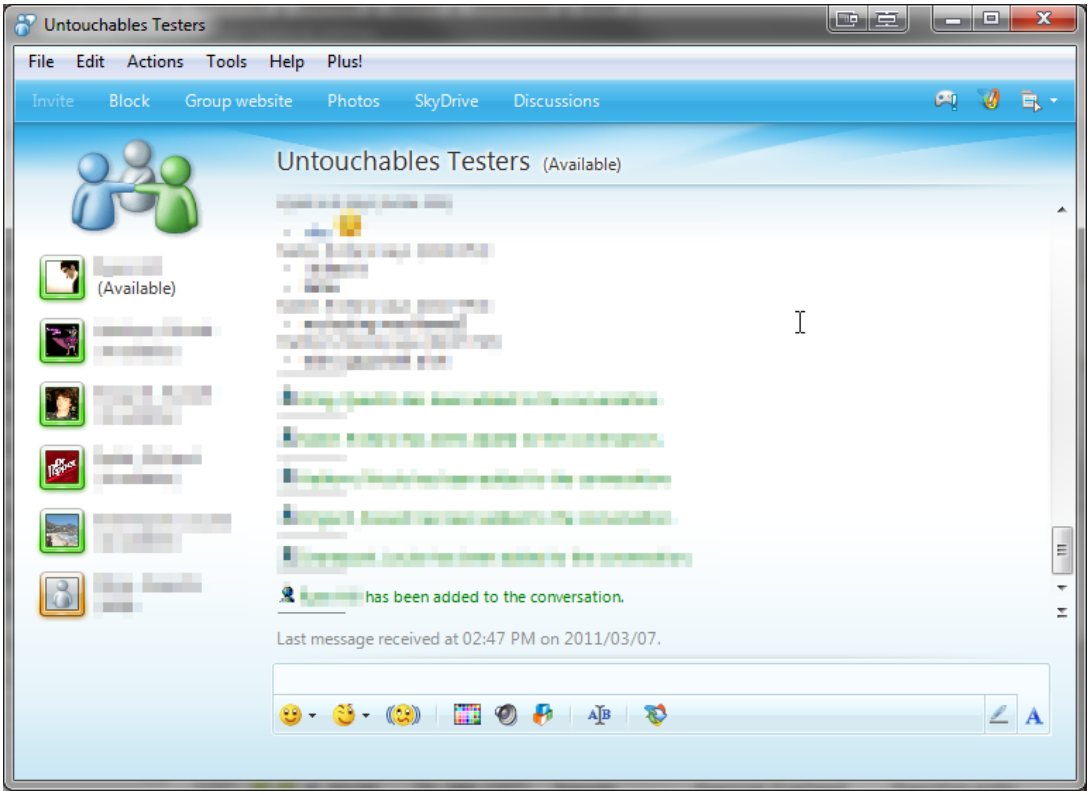

Figure 19: A typical MSN 'group chat' window within the Windows system, retrieved from http://forum.digsby.com/viewtopic.php?id=7309

3.4.4 Procedure

There were two stages in the three group pretest-posttest design in the main study, as shown in Table 13.

Table 13: Two experimental stages in the main study

	The first stage Doing the pretest group assignment	**The second stage** Doing the posttest group assignment
Experimental group one	No treatment implemented	Treatment: Six Thinking Hats
Experimental group two	No treatment implemented	Treatment: Brainstorming
Control group	No treatment implemented	No treatment implemented

To consider the potential influence of pre-existing differences in group creativity between the experimental and comparison groups, the score of group creativity before conducting the experiment was controlled. Each group had to hold four separate MSN conferences for both the pretest and posttest group assignments. During the first stage, no treatment took place for all classes. During the second stage, treatments were implemented.

The main study was conducted in the following steps:

(1). *Random treatment assignment*: The first step involved random assignment of the treatments to the classes. Three intact classes were randomly assigned to two experimental classes and one comparison class. The students from the

same class were assigned to the same conference structure in order to minimize unwanted interaction and communication among individuals from different treatments.

(2). *Data of attribute variables collected before the experiment*: The students' characteristics (i.e., thinking styles and creative thinking abilities) were collected at the beginning of the semester.

(3). *Grouping*: Based on the scores of the TSI, students were assigned to Executive Group, Legislative Group and Mixed Group.

(4). *Setting up MSN groups*: The fourth step involved setting up the MSN Messenger groups and practicing synchronous computer conferencing. The majority of the participants were already regular users of MSN Messenger, and thus familiar with the related interface. However, they did not have any previous experience of using MSN Messenger to complete a group assignment. To develop the participants' synchronous computer conferencing skills, and at the same time to prevent interruptions from external text messages when logging into their existing accounts, it was necessary to ask each student to use his/her student ID to create a new user account and add only group members to the contact list. Practice of synchronous computer conferencing for each class

was held in a computer lab during a two hour session. Every group leader created a discussion group first, and then invited the group members to join the conversation and introduce themselves to their partners.

(5). *Holding MSN group conferencing*: No conference structure was imposed on any of the classes, and the group discussion did not affect the participants' regular class time. Each group undertook synchronous computer conferencing to complete the group assignments in their own scheduled time after class. Students were required to hold one-hour of MSN group conferencing once a week, and submit the complete transcript of messages exchanged during each period. There were four MSN conferences in total.

(6). *Pretesting*: The sixth step was to conduct the pretesting, in which all the groups finished their first blogs and submitted the links for assessment.

(7). *Treatment practices*: Preliminary training for group discussion using the creative strategies was organized and held in a computer lab over a two-hour session. The purpose of this preliminary training was to familiarize the experimental groups with the creative strategy each was asked to adopt. Guidelines and step by step instructions for MSN group conferences were provided separately to the two experimental classes: one class for practicing

Brainstorming and the other for practicing the Six Thinking Hats method. Based on the different treatments, the conference structure was defined very thoroughly (the Six Thinking Hats groups), or with some degree of freedom (the Brainstorming groups) with regard its execution. An example of the conference structures for different research groups is presented in Table 14. Based on the discussion topic, the group members shared their ideas and opinions. Specifically, experimental groups should follow the sequence to discuss all the prescribed questions.

Table 14: An example of the conference structures for the different research groups

Research group	The second stage	MSN conferencing
	Treatment	Discussion topic: How to improve the group blog?
Experimental group one	Six Thinking Hats (high structure)	*White Hat:* What is in our group blog? *Red Hat*: How do you feel about our group blog? *Yellow Hat*: What value does our group blog have? *Black Hat*: What shortcoming does our group blog have? *Green Hat*: Do you have any innovative ideas for our group blog? *Blue Hat*: Any other ideas? Make decisions based on the discussion.
Experimental group two	Brainstorming (low structure)	*Brainstorming session*: no criticism of ideas *Analysis session*: analyze and explore the best solutions
Control group	No (no structure)	No instruction

(8). *Holding MSN group conferences with treatments*: Again, each group held

synchronous computer conferences in their own time after class. Students were required to hold a one-hour MSM group conference once a week, and then submit a complete transcript of the messages exchanged. There were thus a total of four MSN conferences.

(9). *Post-testing*: The final step was to conduct the post-testing, in which all groups finished their second blogs and submitted the links for assessment.

3.4.5 Data collection and scoring

Before the experiment, information concerning the following variables was collected: thinking styles, creative thinking abilities and pretest group creativity. The second round of data collection was conducted after the experiment, and this included the posttest of group creativity, as well as the participants' perceptions of transactional distance along with their demographic information.

(1). Thinking styles, creative thinking abilities, participants' perceptions of transactional distance

These data were collected based on the same procedure as described in the pilot study (see Section 3.3.5). The rating processes for these instruments were the same as those in the pilot study.

(2). Group creativity

Revised from the pilot study, the main study employed a pre- and post- design, and therefore the evaluation, of group creativity in terms of the group blogs, based on the Creative Product Semantic Scale (CPSS), was conducted at the midterm of the semester (pretest) and again at the end of the semester (posttest). The raters were recruited from volunteer students not participating in either the pilot or the quasi experiments, and they did not know who created the blogs, and this may have biased their evaluations. To assess both the pretest and posttest, this group of raters was taken to a computer networking classroom once at the midterm of the semester and again at the end of the semester. In random order, links to all of the group websites were presented on computer screens. Before assessment, raters were given three forms: the participant consent form, instructions, and assessment form. Raters were asked to evaluate each blog using the nine-item evaluation form (refer to Section 3.3.5.4. for the evaluation procedure). The same teacher-raters used in the pilot study were used in the main study to conduct the consensual assessment technique (CAT).

All the collected data were organized and compiled for analysis using SPSS Statistics 17.0. The variables of interest were analyzed with descriptive statistics, Pearson correlation tests, the *t*-test and analysis of variance (ANOVA). Descriptive statistics were obtained on the background and demographic variables to describe the

sample. Inter-rater and internal consistency coefficients were obtained for the reliability assessment. Factor analysis was conducted to test construct validity. The assessment results of the reliability and validity of the research instruments used in the main study, namely, the TSI, ATTA, CPSS, and questionnaire of transactional distance, are reported in Chapter Four.

3.5. Summary

The concluding section of this chapter is a summary of Chapter 3. This chapter provided the reasons for choosing and the details of the methodological procedures used in this mixed method quantitative study. It began by restating the aims and questions of the research study. Information was provided concerning the background, reliability, validity, and the scoring procedures of the research instruments. The remaining sections of this thesis are the analysis of data results and findings of the present study (Chapter 4), and a discussion of the relevance of the findings will be offered (Chapter 5). Finally, limitations from this study and recommendations for future research will be examined in the last part of this work.

Chapter 4 RESULTS

The primary aim of this study was to identify the impact of group composition and conference structure on group creativity and individual perceptions of transactional distance. The relationships among gender, thinking styles, individual creative ability and group creativity were also explored using both experimental and survey data. The data collection process in the main study was carried out in three stages. The first stage was conducted at the beginning of the main study to investigate the participants' thinking styles and creative thinking abilities in a class setting, using a pencil-and paper test. Before the experiment, the second stage of data collection was a pretest of group creativity. Finally, after the experiment, a posttest of group creativity was conducted, and the participants also completed a questionnaire to obtain their individual perceptions of transactional distance.

Before the data analyses, the researcher examined the collected data to determine whether or not it could be used for further analyses. Exploratory data analysis was performed on all the variables to analyze the distribution of data values and test for outliers. In the formal data analyses, if one student had missing values for specific items, particular instruments or subscales, then these were replaced by the means of the corresponding items. Moreover, only data obtained from those groups that

rigorously followed the prescribed instructions with regard to holding the computer conferences were used to test the research hypotheses. Descriptive statistics were analyzed, and the means of subscales were used to conduct t-tests, Pearson's correlations, Mann-Whitney U, ANOVA and ANCOVA tests.

Although the sample size in the study was small and geographically bound, and thus the results may not be generalized to all university students in Taiwan, the fact that the study was conducted in a real-life setting enhanced its external validity. In addition, there was sufficient control of the demographic variables to increase the internal validity of this work, and thus for the researcher to draw reliable conclusions (Leedy & Ormrod, 2005). The aim of this chapter is to report the reliability and validity of the instruments employed in the main study, and also to present the findings of this work. The chapter is organized into the following four main sections: (a) an examination of the reliability and validity of the instruments in the main study, (b) the results of the descriptive analyses, (c) the results of hypotheses testing, and (d) a summary of the findings.

4.1. Reliability and validity of the instruments in the main study

This section reports on the reliability and validity of the instruments used in the main study: the Thinking Styles Inventory (TSI), the Abbreviated Torrance Test for Adults

(ATTA), the Creative Product Semantic Scale (CPSS), and the individual's perceptions of transactional distance questionnaire. The data obtained from these was then analyzed using the SPSS software, while the open-ended questions were typed up and organized by question for further analysis using a word processor. The internal consistencies of the scales were estimated with the Cronbach's alpha coefficients, and exploratory factor analysis was used to support the factor structures of these instruments within this specific sample.

4.1.1 The Thinking Styles Inventory

Scale Reliabilities. The reliability of the subscales of the TSI was examined. The internal consistency of each of the 13 TSI scales was estimated with the Cronbach's alpha coefficients. The Cronbach's alphas for the 13 scales ranged from Local (.60) to Liberal (.96), with a median of .83. Except for the lower reliability estimates of Local, the others were all above .70. The observed internal consistency reliability estimates of the 13 TSI scales are as reported in Table 15: Legislative (alpha =.87), Executive (alpha = .90), Judicial (alpha =. 88), Monarchic (alpha = .72), Hierarchic (alpha =. 91), Oligarchic (alpha = .80), Anarchic (alpha = .72), Global (alpha =. 77), local (alpha = .60), Internal (alpha = .87), External (alpha = .92), Liberal (alpha = .96), and Conservative (alpha = .93). These estimates are similar in magnitude to those in the

pilot study and comparable in those in Sternberg (Sternberg &Lubart, 1992; Sternberg, 1994b), in which the long version of the inventory was used. These estimates are also in accordance with those in various studies conducted in Taiwan (e.g., Chou, 2001; Chu, 2006; Chuang, 2010; Wu, 2006), in which the short version of the inventory was used.

Table 15: Cronbach's alpha coefficients for Thinking Styles Inventory Scales in the main study (N=138)

Scale	The Main Study	The Pilot Study	Scale	The Main Study	The Pilot Study
	α	α		α	α
1. Legislative	.87	.85	8. Global	.77	.83
2. Executive	.90	.88	9. Local	.60	.64
3. Judicial	.88	.88	10. Internal	.87	.89
4. Monarchic	.72	.68	11. External	.92	.94
5. Hierarchic	.91	.86	12. Liberal	.96	.93
6. Oligarchic	.80	.81	13. Conservative	.93	.91
7. Anarchic	.72	.72			

Scale Intercorrelations. Intercorrelations for the 13 TSI scales are performed by calculating the Pearson product-moment correlations, as shown in Table 16. The absolute values of these scale values ranged from .03 to .57. Generally speaking, these correlations were in the direction predicted by the theory of mental self-government. Examples are Legislative versus Liberal (r=.50), Executive versus Conservative (r=.56), Judicial versus Hierarchic (r=.54), and Internal versus External (r=-.28), with the correlations significant at the .01 level. However, some of the significant correlations were in the direction that was not predicted by the theory of mental

self-government, such as that between Monarchic and Hierarchical was .54 ($p < .01$), is consistent with that the results in Zhang and Sachs (1997) and Zhang (1999). In addition, Conservative versus Liberal (r=-.03) was in the direction predicted by the theory of mental self-government, but the results were not significant, and this may be due to cultural differences, although further study is needed to confirm this.

Table 16: Interscale Pearson correlation matrix for 13 scales of the Thinking styles Inventory (N=138)

Scales	1	2	3	4	5	6	7	8	9	10	11	12
1. Legislative	--											
2. Executive	.46**	--										
3. Judicial	.44**	.33**	--									
4. Monarchic	.43**	.36**	.54**	--								
5. Hierarchic	.51**	.57**	.54**	.46**	--							
6. Oligarchic	.23**	.21*	.09	-.03	.10	--						
7. Anarchic	.38**	.30**	.31**	.15	.30**	.54**	--					
8. Global	.30**	.19*	.35**	.33**	.30**	.10	.23**	--				
9. Local	.48**	.51**	.49**	.46**	.56**	.35**	.54**	.38**	--			
10. Internal	.34**	.09	.24**	.31**	.16	.24**	.03	.25**	.18*	--		
11. External	.22*	.40**	.22*	.06	.30**	.16	.40**	.09	.41**	-.28**	--	
12. Liberal	.50**	.22*	.48**	.30**	.52**	.23**	.43**	.25**	.48**	.15	.45**	--
13. Conservative	.12	.56**	.14	.42**	.30**	.19*	.16	.16	.42**	.14	.28**	-.03

Note: ** Correlation is significant at the 0.01 level (2-tailed);

* Correlation is significant at the 0.05 level (2-tailed).

Factor analysis. A principal-axis factor analysis with an oblimin rotation was conducted to examine the validity of the instrument. Factor analysis of these scales resulted in four factors that accounted for 58.8% of the variance in the main study

sample. Three of the factors (representing the dimensions of function, level, scope and leaning) were coherent with the five-dimension theoretical model. Besides, the factor solutions demonstrated the comparability of the Type I (including legislative, judicial, global, and liberal) and the Type III thinking styles (including anarchic, oligarchic, internal and external), but not the Type II thinking styles (including executive, local, and conservative styles), and the detailed results of the factor analysis are given in Table 17. Whether this is due to the measurement instruments employed in the study needs further investigation.

Table 17: Oblimin-rotated four-factor model for the Thinking Styles Inventory (N=138)

Scales	Factor 1	Factor 2	Factor 3	Factor 4
Legislative	.67			
Executive	.65			
Judicial	.64			
Monarchic	.59	-.47		
Hierarchic	.73			
Oligarchic		.46		.64
Anarchic	.58	.44		
Global	.42			
Local	.80			
Internal		-.42		.45
External	.48	.52		
Liberal	.64		-.41	
Conservative	.49		.77	
% of variance	33.83	9.39	8.40	7.19
Cumulative variance	33.83	43.22	51.63	58.82
Eigenvalue	4.40	1.22	1.09	.94

Note: Variables with factor loadings less than +/- .40 have been omitted.

In summary, the TSI proved to be reasonably reliable and valid for identifying the

thinking styles of this sample. The results indicated that this Chinese version of TSI had marginal to good internal consistency. However, the Local scale needs to be revised. Second, most interscale correlations were in the direction predicted by Sternberg's theory. Finally, the results from the factor analysis in the present study were similar to the findings in the aforementioned studies.

4.1.2 The Abbreviated Torrance Test for Adults

The Abbreviated Torrance Test is rated on four dimensions: fluency, originality, flexibility, and elaboration. Fluency measures the ability to produce quantities of ideas. Originality measures the ability to produce uncommon or unique responses. Elaboration measures the ability to develop and elaborate on ideas. Flexibility measures the ability to produce information or objects in non-traditional ways. After the removal of students who did not complete all three tasks of the ATTA, a total of 127 participants were used in the analysis.

Inter-rater reliability. Two independent raters the same ones used in the pilot study, assessed the participants' creative thinking abilities using the standard ATTA procedure (see 3.3.5.1). 15 randomly selected tests from the participants were scored by both raters to check the inter-rater reliability. Inter-rater reliability (Pearson's *r*)

ranged from .82 to .93 for the four dimensions of the normalized scaled creativity scores, and .89 for the overall creativity (the Creativity Index). As noted above, these two ATTA raters had already established good inter-rater reliability in the pilot study. In order to use time more efficiently and reduce the scoring workload, in the main study each of them scored half of the participants' ATTA booklets independently.

Internal reliability. When the internal consistency reliability of the ATTA was examined, acceptable Cronbach's reliability alphas were yielded. The Cronbach's alpha coefficient for the Creativity Index was .90. The Cronbach's alphas for the normalized scaled scores ranging from .50 to .65 (.57 for Fluency; .64 for Originality; .65 for Elaboration; and .50 for Flexibility) did not prove to be very successful in this sample. These Cronbach's alphas were similar to the pilot data (see Section 3.3.5.1). However, according to the published manual of the Chinese version of the ATTA, the test–retest reliability coefficients for this instrument have ranged from .34 to .68, which is acceptable, and this version has been used in a variety of studies. Given that motivational conditions may affect the measurement (Torrance, 1974) and the complexity of creative thinking (Treffinger, 1985), the Chinese version of ATTA can be seen as having reasonable reliability for research applications.

Factor analysis. To explore the construct validity of the creative thinking ability assessed by the ATTA, the scaled norm-referenced ATTA scores were factor analyzed using the principal component method with varimax rotation. SPSS extracted two factors, which accounted for 71.08% of the variance. The inter-correlations among the scaled scores and factor loadings are presented in Table 18. The first three columns present the inter-correlations among these scores. All of the correlation coefficients between the variables were significant at the .01 level of significance except the correlations between Fluency and Originality (significant at the .05 alpha level), and between Elaboration and Originality (not significant at the .05 alpha level).

Table 18: Pearson correlations and factor loadings for the norm-referenced ATTA scores (N=127)

Scale		Creative thinking ability measures				Factor loadings	
		1	2	3	4	1	2
1	Fluency	--	.48**	.43**	.19*	.83	.09
2	Elaboration		--	.32**	.15	.82	-.02
3	Flexibility			--	.23**	.67	.31
4	Originality				--	.10	.97
	Eigenvalues					1.94	.90
	% of variance					44.82	26.26
	Cumulative variance					44.82	71.08

Note: ** Correlation is significant at the .01 level (2-tailed);

*.Correlation is significant at the .05 level (2-tailed).

The loadings of the measures on these factors are presented in the last two columns of Table 18. Factor 1 was determined primarily by the ATTA measures of Fluency,

Elaboration and Flexibility. Factor 2 was determined only by the ATTA measure of Originality. In line with Kharkhurin et al. (2008) and Kharkhurin (2009, 2010), the four ATTA measures can be grouped together as two types of creative functioning: factor 1 as generative capacity is likely to represent the ability to generate and elaborate on various ideas, while factor 2 as innovative capacity is likely to represent the ability to extract novel and unique ideas. The findings in this study support a two-factor model of the ATTA based on Kirton's (1976, 1978, 1987, 1989) adaptor-innovator theory, which suggests that while adaptors prefer to create changes within a given paradigm, innovators would rather work to transcend existing paradigms. In other words, creative thinking is necessary for generating both meaningful and novel responses. In this study, the first factor appeared to represent the ability to generate various solutions to a problem from different categories within a given paradigm. The second factor seemed to represent the ability to generate novel and unique ideas beyond the existing paradigms. The adaptive factor might be comprised of Fluency, Elaboration and Flexibility, whereas the innovative factor might be comprised of Originality. In sum, the construct validity of the ATTA was supported by the present study.

4.1.3 The Creative Product Semantic Scale

In this study, group creativity in term of the group blogs was rated for the pretest and posttest by two expert judges and 66 university students (see Section 3.4.5). Group creativity was operationalized into three dimensions: Novelty, Resolution, and Elaboration and Synthesis.

Inter-rater reliability. The links to the group blogs were presented in a randomized order. Each expert judge rated all the blogs on the three dimensions traditionally used to assess creative products: novelty, resolution, and elaboration and synthesis. They were asked to use their own definitions in rating each of the dimensions using scales ranging from 1 (a low level for that dimension) to 7 (a high level for that dimension). It turned out that in both the pretest and posttest the Pearson correlation coefficients were low (r <.30) for all three dimensions, and there were no statistically significant correlations (p >.05) between two experts' ratings. This indicated that the inter-rater reliability of the measurement of group creativity using expert judges was not supported. Therefore in the current study, the group creativity data obtained from the expert judges was not taken into account in the further data analysis.

Internal reliability. The measurement of the outcome of group creativity by student evaluators was based on the Creative Product Semantic Scale (CPSS). The CPSS is scored on a seven-point rating scale. A total of 77 undergraduate student volunteers

worked as group creativity evaluators, and these were recruited from different disciplines (32 from Engineering, 27 from Business, and 28 from Humanities and Social Sciences, all aged from 20 to 24 years old). Student raters assessed group blogs using the group creativity assessment form (see Appendix H), in which the items were revised from the CPSS and adapted to fit the context of the criterion task. There were two items for novelty dimension (surprising and original), four items for resolution dimension (logical, useful, valuable and understandable), and three items for elaboration and synthesis dimension (well-crafted, organic and elegant). Student raters were given explicit instructions for judging creativity, and asked to rate the items based on the specific related criteria. Because the main study employed a pre- and post-design, six student raters did not take part in the evaluation of the second group blogs after the experiment, and their data was not used in the further analyses. In addition, five raters were removed due to unreliable ratings, leaving a set of 66 complete assessment recorders for final data analysis. The data appeared to be normally distributed. Missing data was imputed by mean substitution, and items were assembled into dimensions. Mean scores were calculated for each dimension. For each of the group blogs, reliability analyses were performed to check the internal consistency among the raters' judgments. Table 19 presents the scale reliabilities. Most of the alphas were higher than .80, and some of them showed excellent

reliability, while only four were less than .70. Besides, for all except one group (mean α =.69), the mean alpha scores for each of the groups ranged from .75 to .93. The mean Cronbach's alphas for three dimensions were .83 (novelty), .89 (resolution), .82 (elaboration and synthesis) in the pretest, and .85 (novelty), .87 (resolution), .84 (elaboration and synthesis) in the posttest. The reliability of the main study data were thus judged to be good using the CPSS instrument.

Table 19: CPSS reliability (Cronbach's alpha) of the scales by dimension in the main study

Conference Structure		**Novelty** Pretest/Posttest	**Resolution** Pretest/Posttest	**Elaboration and Synthesis** Pretest/Posttest	**Mean** α	**All items** Pretest/Posttest
HIGH	Group 1	.41/.87	.88/.87	.77/.85	.69/.86	.90/.92
	Group 2	.80/.92	.86/.83	.78/.73	.81/.83	.93/.90
	Group 3	.86/.78	.94/.85	.83/.82	.88/.82	.96/.91
	Group 4	.87/.87	.89/.89	.87/.88	.88/.88	.94/.94
	Group 5	.80/.81	.88/.90	.74/.84	.81/.85	.92/.95
	Group 6	.86/.88	.89/.91	.83/.89	.86/.89	.95/..94
	Group 7	.81/.83	.90/.78	.89/.82	.87/.81	.95/.89
	Group 8	.89/.88	.91/.92	.85/.83	.88/.88	.96/.95
	Group 9	.78/.93	.90/.89	.89/.81	.86/.88	.94/.94
LOW	Group 1	.86/.65	.85/.85	.76/.76	.82/.75	.89/.89
	Group 2	.89/.76	.83/.74	.66/.86	.79/.79	.91/.89
	Group 3	.87/.90	.90/.87	.86/.64	.88/.80	.95/.90
	Group 4	.81/.87	.90/.92	.82/.90	.84/.90	.94/.94
	Group 5	.89/.92	.91/.91	.86/.92	.89/.92	.95/.95
	Group 6	.87/.90	.90/.92	.86/.85	.88/.89	.95/.94
	Group 7	.89/.89	.92/.78	.81/.77	.87/.81	.94/.90
	Group 8	.88/.86	.84/.90	.75/.83	.82/.86	.91/.94
NO	Group 1	.91/.68	.88/.88	.73/.82	.84/.79	.92/.90
	Group 2	.88/.90	.90/.88	.82/.85	.87/.87	.94/.94
	Group 3	.82/.79	.90/.83	.90/.78	.87/.80	.95/.90
	Group 4	.82/.83	.91/.89	.87/.84	.87/.85	.95/.93
	Group 5	.71/.88	.92/.89	.82/.88	.82/.89	.94/.95
	Group 6	.87/.76	.93/.92	.87/.88	.89/.85	.96/.93
	Group 7	.88/.94	.94/.91	.89/.93	.90/.93	.96/.96
	Group 8	.88/.94	.89/.88	.89/.90	.89/.91	.95/.94
Mean α		.82/.85	.89/.87	.82/.84		

Factor analysis. A principal components analysis (PCA) with varimax rotation was used separately for each group blog assessment to examine the relations among the scales. The results showed that based on the eigenvalues greater than one, 37 out of 50 the tests (approximately 75%) yielded one factor solution. The one-factor's cumulative percentage variance accounted for by the pretest and posttest ranged from 61.55% to 76.23% and 53.24% to 78.30%, respectively. However, the components of each factor varied across groups, with no patterns being found. For the rest of the tests, two factors were extracted. The two-factor's cumulative percentage variance accounted for by the pretest and the posttest ranged from 68.18% to 71.49% and 66.54% to 79.20%, respectively. A further analysis using principal axis factoring (PAF) and oblimin rotation was also completed for comparison, and the results were compatible with those of PCA. A new relation among the subscales was uncovered after conducting factor analysis on data from the main study sample. It was found that when using the CPSS to assess a blog's creativity, there was no obvious distinction among the three dimensions of Novelty, Resolution, and Elaboration and Synthesis. A single factor solution might thus be more appropriate in this analysis. All the test items were clustered together, and it is reasonable to suggest that these nine items could be combined to make one scale. To test this assumption, a reliability analysis was recomputed with the nine items input simultaneously. The results showed that the

reliability substantially increased, ranging from .89 to .96 (see Table 19). Scales should have a high degree of internal consistency. However, one problem with high internal consistency reliability (i.e., a Cronbach's alpha larger than .95) may be that some items are redundant, which can frustrate the respondents. There are two possible reasons for the high Cronbach's alphas (Miles & Banyard, 2007): one is that the items are very highly correlated, and the other is that test was too long. Based on the results of the present study, the dimensions of creative blogs thus seem to be worthy of further reconsideration, and will be further discussed in Chapter Five.

4.1.4 The transactional distance questionnaire

A questionnaire was developed to measure the concepts related to transactional distance. In the present study, individual perceptions of transactional distance were defined as the degree to which a distance learner participating in an online group meeting perceives the psychological and communications space related to interaction, conference structure, learner autonomy and interface. A pilot survey was conducted to examine the initial questionnaire (see Section 3.3.5.2). Revisions were then undertaken as a result of this pilot survey to enhance the appropriateness and stability of the instrument. Since some poor items in the initial questionnaire were deleted, items belonging to the same dimension were combined together as a scale. The finalized instrument (see Appendix K) included four scales measuring the four

dimensions of transactional distance: interaction, conference structure, learner autonomy and interface. Demographic data about the participants was also collected, and may provide additional information for this study. Items used for the measurement of the constructs are outlined in Table 20.

Table 20: Variables and items on the finalized questionnaire

Construct/Scale	Survey Items
Part 1: Demographic information	See QD1, QD2, QD3, QD4, QD5 and QD6
Part 2: Interaction	See Q1a, Q1b, Q1c, Q1d, Q1e Q1f, Q1g and Q1h
Part 3:Conference structure	See Q2a, Q2b, Q2c, Q2d, Q2e, Q2f, Q2g, Q2h, and Q2i
Part 4: Learner autonomy	See Q3a, Q3b, Q3c, Q3d, Q3e, and Q3f
Part 5: Interface	See Q4a, Q4b, Q4c, Q4d, Q4e, and Q4f
Part 6: Online learning preferences	See Q5, Q6, Q7 and Q8
Open questions	See T1, T2, T3, T4 and T5

138 questionnaires were distributed and 130 were returned to the researcher. The data was entered into SPSS and examined for the accuracy of the data input, missing values and outliers. Two pairs of repeated questions (Q1a and Q1d, Q4f and Q8) were used to gauge internal consistency. If a respondent gave opposite answers, then their survey was deemed invalid, and thus eliminated. Out of 130 questionnaires returned, four were discarded due to unreliable responses, while another two were removed as at least 50% of the survey was uncompleted, leaving 124 usable questionnaires for data analyses. The data from 90% of the initial participants was thus employed in the

analyses of transactional distance. Questionnaire items written in the reverse direction, such as Q1c, Q1e, Q1h, Q2e, Q2h, Q2i, Q3c, Q3f, Q4e and Q4F, were reverse scored before the analysis. Missing values were replaced by the mean values of the corresponding items.

Internal reliability. Cronbach's alpha was applied to the transactional distance questionnaire to determine the degree of reliability. A series of reliability analyses were run to obtain the Cronbach's alpha coefficients of the scales included within the instrument. Table 21 presents each scale's alpha coefficient and the number of items. The Cronbach's alpha coefficients for the scales were .74 (Interaction), .72 (Conference Structure), .55 (Learner autonomy), and .98 (Interface). Two items were excluded from further analysis, as the item-total correlations were low for Q1d (.18) and Q3a (.07), while their deletion increased the Cronbach's alpha coefficient values to .77 and .62, respectively.

Table 21: The reliability of the scales on transactional distance

Subscale	**Number of Items** ***(Initial)***	**Alpha Coefficient** ***(Initial)***	**Number of Items** ***(Poor items excluded)***	**Alpha Coefficient** ***(Poor items excluded)***
Interaction	8	.74	7	.77
Conference structure	9	.72	9	.72
Learner autonomy	6	.55	5	.62
Interface	6	.89	6	.89

The reliability of a scale depends on the number of items included in it. Due to the

fact that there were few items in each scale, the reliability coefficients for most of the scales were only moderate, and the reliability scores should increase by adding more quality items. In addition, compared to a more heterogeneous sample, lower reliability scores might due to the use of a more homogeneous sample, which yields lower total variance. The Cronbach's coefficient alphas might thus increase if the questionnaire was used with a different sample. Although the coefficient alpha for learner autonomy was below the recommend minimum value of .70, an overall high alpha (.88) was obtained, and therefore the questionnaire was considered reliable. However, caution should be taken when interpreting the results. In order not to rely only on questions with specific response categories, open question responses were also obtained to clarify and explain survey results.

Scale Intercorrelations. Intercorrelations for the four transactional distance scales were obtained by calculating the Pearson product-moment correlations, as shown in Table 22.

Table 22: Interscale Pearson correlation matrix for scales of transactional distance

Scale		1	2	3	4
1.	Interaction	--			
2.	Conference structure	.69**	--		
3.	Learner autonomy	.52**	.46**	--	
4.	Interface	.60**	.71**	.51**	--

Note: ** All coefficients are significant at the $p < 0.01$ (2-tailed).

Factor analysis. A series of exploratory factor analysis was run to check the construct

validity of the transactional distance scales for the main study. Factor analysis was performed using principle components extraction, varimax rotation, and repeatedly using principal axis factoring and oblimin rotation. For each test, the appropriateness of the data for factor analysis was confirmed: the Bartlett test of sphericity was significant, the Kaiser-Meyer-Olkin measure of sampling adequacy was far greater than .60, while the determent was greater than .0001. Overall, a consistent pattern was observed across the results, as detailed below:

As indicated in Table 23, it is clear that interaction scale was composed of two factors with eigenvalues greater than one: interaction with group members (Factor 1) and interaction with task content (Factor 2). These were originally divided into two subscales.

Table 23: Results of factor analysis of transactional distance - Interaction scale

Item	Varimax Rotations			Oblimin Rotations		
	Factor loadings			Factor loadings		
	1	2	Community	1	2	Community
Q1a	.77			.73		.54
Q1b	.74		.58	.71		.50
Q1h	.72		.52	.61		.38
Q1e	.69		.49	.60		.36
Q1c	.66		.44	.54		.30
Q1g		.88	.79		.81	.66
Q1f		.87	.77		.69	.48
% of variance	42.06	17.93		34.30	11.55	
Cumulative variance	52.06	59.99		34.30	45.84	
Eigenvalue	2.94	1.26		2.94	1.26	

Factor correlations			
Factor 1	--		
Factor 2	.43	--	

Note: Variables with factor loadings less than +/- .40 have been omitted.

Item descriptions can be found in Table 32.

The conference structure was found to have three factors (see Table 24). When the contents were examined, the four items grouped to Factor 1 related to group conference organization, while the items comprising Factor 2 represented group work delivery.

Table 24: Results of factor analysis of transactional distance - Conference structure scale

Item	Varimax Rotations				Oblimin Rotations			
	Factor loadings				Factor loadings			
	1	2	3	Community	1	2	3	Community
Q2b	.88			.77	.84			.73
Q2a	.85			.77	.86			.71
Q2c	.80			.68	.75			.57
Q2e	.72			.67	.71			.65
Q2g		.83		.74			.63	.41
Q2f		.71		.64			.63	.44
Q2i			.84	.73		.43		.19
Q2h			.58	.56		.52		.36
Q2d			.50	.63		.66		.62
% of variance	44.0	13.19	11.79		39.57	7.15	5.32	
Cumulative variance	44.0	57.19	68.97		39.57	46.72	52.04	
Eigenvalue	3.96	1.19	1.06		3.96	1.10	1.06	
Factor correlations								
Factor 1					--			
Factor 2					.32	--		
Factor 3					.51	.26		--

Note: Variables with factor loadings less than +/- .40 have been omitted.

Item descriptions can be found in Table 32.

The Learner autonomy scale was factored into two domains (see Table 25): learner independence and interdependence. Three items clustered at Factor 1 were concerned with learner independence, whereas two items grouped to Factor 2 were concerned with learner interdependence.

Table 25: Results of factor analysis of transactional distance- Learner autonomy scale

Item	Varimax Rotations			Oblimin Rotations		
	Factor loadings			Factor loadings		
	1	2	Community	1	2	Community
Q3c	.80		.64	.61		.39
Q3d	.79		.64	.70		.49
Q3b	.61		.44	.49		.25
Q3e		.90	.81		.74	.55
Q3f		.69	.61		.50	.36
% of variance	41.12	21.75		29.11	11.61	
Cumulative variance	41.12	62.87		29.11	40.72	
Eigenvalue	2.06	1.09		2.06	1.09	
Factor correlations						
Factor 1				--		
Factor 2				.32	--	

Note: Variables with factor loadings less than +/- .40 have been omitted.

Item descriptions can be found in Table 32.

The Interface scale was split into two factors (see Table 26). Factor 1 was concerned with the computer user satisfaction that could be attributed to psychological space. Factor 2, with the exception of item Q4f, was concerned with conditions impacting communication.

Table 26: Results of factor analysis of transactional distance - Interface scale

Item	Varimax Rotations			Oblimin Rotations		
	Factor loadings			Factor loadings		
	1	2	Community	1	2	Community
Q4a	.89		.81	.86		.74
Q4c	.87		.77	.88		.78
Q4b	.87		.82	.79		.62
Q4e		.77	.60		.43	.18
Q4d		.74	.59		.66	.44
Q4f		.63	.58		.66	.47
% of variance	49.96	19.36		43.97	9.92	
Cumulative variance	49.96	69.32		43.97	53.89	
Eigenvalue	3.00	1.16		3.00	1.16	
Factor correlations						
Factor 1				--		
Factor 2				.48	--	

Note: Variables with factor loadings less than +/- .40 have been omitted.

Item descriptions can be found in Table 32.

The results presented in this section show that the research instruments employed in the main study, including the TSI, ATTA, the group creativity assessment using CPSS and the transactional distance questionnaire, had statistically acceptable reliabilities and validities.

4.2. Descriptive analysis

Descriptive analyses of the collected data were performed using SPSS (Release 17.0) to investigate the distribution of the variables, and these results are presented in this section.

4.2.1 Results of the Thinking Style Inventory

The descriptive results of the Thinking Style Inventory (TSI) are presented in Table 27. The maximum score for each thinking style is seven, while the minimum is one. In this study, the function dimension of mental self-government, including the legislative, executive and judicial thinking styles, was used as one of the independent variables to create different types of collaborative groups. The statistical results show that the means of the legislative, executive and judicial scores were 5.43 (*SD* =.84), 5.11 (*SD* =.96), and 4.40 (*SD* =1.01), respectively. Therefore, in the function dimension of mental self-government, the participants preferred the legislative thinking style the most, and the judicial one the least.

According to Lomax (2001), the problem of an asymmetrical distribution is a concern if the skewness value is greater than 1.5 or 2.0. In this study, the skewness values among these three thinking styles ranged from .50 to -.32, within the range of 1 and -1, which is an acceptable range for a normal distribution. Visual inspection of the histograms of the normal probability plots as shown in Figure 20, 21 and 22, reveal the approximately normal distributions of the legislative, executive and judicial thinking styles.

Table 27: Descriptive information of the TSI results

Thinking style		n	M	SD	Skewness	Kurtosis
1.	Legislative	135	5.43	.84	-.32	-.57
2.	Executive	135	5.11	.96	-.24	-.74
3.	Judicial	135	4.40	1.01	.19	-.53
4.	Monarchic	134	4.45	.86	.21	-.29
5.	Hierarchic	134	5.03	1.02	-.14	-.80
6.	Oligarchic	134	4.18	.88	.22	.78
7.	Anarchic	135	4.57	2.16	.43	-.29
8.	Global	135	4.60	.83	.21	-.36
9.	Local	135	4.32	.68	.50	.20
10.	Internal	135	3.76	1.18	-.04	-.32
11.	External	133	5.32	1.01	-.14	-.95
12.	Liberal	133	5.12	1.08	-.15	-.65
13.	Conservative	133	4.23	1.09	.09	.18

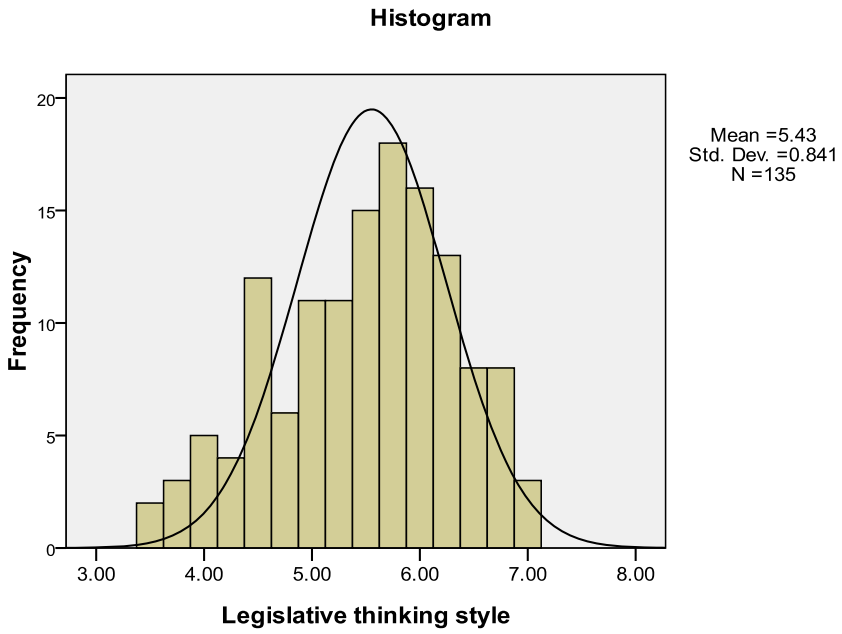

Figure 20: The frequency distribution of the legislative thinking style scores

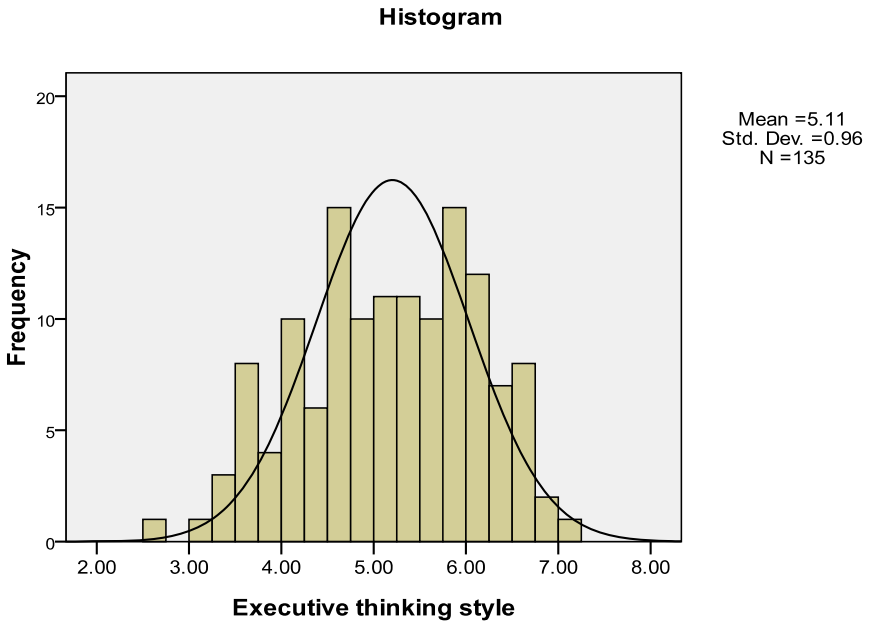

Figure 21: The frequency distribution of the executive thinking style scores

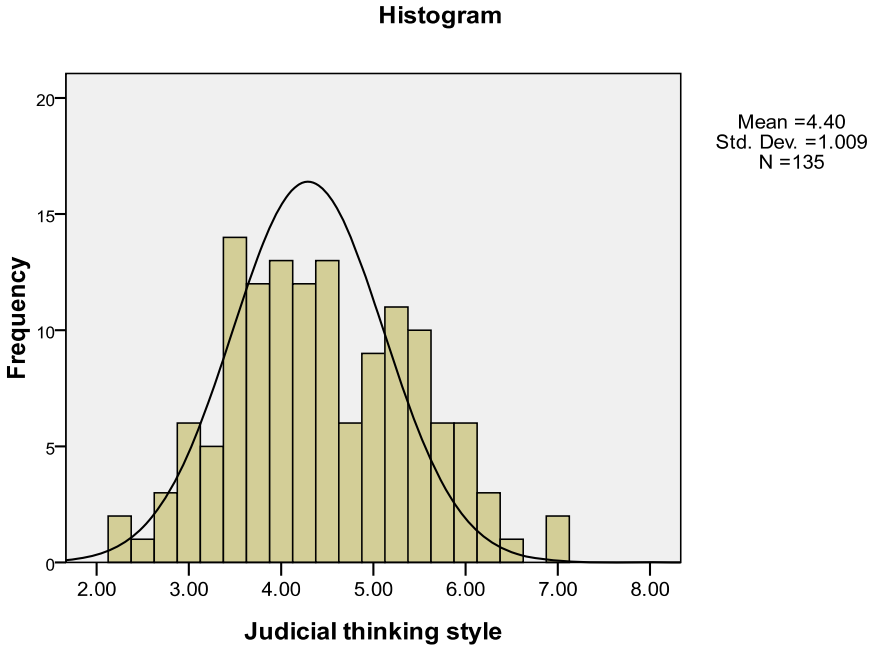

Figure 22: The frequency distribution of the judicial thinking style scores

4.2.2 Results of the ATTA for Creative Ability

This section presents the results of the ATTA. As mentioned in Chapters 2 and 3, the ATTA measures four creative abilities: (1) Fluency; (2) Originality; (3) Elaboration; and (4) Flexibility. Each of the four creative abilities is norm-referenced to a scale that ranges from 11 to 19. The overall creative performance, namely Creative Index (CI), is the sum of the four scores plus other creative indicators (see Section 3.2.2). Based on the CI scores, the creativity level ranges from one to seven. In the present research, the ATTA was used to determine the overall creative ability of the individual university students in the sample. Simple descriptive statistics were first computed for all the scaled measures. As indicated in Table 28, the scaled score with the highest average for the main study sample was for Elaboration, whereas the lowest score was for Flexibility. As indicated in Table 29, the majority of the participants were at the below average level of creativity (Level 3, 38.6%, 49 out of 127). The second largest group was located at the average level (22.8%, 29 out of 127), while the rest were at Level 2 (16.5%, 21 out of 127), Level 5 (9.4%, 12 out of 127), Level 1 (4.7%, 6 out of 127), Level 6 (3.9%, 5 out of 127) and Level 7 (3.9%, 5 out of 127). When comparing these results with those for the norm referenced group provided by the ATTA Chinese version (see Table 30), it can be seen that, generally speaking, the participants in this study were found to have less creativity. 62% of the norm referenced group was in the level of average to above average, while only 40% of the participants in the main

study (51 out of 127) were in the same range. In this study, the highest percentage of respondents was in the level of below average, and a slightly higher percentage of them were in the lowest two levels (minimal and low, 21.1%) compared to the norm (16%). While 16% of the norm group were in the highest two levels, less than half that (7.8%) were found in this study.

Table 28: Mean, standard deviation, skewness and kurtosis of the ATTA scores (N=127)

Measure	Mean	SD	Skewness	Kurtosis
Fluency (scaled)	14.12	1.51	-.05	-.19
Originality (scaled)	13.35	2.17	.52	-.81
Elaboration (scaled)	16.68	1.98	-.99	1.12
Flexibility (scaled)	13.33	1.39	.80	1.28
Creativity norm-referenced score [a]	57.49	4.81	-.25	.64
Creativity Index (CI)[b]	60.65	6.84	.18	.59
Level of creativity	3.43	1.33	.72	.65

Note. SD = standard deviation. Possible ranges for each measure: normalized scaled scores including Fluency, Originality, Elaboration, and Flexibility (11-19), Creativity norm-referenced score (44-76), Creativity Index (44-76) and Level of Creativity (1-7).

[a] Creativity norm-referenced score results from summing the scaled Fluency, Originality, Elaboration and Flexibility.

[b] CI is a composite of the creativity norm-referenced score plus other creative indicators

Table 29: Descriptive information of the ATTA results (N=127)

Measure	n	%
Scaled Fluency scores		
11	7	5.5
12	9	7.1
13	30	23.6
14	25	19.7
15	35	27.6
16	16	12.6
17	3	2.4
18	2	1.6

Scaled Originality scores

11	43	33.9
13	40	31.5
14	19	15.0
15	12	9.4
16	9	7.1
17	3	2.4
18	1	.8

Scaled Elaboration scores

11	6	4.7
14	8	6.3
15	17	13.4
16	20	15.7
17	31	24.4
18	17	13.4
19	28	22.0

Scaled Flexibility scores

11	10	7.9
12	21	16.5
13	45	35.4
14	37	29.1
16	12	9.4
18	2	1.6

Creativity norm-referenced score

44-47	4	3,2
48-51	9	7,1
52-55	25	19,7
56-59	48	37.7
60-63	30	23.6
64-67	7	5.5
68-71	4	3.2

CI/ Creativity Level

1-49/ ***1*** (Minimal level of Creativity)	6	4.7
50-56/ ***2*** (Low level of Creativity)	21	16.5
57-61/ ***3*** (Below Average level of Creativity)	49	38.6
62-66/ ***4*** (Average level of Creativity)	29	22.8
67-70/ ***5*** (Above Average level of Creativity)	12	9.4
71-75/ ***6*** (High level of Creativity)	5	3.9
76+ / ***7*** (Substantial level of Creativity)	5	3.9

Note. CI = Creativity Index

Table 30:

Comparison of overall creative ability between the norm referenced group and the main study sample

CI	1-49	50-56	57-61	62-66	67-70	71-75	76+
Creativity Level	Minimal	Low	Below Average	Average	Above Average	High	Substantial
Norm Reference Group	4%	12%	20%	26%	20%	12%	4%
Main Study Sample	4.7%	16.5%	38.6%	22.8%	9.4%	3.9%	3.9%

As shown in Figures 23 and 24, the shapes of the scaled scores (skewness = -.25) and CI scores (skewness = .18) were very close to the normal distribution. In this study, the overall creativity ability was represented by CI.

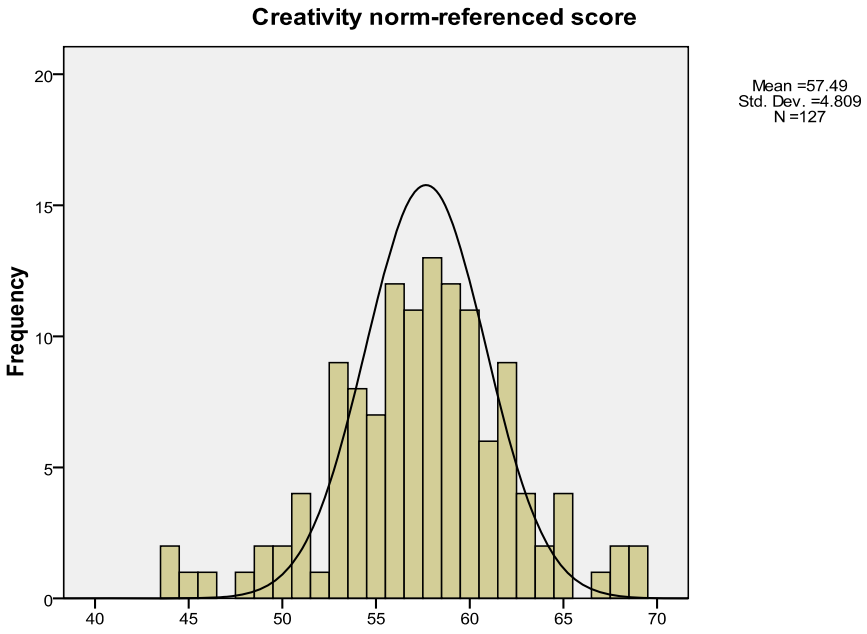

Figure 23: The frequency distribution of the Creativity norm-referenced scores

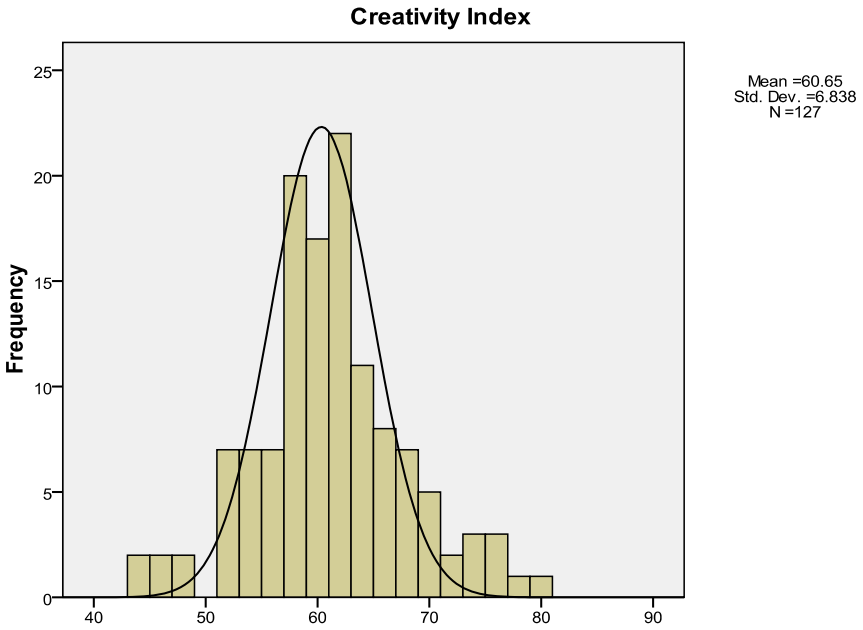

Figure 24: The frequency distribution of the Creativity Index scores

4.2.3 Summary of transactional distance survey

The details of the 124 students who returned the questionnaire are summarized below.

4.2.3.1 Demographic characteristics and Internet experience

Table 31: Demographic details of questionnaire respondents (N=124)

Characteristic	n	%
Student major		
International Business (*Six Thinking Hats Group*)	42	33.9
Leisure Management (*Brainstorming Group*)	45	36.3
Information Management (*Comparison Group*)	37	29.8
Gender		
Male	31	25.0
Female	93	75.0
Thinking style		
Executive	40	32.3
Legislative	77	62.1
Judicial	6	4.8
Missing	1	.8
Internet accessibility		
Very Difficult	1	.8

Neutral	4	3.2
Easy	41	33.1
Very Easy	71	57.3
Missing	7	5.6
Weekly Internet use		
1-5	23	18.5
6-10	23	18.5
11-15	18	14.5
16-20	13	10.5
Over 20	44	35.5
Missing	3	2.4
Online learning experience		
No	32	25.8
Yes	92	74.2
Satisfaction with online learning		
Unsatisfactory	6	6.5
Neutral	22	23.9
Satisfactory	44	47.8
Very Satisfactory	16	17.4
Missing	4	4.3
Preferences in online learning		
Yes	77	62.1
No	16	12.9
Not Sure	30	24.2
Missing	1	.8
Confidence in online discussions		
Yes	105	84.7
No	4	3.2
Not Sure	11	8.9
Missing	4	3.2
Preferences for receiving immediate responses		
Yes	105	84.7
No	3	2.4
Not Sure	14	11.3
Missing	2	1.6
Satisfaction with online activities		
Yes	85	68.5
No	7	5.6
Not Sure	27	21.8
Missing	5	4.0

The total of 139 subjects came from three departments, with 46 International Business majors, 50 Leisure Management majors, and 42 Information Management majors. For

the questionnaire survey, Table 31 and Figure 25 show that a total of 124 valid responses were obtained: 33.9% (42 out of 124) in International Business; 36.3% (45 out of 124) in Leisure Management; and 29.8% (37 out of 124) in Information Management.

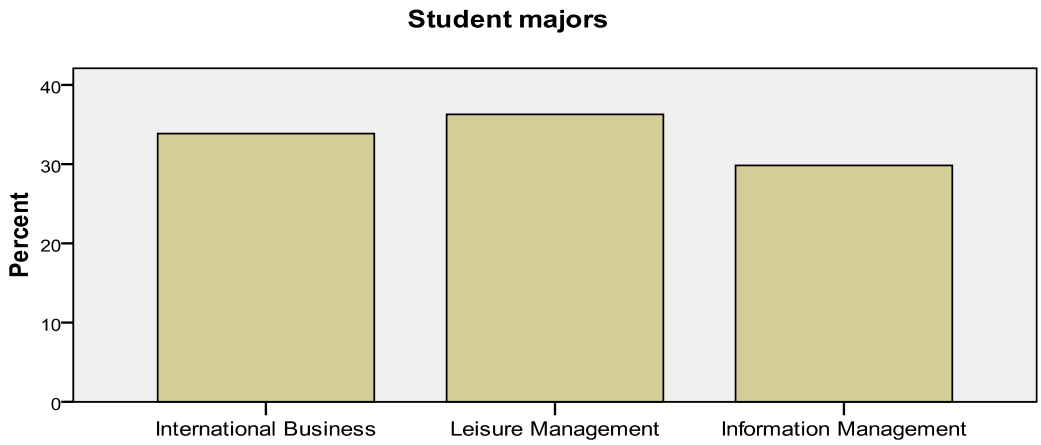

Figure 25: Summary of majors of the respondents

In the main study, the participants were mostly female (n=100), and only 38 participants were male. As shown in Table 31 and Figure 26, 25.0% (31 out of 124) of the valid responses were from male students and 75% (93 out of 124) were from female ones.

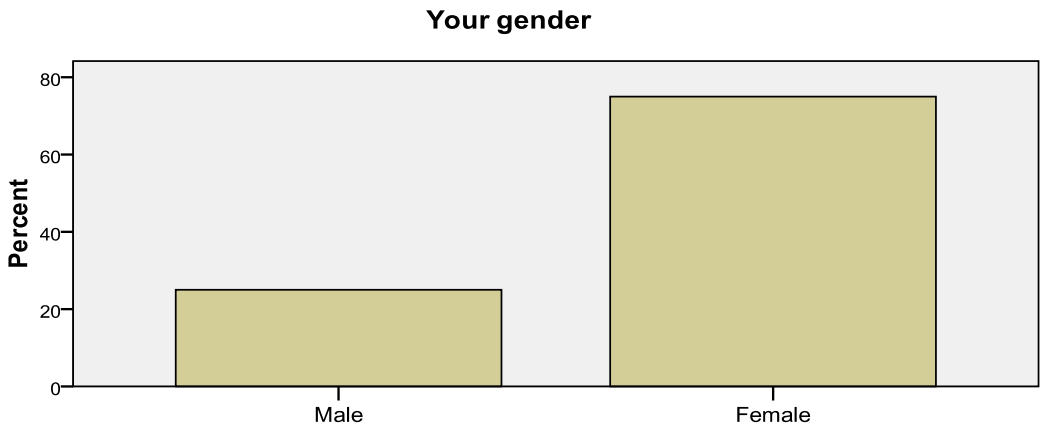

Figure 26: Summary of student gender

Based on the results of the TSI, the dominant thinking style was determined by the highest rating in the function dimension. The main study sample consisted of 48 executive thinkers, 81 legislative thinkers, and 9 judicial thinkers. Table 31 and Figure 27 show that 32.3% (40 out of 124) of the valid responses were from respondents with an executive thinking style, 62.1% (77 out of 124) were from those with a legislative thinking style, and 4.8% (6 out of 124) were from those with judicial thinking style. There was only one missing value.

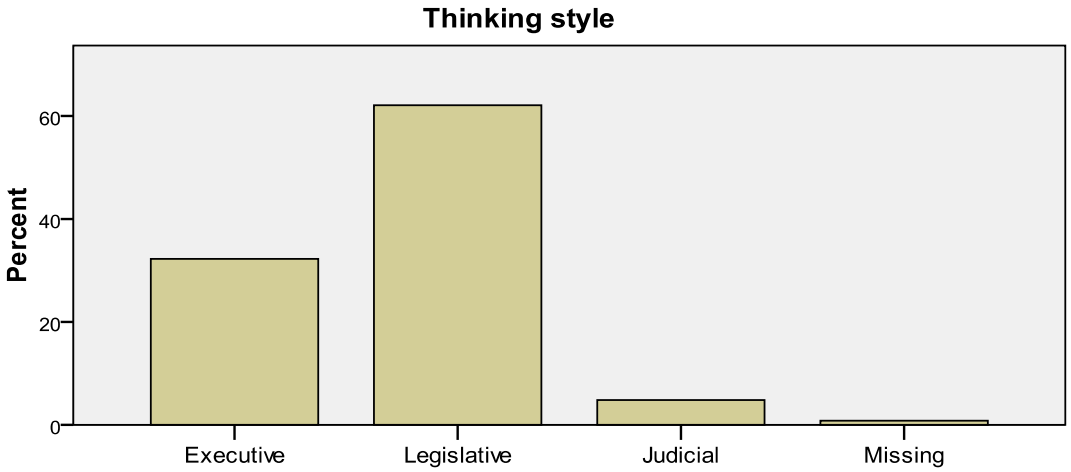

Figure 27: Summary of thinking styles

As indicated in Table 31 and Figure 28, Internet accessibility is no longer a problem for university students, with over 90% of the respondents (33.1% and 57.3% respectively) choosing the options “Easy” and “Very Easy”, and only one selecting “Very Difficult”.

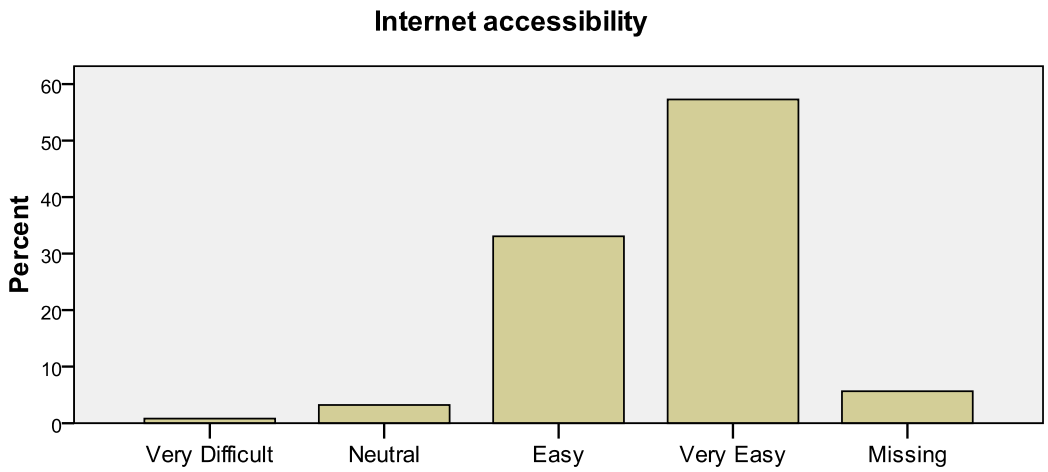

Figure 28: Summary of Internet accessibility

Weekly Internet use ranged from 1-5 hours (18.5% of the respondents), 6-10 hours (18.5% of the respondents), 11-15 hours (14.5% of the respondents), 16-20 hours (10.5% of the respondents), to over 20 hours (35.5% of the respondents) (see Table 31 and Figure 29).

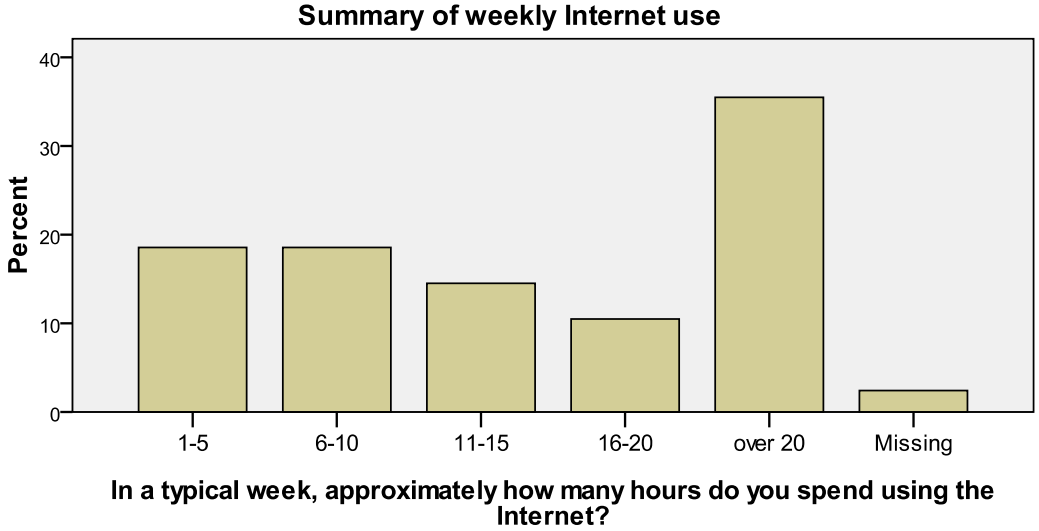

Figure 29: Summary of weekly Internet use

Close to three-quarters of the respondents, 74.2%, reported that they had engaged in on-line learning before, and one-quarter, while 25.8%, had no online learning experience (see Table 31 and Figure 30). Over half of the respondents who has taken part in online learning before had positive experiences with it, with 47.8% stating that it was “Satisfactory” and 17.4% “Very Satisfactory”. 23.9 % of the respondents reported “Neutral”, and only a very few people, 6.5%, reported having a negative experience with online learning (see Table 31 and Figure 31).

Table 31 and Figure 32 reveal that most students, 62.1%, preferred online to traditional classroom learning, with only 12.9% holding the opposite view. However, there were still a large proportion of respondents, 24.2%, who were not sure which they preferred.

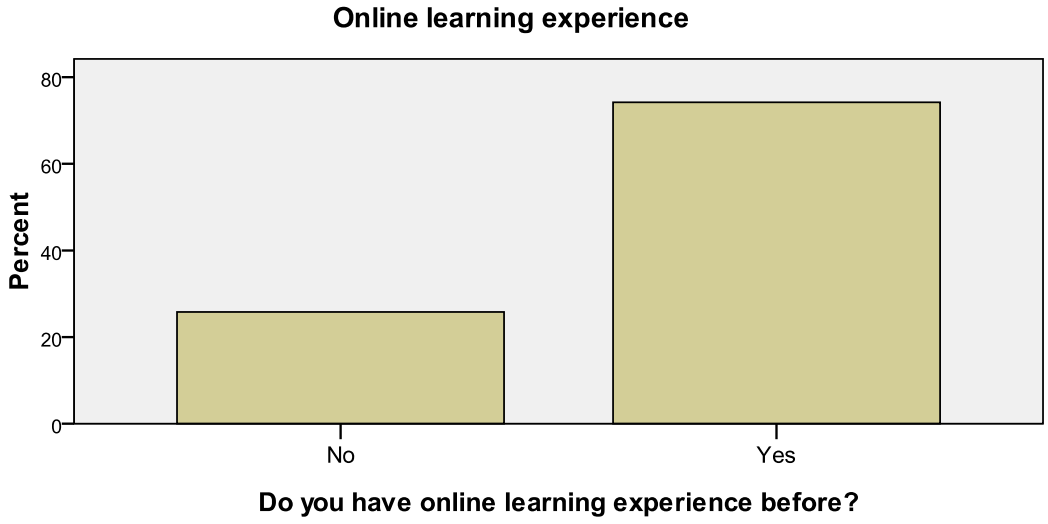

Figure 30: Summary of online learning experience

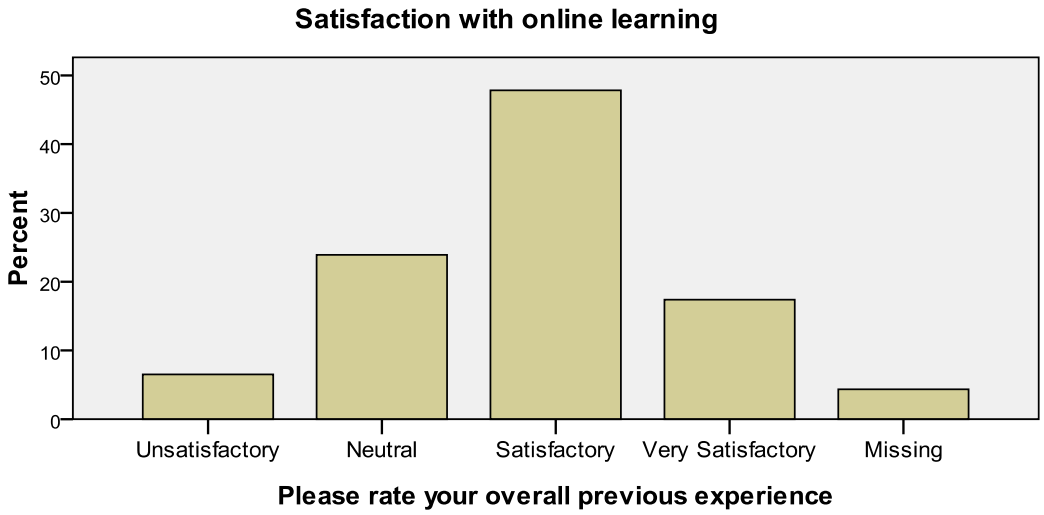

Figure 31: Summary of satisfaction with online learning

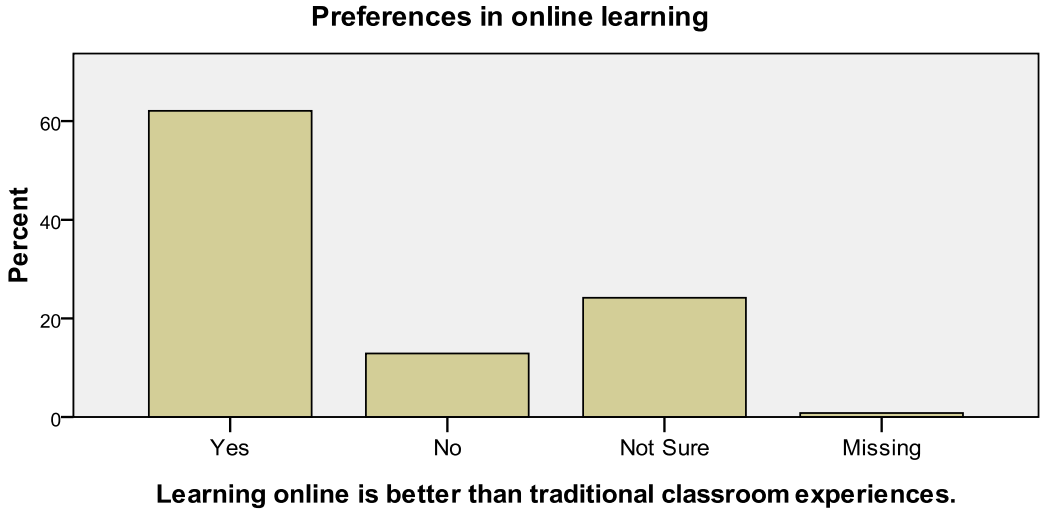

Figure 32: Summary of preferences in online learning

The majority of the respondents (> 80%) indicated that they felt confident about engaging in online discussions, while only 3.2% chose the "No" option. 12.2% were either "Not sure" or had missing answers (see Table 31 and Figure 33).

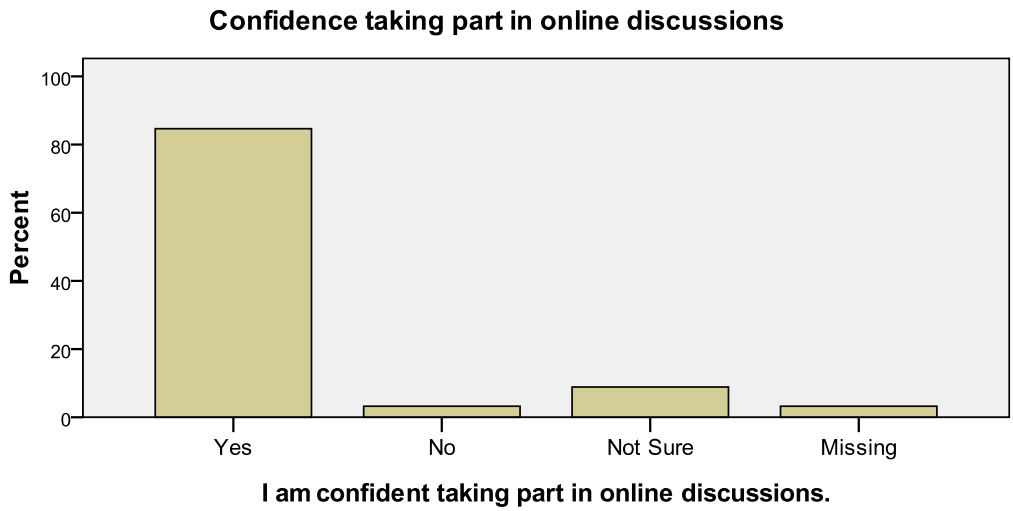

Figure 33: Summary of confidence in online discussions

The majority of the respondents (> 80%) indicated that they preferred receiving immediate responses when working on the Internet, while only 2.4% preferred not to. 12.9% were either "Not sure" or had missing answers (see Table 31 and Figure 34).

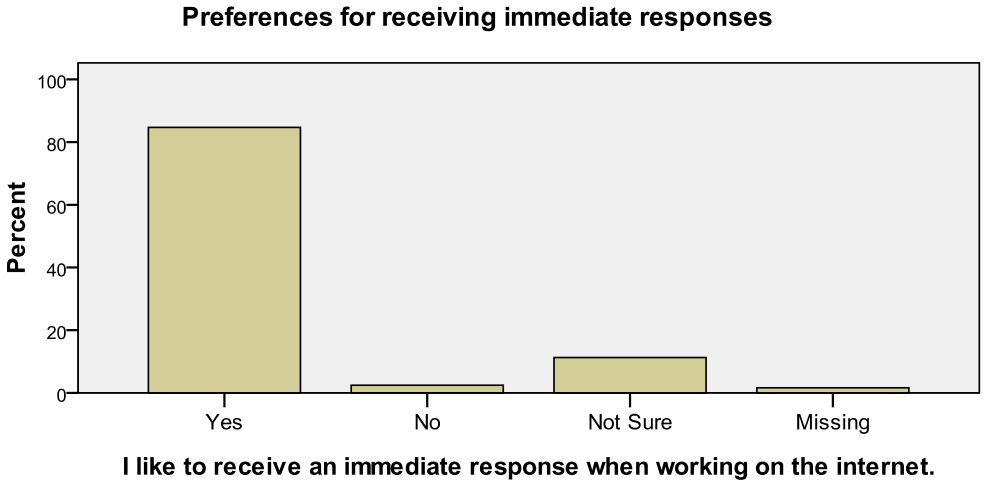

Figure 34: Summary of preferences for receiving immediate responses

With a similar response pattern to the earlier question that compared online and traditional classroom learning, most students, 68.5% , stated that they were satisfied with the online activities used in this study, with only 5.6% being dissatisfied. 25.8 % of respondents had no opinion on this issue (see Table 31 and Figure 35).

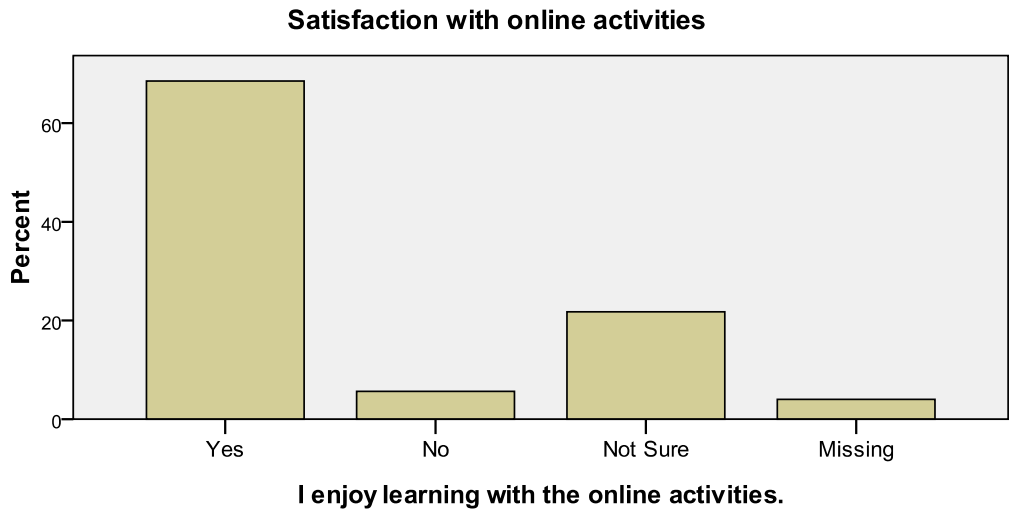

Figure 35: Summary of satisfaction with online activities

In sum, most of the respondents had positive perceptions and attitudes toward their online learning experience. It is anticipated that further investigations into transactional distance will assist in guiding future research and development efforts to design online learning activity.

4.2.3.2 Transactional distance scales

For the purpose of analysis, the items were grouped according to the construct

measures. Valid responses for each item could range from one (Strongly Disagree) to five (Strongly Agree). To make the responses clear and consistent, the negatively worded items were reverse coded. When interpreting the results, high values have a positive meaning. In other words, the higher the value, the less the individual perception of transactional distance. The means, standard deviations (SD), skewness, and kurtosis of the items were calculated. Except for item Q2i, all item means were above 3.0, and the standard deviations ranged from .61 to 1.05. A summary of the results is presented in Table 32. The data appeared to be normally distributed for the majority of the questionnaire items, and only items Q1b, Q1h, Q2c and Q2g had kurtosis levels that were over one, and 28 out of 29 items' skewness was within the range of the absolute value of one, indicating that the distribution of the items was within the normal range (Lomax, 2001).

Table 32: Item statistics for the transactional distance scales

Construct/ Item	**Mean**	**S D**	**skewness**	**Kurtosis**	**Valid N**
Interaction subscale					
Q1a. I like to share information and ideas with other group members.	3.73	.74	-.385	.087	124
Q1b. I receive feedback from other group members as often as I need to.	3.62	.77	-.631	1.175	124
Q1c. Interaction with other group members doesn't help my understanding. (*reverse coded*)	3.80	.94	-.791	.638	124
Q1d. I would like to have a chat with other group members if I had the chance to do so. *(excluded)*	3.18	.83	.458	-.161	121
Q1e. I feel there is a psychological distance between other group members and myself. (*reverse coded*)	3.24	.98	-.034	-.403	124
Q1f. I understand the task content.	4.05	.61	-.243	.550	124

Q1g. I can get help to understand the task content.	3.85	.64	-.063	-.106	123
Q1h. The task content doesn't help me learn more. (*reverse coded*)	3.80	.93	-1.003	1.235	123
Conference structure subscale					
Q2a. I believe the group discussion format is well presented.	3.60	.75	-.365	.521	124
Q2b. I believe the group discussion format meets my needs.	3.35	.83	-.200	.130	124
Q2c. I believe the group work requirements are reasonable.	3.69	.78	-.564	1.127	124
Q2d. I feel the group discussion format increases interaction with group members.	3.23	.94	-.185	-.291	124
Q2e. I feel the group discussion style is not a valid way of learning. (*reverse coded*)	3.26	.94	-.116	-.134	124
Q2f. I am able to participate in group discussions at any time.	3.11	1.05	-.229	-.751	124
*Q2*g. I am confident with online discussion tools.	3.92	.83	-.954	1.796	123
Q2h. I find it is difficult to actively participate in the discussion process. (*reverse coded*)	3.41	.99	-.122	-.453	123
Q2i. I need more guidance to complete group work. (*reverse coded*)	2.82	.83	.617	.776	118
Learner autonomy subscale					
Q3a. I like to take part in a group task at my own pace. *(excluded)*	3.55	.77	-.125	-.315	123
Q3b. I am able to direct my own task.	3.65	.61	-.284	.027	124
Q3c. I feel it is difficult to find resources for my task. (*reverse coded*)	3.45	.87	-.101	-.322	123
Q3d. I am able to complete my task on time.	3.57	.97	-.235	-.683	124
Q3e. I feel that discussion with other group members is a vital part of the learning experience.	3.80	.67	.266	-.802	124
Q3f. I have no intention to actively participate in group discussion. (*reverse coded*)	3.65	.85	-.385	.017	124
Interface subscale					
Q4a. I believe computer conferencing provides an efficient way for interactive learning.	3.80	.70	-.002	-.399	122
Q4b. I believe all the information is well presented on each page.	3.75	.71	-.177	-.093	122
Q4c. I believe computer conferencing provides a good learning environment.	3.66	.65	.100	-.307	122
Q4d. The tools used in computer conferencing are easy to use.	3.57	.85	-.030	-.987	122
Q4e. A great deal of time can be wasted just searching for information when using the Internet. (*reverse coded*)	3.28	.91	-.192	.039	121
Q4f. Computer conferencing does not enhance my interest in learning. (*reverse coded*)	3.29	.83	.243	-.418	118

Note. SD = standard deviation

To test the research hypotheses, the mean score of the items on the same construct was computed for the corresponding scale. The slightly skewed distributions of some

items did not affect the normal distribution of the constructs (variables) involved in transactional distance: interaction, conference structure, learner autonomy, and interface (see Table 33). Visual inspection of the histograms of the normal probability plots revealed that all four of the variables were relatively symmetric (see Figure 36, 37, 38 and 39).

Table 33: Mean, standard deviation, skewness and kurtosis of transactional distance variables

Measure	Mean	SD	Skewness	Kurtosis	Kolmogorov-Smirnov[a]	Sig.
Interaction	3.66	.50	-.334	.158	.109	.10
Conference Structure	3.38	.56	-.209	.878	.084	.14
Learner Autonomy	3.61	.45	.077	-.418	.106	.12
Interface	3.56	.52	.230	-.416	.098	.14

Note. SD = standard deviation

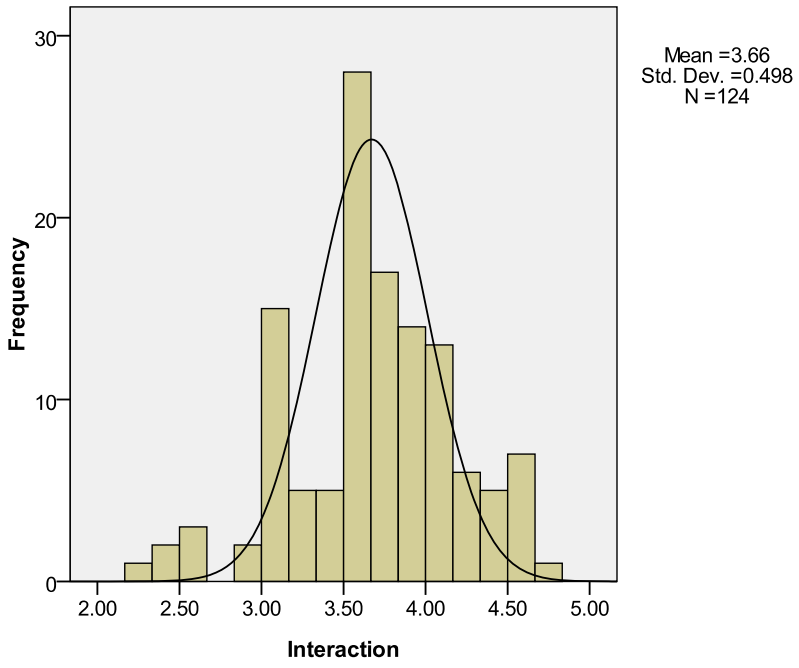

Figure 36: The frequency distribution of the interaction scores

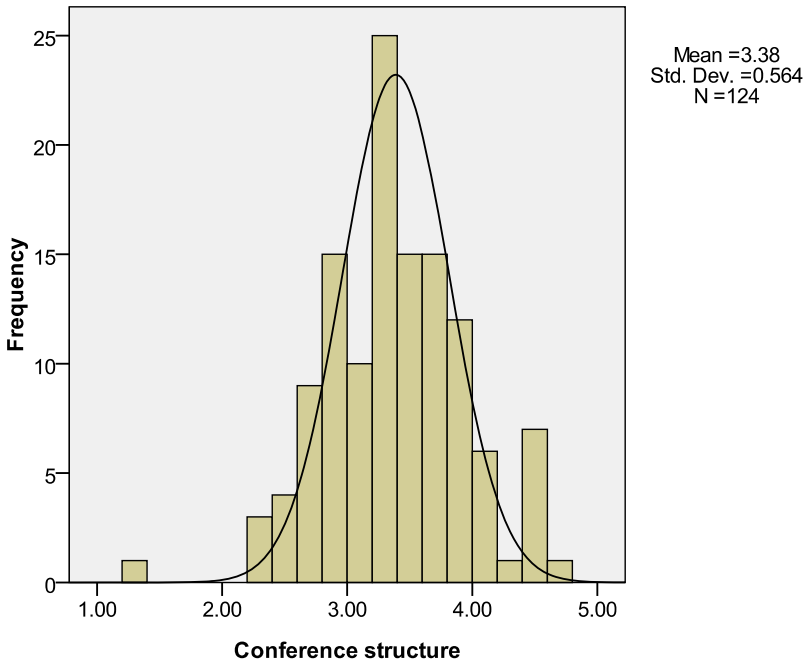

Figure 37: The frequency distribution of the conference structure scores

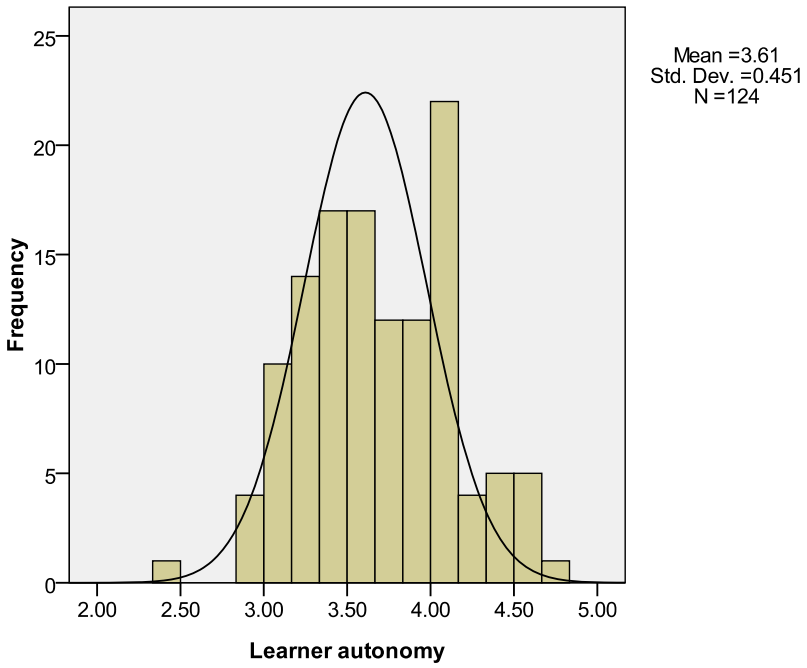

Figure 38: The frequency distribution of the learner autonomy scores

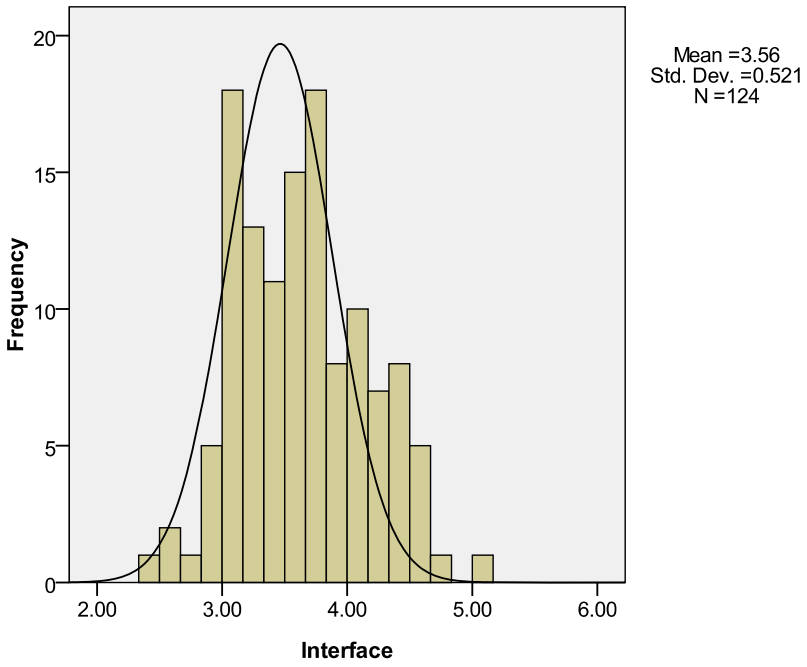

Figure 39: The frequency distribution of the interface scores

4.3. Hypotheses results

The design of this study was to examine the empirical relationships among gender, thinking style, individual creative ability, group creativity, and individual perceptions of transactional distance. According to various previous studies (e.g., L. F. Zhang, 2003a, 2003b; Zhang & Sachs, 1997), individuals' background factors, namely age, discipline and gender, are important influencing variables. However, the age range of the sample was very limited (over 95 percent of participants were 21 to 22 years old), and they were majoring in related disciplines, so age and discipline differences were not considered in the study. After obtaining descriptive information on the four instruments, the tests of two-sample difference of means, Pearson's correlation,

analyses of variance and covariance were carried out. All hypotheses were tested at the .05 level of significance.

4.3.1 Findings related to gender, thinking styles and creative ability

Question 1

Are there any relationships among gender, thinking styles and creative ability?

This study first examined whether male and female students differ in their thinking styles, as measured by the TSI and in creative ability, as measured by the ATTA. Two-independent-samples tests were run to explore the relationship between gender and thinking styles, as well as gender and creative thinking. In addition, since both thinking style and creative ability are interval variables, Pearson's product moment correlation coefficients were computed to represent the magnitude and direction of the relationship between them.

Hypothesis 1.1

Ho: There are no differences between male and female students in thinking styles.

Ha: There are differences between male and female students in thinking styles.

Before performing a two-independent-sample test, the assumptions of the test, which

are independence of groups, normality, and homogeneity, were checked. For the independence assumption, male or female students were put into separate groups, and the two groups were not related. For the second assumption, Kolmogorov-Smirnov tests were conducted to check the normality of the thinking style scores for each group. The results revealed that, for legislative (p = .10 for male, p = .20 for female), executive (p = .20 for male, p = .07 for female) and judicial (p = .20 for male, p = .11 for female) thinking style scores, the normality assumption was satisfied. Finally, Levene's test of equal variance was examined. No test revealed a significant result (p = .63 for legislative, p = .85 for executive, and p = .57 for judicial). Therefore, independent-groups *t*-tests assuming equal variances were performed to test whether there were any significant differences in thinking styles between male and female groups. Means and standard deviations of the thinking styles by gender and *t*-test results are reported in Table 34.

Table 34: Means, standard deviations and *t*-tests for thinking styles between male and female students

	Male (n=35)		**Female (n=100)**		***t*-test**		
Thinking style	***M***	***SD***	***M***	***SD***	***T(df =133)***	***p***	***d***
Legislative	5.69	.81	5.34	.84	2.14	.03*	.42
Executive	5.03	.94	5.14	.97	-.51	.61	
Judicial	4.63	1.09	4.32	.97	1.61	.11	

Note. M = mean. SD = standard deviation. df = degrees of freedom. *p < .05.

This study found a significant difference between male (M = 5.59, SD = .81) and female students (M = 5.34, SD = .84) on the legislative thinking style, $t(133) = 2.14$, $p < .05$. The difference between means was .34 on an eight-point test. The effect size d was approximately .42, which according to Cohen (1988) is a small to medium effect size. A 95% confidence interval on the difference between the two population means using a Student's t distribution with 133 degrees of freedom was obtained with (.03, .67). This suggests that the male students tended to prefer the legislative thinking style more than their female counterparts. In other words, the male students preferred to be creative, inventive, and do things in their own way more than the female ones did. Furthermore, as shown in Figure 40, the male students appeared to score higher than the female ones on the judicial thinking style, while the latter scored higher on the executive thinking style. However, the statistical results also show that the males did not differ significantly from the females on the executive (p = .61) and judicial thinking styles (p = .11).

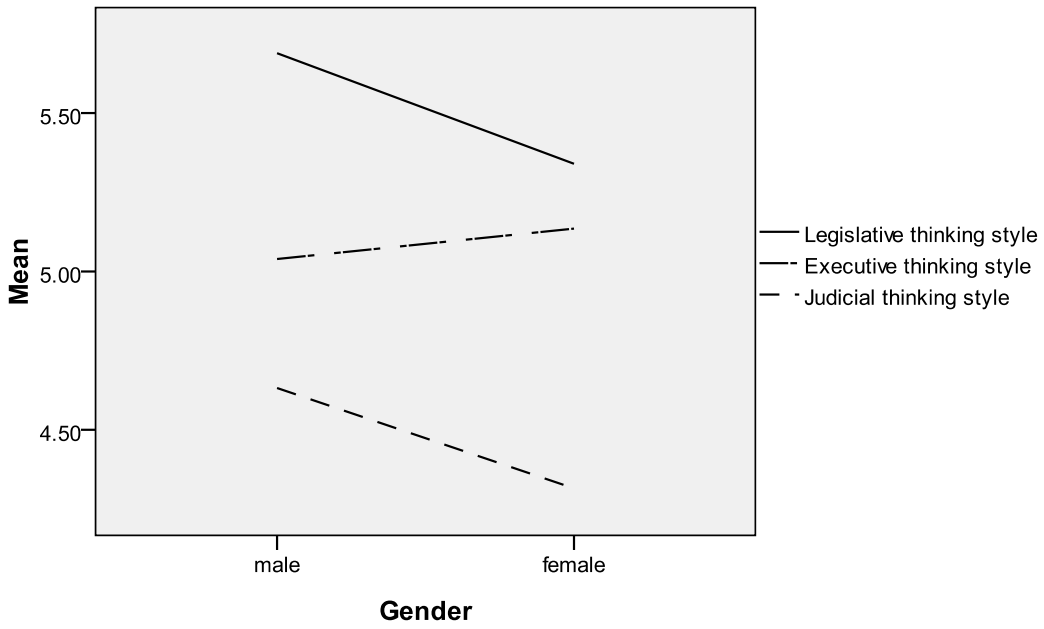

Figure 40: Gender mean difference in thinking styles

Hypothesis 1.2

Ho: There are no differences between male and female students in creative ability.

Ha: There are differences between male and female students in creative ability.

The relationship between gender and overall creative ability was analyzed first. The frequency distributions of the Creativity Index and Creativity Level for each group are shown in Table 35. The results revealed that the majority of participants in both groups were at the Below Average level.

Table 35: Distributions of overall creative ability

CI	**1-49**	**50-56**	**57-61**	**62-66**	**67-70**	**71-75**	**76+**
Creativity Level	**Minimal**	**Low**	**Below Average**	**Average**	**Above Average**	**High**	**Substantial**
Male Group n=33	1 (3.0%)	3 (9.1%)	13 (39.4)	8 (24.2%)	6 (18.2%)	0 (18.2%)	2 (6.1%)
Female group n=94	5 (5.3%)	18 (19.1%)	36 (38.3)	21 (22.3%)	6 (6.4%)	5 (5.3%)	3 (2.4%)

As shown in Figure 41, the creativity levels of each group indicated an approximately normal distribution among the participants. Two-sample Kolmogorov-Smirnov tests were conducted to validate the assumption of normality. The results indicate (p = .30 for males, p = .15 for females) that the data were normal. Moreover, the Levene's test for equality of variances reveals that the variances were not significantly different between each group (F = .35, p > .05). An independent-groups t-test assuming equal variances was performed to compute the means and standard deviations, and to test whether there was any significant difference in overall creative ability between the male and female groups (see Table 36). No significant difference was found regarding gender, $t(125) = 1.02$, $p > .05$, which indicates that there was no significant evidence that the male students (M = 61.7, SD = 6.48) had a different mean overall creative ability than the female ones (M = 60.29, SD = 6.96). A 95% confidence interval on the difference between the two populations' means using a Student's t distribution with 125 degrees of freedom was obtained with (-1.33, 4.15).

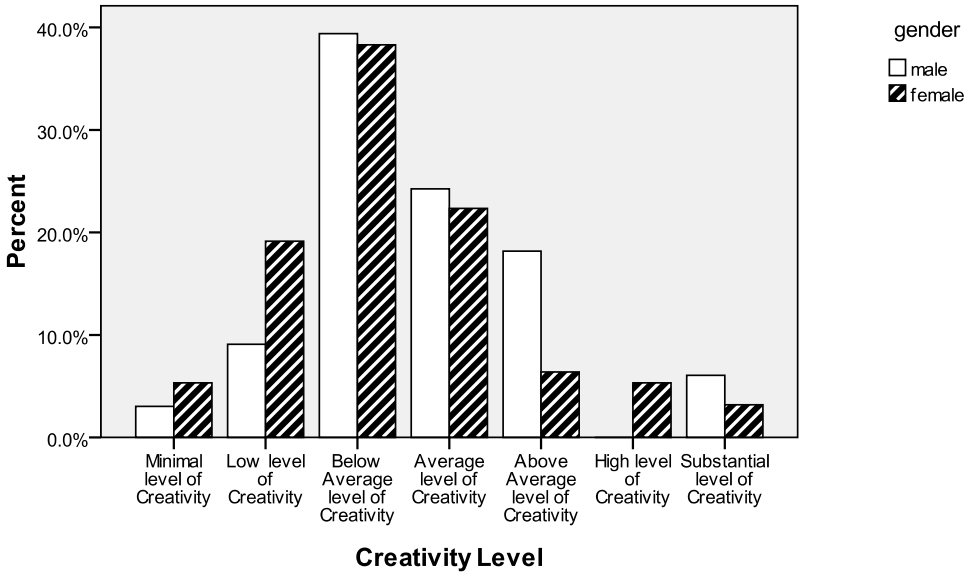

Figure 41: Gender comparison on the percentage of the Creativity Level

Table 36:

Means, standard deviations and *t*-test for overall creative ability between male and female students

	Male (n=33)		Female (n=94)		*t*-test	
Measure	***M***	***SD***	***M***	***SD***	***T(df =125)***	***p***
CI	61.7	6.48	60.29	6.96	1.02	.31

Note. M = mean. SD = standard deviation.

Before the subsets of the ATTA were compared with regard to gender differences, the results of the preliminary Levene's tests for equality of variances indicated that the variances of the two groups were not significant in the fluency (p = .93), originality (p = .64) and elaboration (p = .3) scores, whereas they were significant in the flexibility scores (p = .003). However, because of the unequal sample sizes and the fact that the results of the normality tests for the four creative abilities were all significant (see Table 37), comparisons were performed by Mann-Whitney U test.

Table 37: Tests of normality for fluency, original, elaboration and flexibility

Measure	Gender	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Fluency	Male	.164	33	.024*
	Female	.168	94	.000**
Originality	Male	.230	33	.000**
	Female	.232	94	.000**
Elaboration	Male	.167	33	.020*
	Female	.162	94	.000**
Flexibility	Male	.176	33	.011*
	Female	.207	94	.000**

Note: ** Correlation is significant at the 0.01 level (2-tailed);

* Correlation is significant at the 0.05 level (2-tailed).

The Mann-Whitney test is similar to the two independent samples *t*-test without the normality or equal variance assumption. As shown in Table 38, the only significant difference was observed in originality. The male students had significantly higher mean ranks (75.55) than the 94 females (59.95) on originality, Mann-Whitney U = 1170.0, p = .03, r = -.19, which according to Cohen (1988) is a small to medium effect size. Although the male students scored higher than the female ones on elaboration and flexibility, and the female students higher on fluency (Figure 42), no significant differences were found between the genders on these creative abilities. For fluency, the mean ranks were 63.25 and 64.25, respectively, U = 1257.5, p = .90. For elaboration, the mean ranks were 54.91 and 67.19, respectively, U = 1251.0, p = .09. For flexibility, the mean ranks were 65.70 and 63.40, respectively, U = 1495.0, p = .90.

Table 38: Means, standard deviations and Mann-Whitney tests for The ATTA subscales between male and female students

	Male (n=33)			Female (n=94)			Mann-Whitney *U* test		
Measure	**M**	**SD**	**Mean Rank**	**M**	**SD**	**Mean Rank**	***U***	***p***	***r***
Fluency	14.1	1.52	63.29	14.12	1.51	64.25	1257.5	.90	
Originality	14.03	2.14	75.55	13.12	2.15	59.95	1170.0	.03*	-.19
Elaboration	16.24	1.94	54.91	16.83	1.98	67.19	1251.0	.09	
Flexibility	13.48	1.81	65.70	13.28	1.21	63.40	1495.0	.75	

Note: *r* = effect size. **p* < .05.

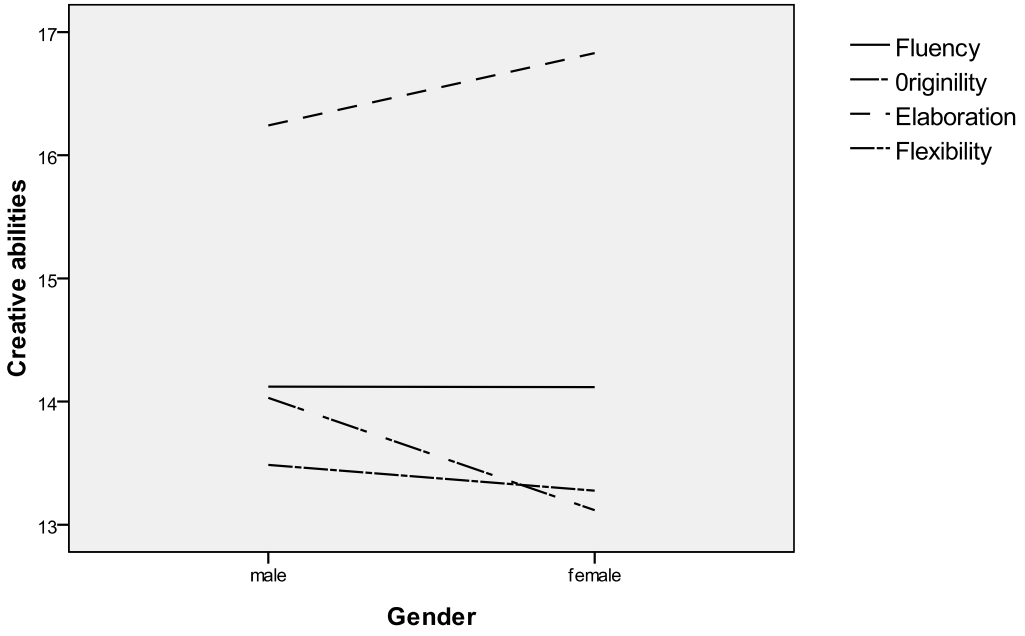

Figure 42: Gender mean differences in the four creative abilities

Hypothesis 1.3

Ho: There is no association between individual creative ability and thinking styles.

Ha: There is an association between individual creative ability and thinking styles.

According to the previous studies mentioned in Section 2.4.1.2, thinking styles are

correlated with some personality traits, although no significant evidence has been found to support the correlations between thinking styles and creative ability. According to Sternberg, a thinking style is a preferred way of expressing or using one or more abilities, and no thinking style is superior; they are simply different (Sternberg, 1997). An individual's preference may be different in different situations, and they may be modified by time and demands (Sternberg & Zhang, 2001). However, a greater understanding of the relationship between different thinking style preferences and creative ability will provide valuable information to better meet individualized needs, and thus to help students to maximize their creativity.

In this study, the relationship between individual creative ability and thinking style were examined. The correlation analyses between thinking styles (legislative, executive and judicial) and creative ability (the creative Index, fluency, originality, elaboration and flexibility) were undertaken to find out any possible associations. A scatterplot matrix was first examined for these data to visualize the nature of the relationships. With the consideration of the normality assumption, if the number of degrees of freedom is greater than 25, then a failure to meet the normality assumption has little consequence (Morgan et al., 2007). Therefore, an evaluation of the linear relationship between thinking styles and creativity was measured in this work using Pearson's correlation coefficient, since both variables represent interval data and there

were more than 30 participants. Table 39 demonstrates that there were some slight relationships between thinking styles and creative ability, although there were no significant results between any pair of variables ($p > .05$). Sternberg's argument that ability (e.g. how creative a person is) is different from style (e.g. how much a person likes to be creative) was thus supported in this study. Abilities refer to what we can do, whereas styles refer to our preferred ways of using our abilities (Sternberg & Zhang, 2001). Those individuals in this study who preferred using a creative thinking style did not in fact have any greater creative ability.

Table 39: Intercorrelations between thinking styles and creative ability (N=124)

Measure	Fluency	Originality	Elaboration	Flexibility	Creativity Index
Legislative	-.13	.13	-.06	.05	.09
Executive		-.15	-.06	.01	-.14
Judicial			-.09	.11	-.003

In consideration of gender differences, the correlation analyses between thinking styles and creative ability were performed again separately with the male and female groups. The relationship between thinking styles and creative ability in both groups was slight (see Tables 40 and 41). No significant relationships were found for the male group ($p > .05$), while for the female group, only the executive thinking style was negatively correlated with originality, $r = -.21$, $p < .05$. This means that female

students who had relatively high executive thinking style scores were likely to have low originality scores, which is a small to medium effect size or correlation according to Cohen (1988). This result was basically consistent with the theory of mental self-government. Executive thinkers like to do things in a way that appears to follow a set of rules or guidelines, and also prefer problems that are given to them or are clearly structured for them. In contrast, people with more originality would rather to generate novel and unique ideas that go beyond the existing paradigm

Table 40: Intercorrelations between thinking styles and creative ability for the male group (N=32)

Measure	Fluency	Originality	Elaboration	Flexibility	Creativity Index
Legislative	.02	.17	.20	.07	.11
Executive		.06	.06	.01	-.03
Judicial			.14	.15	.07

Table 41: Intercorrelations between thinking styles and creative ability for the female group (N=92)

Measure	Fluency	Originality	Elaboration	Flexibility	Creativity Index
Legislative	-.18	.08	-.11	.02	.06
Executive		-.21*	-.11	.03	-.17
Judicial			-.15	.08	-.06

Note: *. Correlation is significant at the 0.05 level (2-tailed).

4.3.2 Findings related to individual creative ability and group creativity

Question 2:

Is individual creative ability related to the overall group creative performance?

The researcher also wanted to investigate the relationship between an individual group member's creative ability and the overall creative performance of the group. It is usually taken for granted that group creativity is primarily determined by individual creativity. However, it has consistently been found that groups perform worse than the sum of the individuals involved (Nijstad & Paulus 2003). Therefore, it is questionable whether group creativity is completely determined by individual creativity. In other words, is group creativity simply the sum of its members' creative ability? In this study, Pearson's correlation coefficient was computed to measure whether a group blog created by members with a higher average creative ability score got a higher creativity rating. Individual overall creative ability was represented by the Creativity Index (CI) measured with the ATTA. The overall group creative performance referred to the score for the first group blog, as assessed by raters using CPSS.

Hypothesis 2

Ho: The average of group member creative ability is not correlated with the overall group creative performance.

Ha: The average of group member creative ability is correlated with the overall

group creative performance.

The assumptions of the correlation analysis were met, as the scores on the two interval variables were normally distributed and did not show any curvilinear relationships (see Table 42). The results reveal that the correlation coefficient for these two variables was r =.007, p =.98, and thus there was no significant association between the average result for group member creative ability and that for overall group creative performance. The following research questions were aimed to examine the proposed effects of group composition and conference structure on group creativity and individual perceptions of transactional distance

Table 42: Correlation between the average of group member creative ability and the overall group creative performance (N=24)

Variable	M	SD	Skewness	Kurtosis	Kolmogorov-Smirnov[a] / Sig.	*Pearson's r*	*p*
Average of group member creative ability	60.96	4.42	.16	.23	.113/ .20	.007	.98
Overall group creative performance	13.58	.70	.86	1.03	.100/ .20		

Note. M = mean. SD = standard deviation.

4.3.3 Findings related to factors influencing on group creativity

Question 3

Do group composition and conference structure have an effect on group creativity, and do group composition and conference structure interact?

In this study, the researcher wanted to know whether heterogeneous groups achieved more group creativity than the homogeneous ones, and thus group composition was manipulated into three types: legislative, executive and mixed thinking style groups. The researcher also wanted to know whether the level of conference structure had an influence on group creativity. Conference structure was manipulated into high-structured, low-structured and no-structured. The former two were the experimental groups, and the latter one the control group. After the experiment, the participants were again assessed for group creativity, based on the scores of the second group blog as determined by the CPSS. In consideration of the potential influence of pre-existing differences in group creativity between the experimental and comparison groups, the researcher performed a 3 x 3 factorial ANCOVA to determine how group creativity was influenced by group composition and conference structure, while controlling the score of group creativity before conducting the experiment. The independent variables were group composition and conference structure, the covariate was the score of the first group blog (pretest), and the dependent variable was the score of the second group blog (posttest).

Before performing the inferential analysis, the assumptions of ANCOVA

(Pallant, 2007) were checked: 1. The results of Kolmogorov-Smirnov tests indicated that the data were normal (see Table 43). In addition, the skewness and kurtosis values were both between -2 and 2 (Pallant, 2007), as seen in the table, and the normality of both scores was thus supported. 2. Every subject was assigned to only one group. 3. A test for homogeneity of variance with cells (Levene's Test) gave a p= .11, suggesting the assumption of equal variances within cells was not a problem. 4. The covariate was measured before the treatment started, so that the pretest scores were not influenced by the treatment. 5. The assumption of linear relationship was not violated, and the relationship was linear for both group composition and conference structure. 6. The interaction of group composition and pretest (F (2, 19) = 1.13, p = .34) and the interaction of conference structure and pretest (F (2, 19) = .15, p = .86) were not significant. In other words, there were no interactions between the covariate and treatments. Therefore, the assumption of the homogeneity of the regression slopes was met, and thus the researcher proceeded with the ANCOVA analysis.

Table 43: Skewness and Kurtosis Values of the pretest and posttest of group creativity

Variable	M	SD	Skewness	Kurtosis	Kolmogorov-Smirnov[a]	Sig.
Pretest	13.58	.70	.86	1.03	.100	.20
Posttest	13.09	.72	-.15	.40	.087	.20

Note. M=mean. SD = standard deviation.

Hypothesis 3.1

Ho: There is no difference between the types of group composition with regard to group creativity.

Ha: There is a difference between the types of group composition with regard to group creativity.

Hypothesis 3.2

Ho: There is no difference between the levels of conference structure with regard to group creativity.

Ha: There is a difference between the levels of conference structure with regard to group creativity.

Hypothesis 3.3

Ho: There is no interaction of group composition and conference structure with regard to group creativity.

Ha: There is an interaction of group composition and conference structure with regard to group creativity.

The ANCOVA table for this analysis is presented in Table 44, and the significances of the effects are examined below. The covariate in terms of the score of the first group blog (pretest) had no significant effect on the score of the second group blog (posttest). The results also shows that after controlling for the pretest, no significant effects were found for either the group composition or conference structure variables. Table 45 presents the means and standard deviations for the levels of group composition and conference structure on the posttest before and after controlling for the pretest. The

unadjusted and statistically adjusted marginal means for the posttest were very similar. As is evident from the table, there were no significant differences among the legislative, executive and judicial groups ($F(2, 15) = 1.33$, $p = .29$, partial $\eta^2 = .15$)). Moreover, there were also no significant differences among the high-structured, low-structured and no-structured conferences ($F(2, 15) = 3.56$, $p = .054$, partial $\eta^2 = .32$). Furthermore, no significant interaction was found between group composition and conference structure ($F(4, 15) = 1.62$, $p = .22$, partial $\eta^2 = .30$).

Table 44: Two-way ANCOVA table for group composition and conference structure

Source	Sum of Squares	df	Mean Square	F	Sig.	η^2	Power[b]
Corrected model	5.93[a]	9	.66	1.53	.22	.48	.48
Intercept	9.37	1	9.376	21.82	.000	.59	.99
Covariance (pretest)	.001	1	.001	.001	.97	.000	.05
Group composition	1.14	2	.576	1.33	.29	.15	.24
Conference structure	3.06	2	1.54	3.56	.05	.32	.57
Group composition * Conference structure	2.78	4	.70	1.62	.22	.30	.38
Error	6.44	15	.43				
Total	4295.81	25					
Corrected total	12.37	24					

Note. η^2 (eta squared) = effect size.

a. R squared = .479 (Adjusted R squared = .167). b. Computed using alpha = .05

Table 45: Adjusted and unadjusted means and variability for the score of the second group blog using the score of the first group as a covariate

		Unadjusted		Adjusted	
	N	**M**	**SD**	**M**	**SD**
Group composition					
Legislative	12	13.00	.69	13.03	.20
Executive	8	13.27	.90	13.57	.29
Mixed	5	13.04	.64	13.04	.32

Conference structure					
High	9	13.28	.53	13.25	.28
Low	8	12.61	.82	12.70	.24
No	8	13.37	.60	13.69	.29

A nonsignificant result can be obtained because the null hypothesis is true, or the null hypothesis may not be rejected because the test used lacks sufficient power to detect the true state of affairs represented by the data (Huck, 2007). In this study, the observed powers for group composition, conference structure and interaction were .24, .57 and .38, respectively, all of which indicate low power. Power is affected by the significance level, effect size and sample size. In this study, with the current small sample size (N=25), the probability of rejecting the null hypothesis was far below the minimum level of .80 (Cohen, 1988), and thus it is possible that important differences were overlooked because of the low power. Therefore, although the groups did not differ significantly, this issue is worth further consideration, since the power was not equal to or greater than .80. As shown in Figure 39, there were only slight differences for the mixed groups with regard to the different conference structure levels. If no interaction occurred, then the lines in the figure would be parallel – and whatever differences between the conference structure levels existed for the legislative groups would be equally present for the executive and mixed ones, regardless of whether one group was generally superior to the others, or whether all

three groups were roughly the same. Although no statistically significant interaction effect was found, as shown in Figure 43, it seems possible that different structural conditions could make lead to different outcomes for the legislative and executive groups. Issues related to group creativity will be further discussed in Chapter Five.

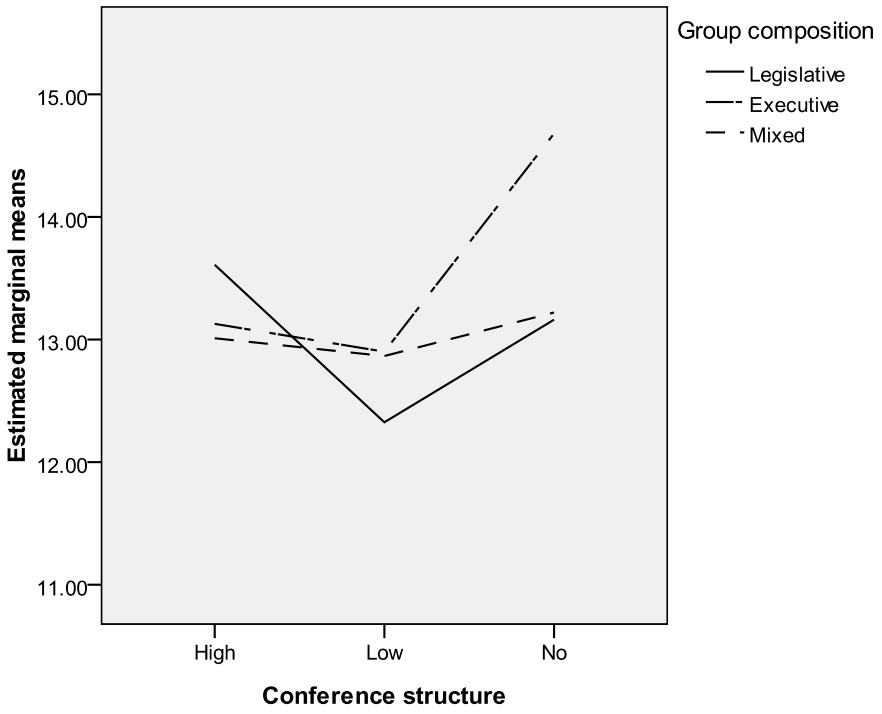

Figure 43: The interaction between group composition and conference structure

4.3.4 Findings related to factors influencing transactional distance

Question 4:

Do group composition and conference structure have an effect on individual perceptions of transactional distance, and do group composition and conference

structure interact?

The theory of transactional distance was originally based on the context of the interactions between a teacher and student, with course delivery being pre-structured by the teacher. In the present study, the researcher extended the theory to the context of interactions among group members in a synchronous computer conference, in which the structure was manipulated by the researcher. To investigate the effects of group composition and conference structure on individual perceptions of transactional distance, two-way 3 x 3 ANOVAs were conducted, with two between subject factors (independent variables): three types of group composition (legislative, executive, mixed thinking style groups) and three conditions of conference structure (high, low, no), to examine the differences with regard to transactional distance that the students perceived in synchronous online group meetings among the experimental and comparison groups. The scores of the transactional distance collected from the self-developed questionnaire served as the dependent variable.

In this study, transactional distance (TD) was composed of four subscales: interaction, conference structure, learner autonomy and interface and scores of these four subscales were tested in four separate ANOVAs. The variables of transactional distance were calculated as presented in Table 46.

Table 46: Transactional distance variables and their calculations

TD Variable	Average item-sum score
Interaction	The sum of questionnaire items Q1a, Q1b, Q1c, Q1e Q1f, Q1g and Q1h, divided by 7
Conference structure	The sum of questionnaire items Q2a, Q2b, Q2c, Q2d, Q2e, Q2f, Q2g, Q2h, and Q2i, divided by 9
Learner autonomy	The sum of questionnaire items Q3b, Q3c, Q3d, Q3e, and Q3f, divided by 5
Interface	The sum of questionnaire items Q4a, Q4b, Q4c, Q4d, Q4e, and Q4f divided by 6

As Table 46 shows, the questionnaire items related to interaction, conference structure, learner autonomy and interface were summed, and each of the four sums was divided by the number of the items that represented the corresponding variable. The averaged scores were then used for the statistical analyses.

Before performing the inferential analysis, the assumptions of ANOVA (Pallant, 2007) were checked: 1. Every subject was assigned to only one group. 2. The normality of scores was supported, with the skewness and kurtosis values being between -2 and 2. The results of Kolmogorov-Smirnov tests indicate that the data was normal (see Table 33 in Section 4.2.3.2). The histograms with normal curves also support the normality of the four subscales (see Figures 36 – 39 in Section 4.2.3.2). 3. The results of the preliminary Levene's tests for equality of variances indicate that the variances of the groups were not significant in the interaction (p = .25), conference structure (p = .14), learner autonomy (p = .73), and interface (p = .55) scores. That is to say, the assumption of equal variances within cells was not a problem. Therefore,

the researcher proceeded with the ANOVA analysis. An overall summary of descriptive and inferential statistics of the ANOVAs are given in Tables 47 and 48.

Hypothesis 4.1

Ho: There is no difference between the levels of group composition with regard to individual perceptions of transactional distance.

Ha: There is a difference between the levels of group composition with regard to individual perceptions of transactional distance.

As shown in Table 48, the main effect of group composition with regard to individual perceptions of transactional distance was only statistically significant in the dimension of learner autonomy ($F(2, 115) = 3.11$, $p = .048$, with a small to medium effect size (partial $\eta^2 = .05$)), which means that being in different thinking style groups explains 5% of the variance in TD – learner autonomy scores. In this study, TD – learner autonomy was defined as the psychological or communicational distance learners perceive with regard to both independent and interdependent participation in online group activities, involving both the learner's ability to be self-directed and his or her preference or need for collaboration. This potential psychological or communicational distance can produce misunderstandings among the inputs of the group members, and thus leads to negative feelings about the online

activities. Significantly, group composition has an influence on the perceptions of learner autonomy distance, when the group members were taking part in the online activities to complete the group tasks.

However, no significant differences were found in TD – interaction ($F(2, 115) = 1.45$, $p = .24$, with a small effect size (partial $\eta^2 = .03$)), TD – conference structure ($F(2, 115) = .43$, $p = .65$, with a small effect size (partial $\eta^2 = .01$)) and TD – interface ($F(2, 115) = 2.69$, $p = .07$, with a small effect size (partial $\eta^2 = .04$)).

Hypothesis 4.2

Ho: There is no difference between the levels of conference structure with regard to individual perceptions of transactional distance.

Ha: There is a difference between the levels of conference structure with regard to individual perceptions of transactional distance.

As shown in Table 48, the factor of conference structure had an significant effect on TD – interaction ($F(2, 115) = 6.99$, $p = .001$, with a medium to large effect size (partial $\eta^2 = .11$)), TD – conference structure ($F(2, 115) = 12.89$, $p < .001$, with a large effect size (partial $\eta^2 = .18$)) and TD – interface ($F(2, 115) = 10.03$, $p < .001$, with a large effect size (partial $\eta^2 = .15$)). This means that being in different levels of conference structure explains 11%, 18% and 15% of the variance in TD – interaction,

TD – conference structure and TD – interface scores, respectively. In this study, TD – interaction was defined as the psychological or communicational distance learners perceive when they interact with group members and task contents in the online activities. TD – conference structure was defined as the psychological or communicational distance learners perceive related to the rigidity or flexibility of the organization and the delivery of group events and activities in the implementation of online conferencing. TD – interface was defined as the psychological or communicational distance learners perceive when they use the online communication tools for carrying out online group activities. Based on the test results, the level of conference structure (high, low and no) had significant effects on individual perceptions of interaction, conference structure and interface distance, which has the potential to create misunderstandings among group members, and thus lead to negative feelings about online conferences. No significant difference was found in the TD - learner autonomy scores ($F(2, 115) = 2.20$, $p = .12$, with a small effect size (partial $\eta^2 = .04$)).

Hypothesis 4.3

Ho: There is no interaction of group composition and conference structure with regard to individual perceptions of transactional distance.

Ha: There is an interaction of group composition and conference structure with

regard to individual perceptions of transactional distance.

In this study, no statistically significant interactions were found between the factors of group composition and conference structure with regard to TD – interaction ($F(2, 115) = 1.53$, $p = .20$, with a small to medium effect size (partial $\eta^2 = .05$)), TD – conference structure ($F(2, 115) = .80$, $p = .53$, with a small effect size (partial $\eta^2 = .03$)), TD – learner autonomy ($F(2, 115) = 1.62$, $p = .17$, with a small to medium effect size (partial $\eta^2 = .05$)) and TD – interface ($F(2, 115) = .41$, $p = .80$, with a small effect size (partial $\eta^2 = .01$)).

Table 47: Means and standard deviations for transactional distance scores as a function of group composition and conference structure

	Conference structure									
	High			*Low*			*No*		*Total*	
Group composition	n	M	SD	n	M	SD	n	M	SD	M	SD
TD-Interaction											
Legislative	16	3.93	.37	23	3.34	.58	26	3.69	.46	3.63	.53
Executive	21	3.88	.34	13	3.76	.42	3	3.67	.26	3.82	.39
Mixed	5	3.88	.52	9	3.32	.45	8	3.38	.42	3.47	.49
Total	42	3.90	.39	45	3.47	.54	37	3.62	.45	3.66	.50
TD-Conference structure											
Legislative	16	3.71	.62	23	3.11	.48	26	3.40	.51	3.37	.57
Executive	21	3.67	.43	13	3.29	.47	3	3.16	.06	3.50	.47
Mixed	5	3.78	.60	9	2.86	.76	8	3.21	.23	3.20	.66
Total	42	3.70	.52	45	3.11	.55	37	3.34	.45	3.38	.56
TD-Learner autonomy											
Legislative	16	3.77	.39	23	3.40	.43	26	3.64	.41	3.58	.43
Executive	21	3.75	.40	13	3.85	.43	3	3.72	.82	3.78	.44

Mixed	5	3.67	.46	9	3.30	.45	8	3.35	.39	3.40	.44
Total	42	3.75	.40	45	3.51	.48	39	3.58	.45	3.61	.45
TD-Interface											
Legislative	16	3.86	.42	23	3.34	.44	26	3.52	.46	3.54	.48
Executive	21	3.89	.54	13	3.57	.49	3	3.63	.66	3.76	.54
Mixed	5	3.73	.67	9	3.04	.34	8	3.31	.30	3.30	.49
Total	42	3.86	.51	45	3.35	.47	39	3.48	.45	3.56	.52

Note. M = mean. SD = standard deviation. TD = transactional distance.

Table 48: ANOVA results for the four transactional distance measures

Variable and source	df	MS	F	η^2	Power [a]
TD-Interaction					
Group composition	2	.30	1.45	.03	.30
Conference structure	2	1.47	6.99**	.11	.92
Group composition* Conference structure	4	.32	1.53	.05	.42
Error	115	.21			
TD-Conference structure					
Group composition	2	.11	.43	.01	.12
Conference structure	2	3.39	12.89***	.18	.99
Group composition* Conference structure	4	.21	.80	.03	.25
Error	115	.26			
TD-Learner autonomy					
Group composition	2	.57	3.11*	.05	.59
Conference structure	2	.40	2.20	.04	.44
Group composition* Conference structure	4	.29	1.62	.05	.49
Error	115	.18			
TD-Interface					
Group composition	2	.59	2.69	.05	.52
Conference structure	2	2.21	10.03***	.15	.98
Group composition* Conference structure	4	.09	.41	.01	.14
Error	115				

Note. TD=transactional distance.η^2 (eta squared) = effect size. *$p < .05$. **$p < .01$. ***$p < .001$.

a. Computed using alpha = .05

Since these two-way ANOVA tests yielded significant differences for the two main effects. which both involved three levels but failed to reject all the null interaction

hypotheses, a *post hoc* investigation using pairwise comparisons was conducted on each set of the main effect means to evaluate which levels were significantly different from one another. Many statisticians recommend the Tukey HSD test for *post hoc* comparisons if the variances can be assumed to be equal. The reason for this is that the LSD *post hoc* test is quite liberal and the Scheffé test is quite conservative (Morgan et al., 2007). Therefore, significant differences between group means were examined using the Tukey *post hoc* test to control for Type I errors across the pairwise comparisons in this study. The questionnaire items used a five-point Likert scale ranging from one (strongly disagree) to five (strongly agree). The higher the score, the less the individual perceptions of transactional distance. For the students surveyed in this work, the degree of transactional distance was low, as all the subscales' mean scores were above 3. The results of the Tukey *post hoc* tests are presented below:

(1). TD – learner autonomy: The results indicate that the executive thinking style groups (M = 3.78, SD = .44) perceived significantly less transactional distance than the mixed ones (M = 3.40, SD = .44, with a large effect size (d) = .86) in the dimension of learner autonomy (see Figure 40), but no significant differences were found between either the executive and the legislative thinking style groups (M = 3.58, SD = .43), or the legislative and mixed ones.

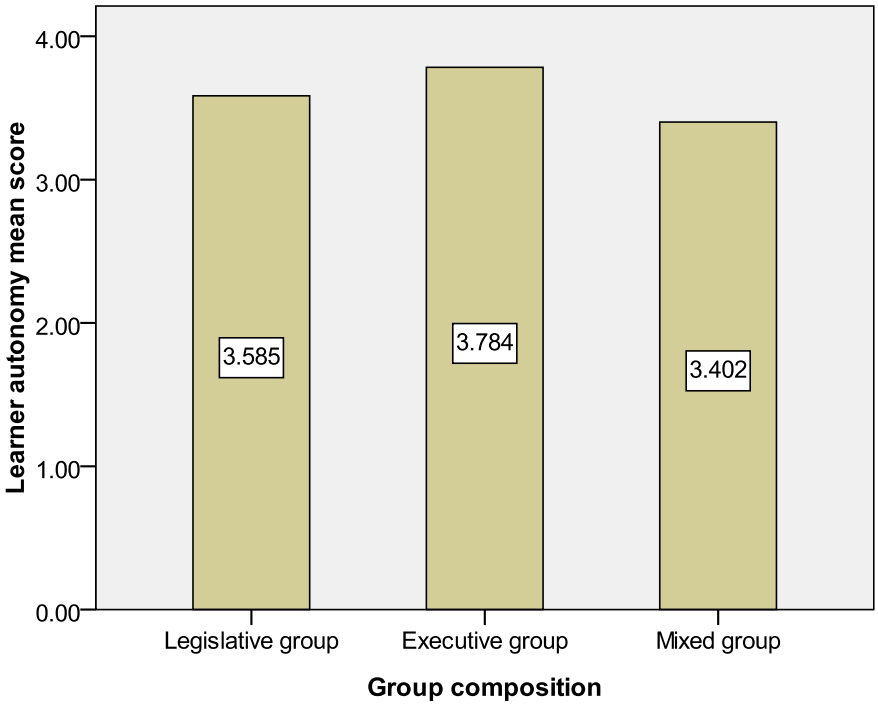

Figure 44: Comparison of group means for the group composition effect in TD – learner autonomy

(2). TD – interaction: For the dimension of interaction, the results indicate that group members in high-structured conferences (M = 3.90, SD = .39) perceived significantly less transactional distance than those in the low-structured (M = 3.47, SD = .54, with a large effect size (d) = .91) and the control ones (M = 3.62, SD = .45, with a large effect size (d) = .66) (see Figure 41). In addition, no significant differences were found between the low-structured and the control ones. The same trend was found among the groups for TD – conference structure and TD – interface.

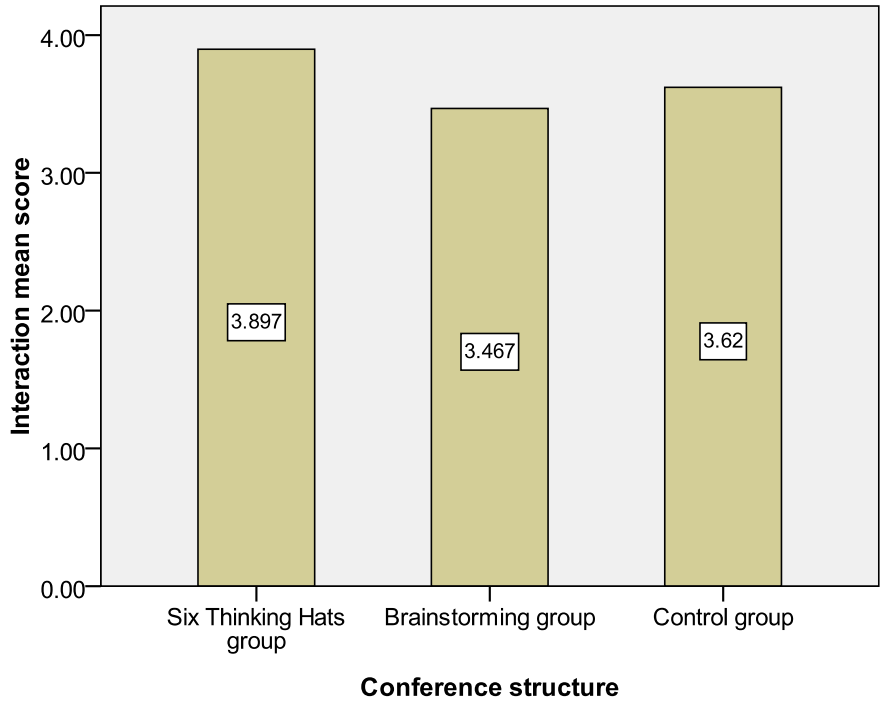

Figure 45: Comparison of group means for the conference structure effect in TD – interaction

Note. Six Thinking Hats = high-structured. Brainstorming = low-structured. Control = no-structured.

(3). TD – conference structure: The results indicate that the group members in high-structured conferences (*M* = 3.70, *SD* = .52) perceived significantly less transactional distance in the conference structure dimension than those in the low-structured (*M* = 3.11, *SD* = .55, with a large effect size (*d*) = 1.10) and the control groups (*M* = 3.34, *SD* = .45, with a large effect size (*d*) = .74) (see Figure 42), but no significant difference was found between the low-structured and the control ones.

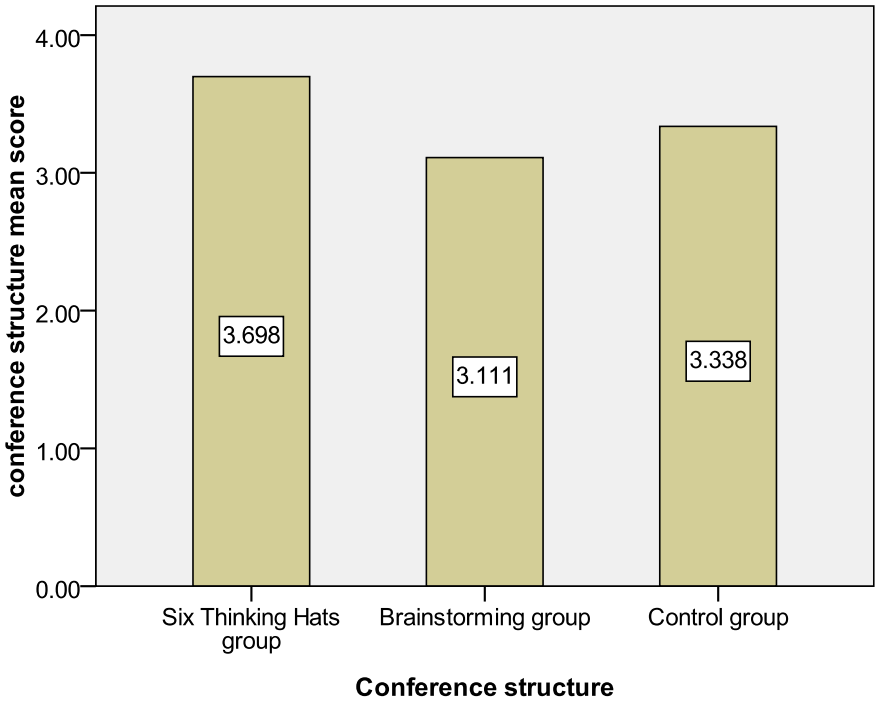

Figure 46: Comparison of group means for the conference structure effect in TD – conference structure

Note. Six Thinking Hats = high-structured. Brainstorming = low-structured. Control = no-structured.

(4). TD – interface: The results indicate that the group members in high-structured conferences (M = 3.86, SD = .51) perceived significantly less transactional distance in the dimension of interface than those in the low-structured (M = 3.35, SD = .47, with a large effect size (d) = 1.04) and the control groups (M = 3.48, SD = .45, with a large effect size (d) = .79) (see Figure 43), but no significant difference was found between the low-structured and the control ones.

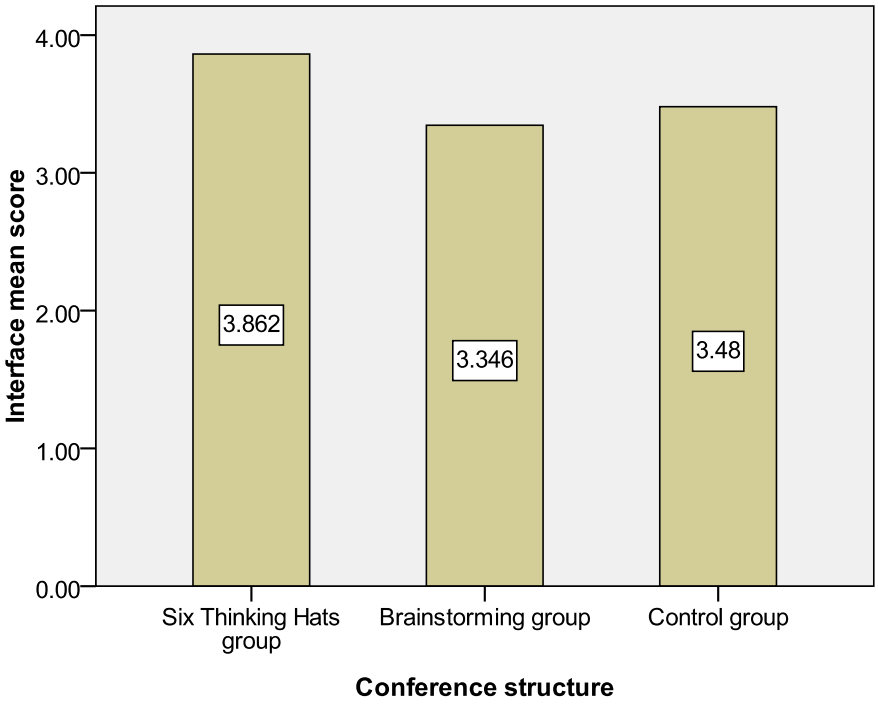

Figure 47: Comparison of group means for the conference structure effect in TD – interface

Note. Six Thinking Hats = high-structured. Brainstorming = low-structured. Control = no-structured.

The results of a two-way analysis of variance of individual perceptions of transactional distance with group composition and conference structure as between subjects variables do not support the researcher's original postulation that group composition and conference structure have an interaction effect, and thus students with the legislative thinking style under the high-structured condition and students with executive thinking style under the no-structured one will perceive more transactional distance, and thus have more negative online experiences. On the other hand, legislative style students under the no-structured condition and executive style ones under the high-structured condition perceived less transactional distance, and

thus had more positive online experiences. Nevertheless, based on the findings of this study, among the various dimensions of transactional distance including interaction, conference structure and interface, students in the high-structured conference group using Six Thinking Hats, no matter they were in homogeneous or heterogeneous groups, always felt less transactional distance than those in the low- and no-structured conference groups. In contrast, students in the low- (using brainstorming) or no-structured conference groups always felt more transactional distance. The strategies of course design used for an online group discussion have a significant impact on the quality of the discussion, performance and satisfaction of a group of participants. Collaboration can be promoted by grouping and structuring the collaborative process to promote the emergence of productive interactions (Hakkinen, 2004), and furthermore to prevent a feeling of social disconnection, a factor related to transactional distance. Specifically, in a context of a synchronous group online meeting, conference structure has a substantial impact on individual perceptions of transactional distance, as seen by the large effect sizes found in this study. Also, based on the findings in this study, it is necessary to provide students with clear guidelines for reading and posting discussion entries (Brannon & Essex, 2001). A low- or no-structured conference usually results in a trivial group conversation (Kanuka, 2005), as shown by the online conference text messages.

Group composition, the other between-groups factor, had a significant impact on only one dimension of transactional distance - learner autonomy. The essence of collaborative learning is quite different from independent learning, and the level of individual satisfaction with the former is greatly influenced by the relationships within a group, especially when the ultimate goal of the collaboration is to complete a group project. Executive thinkers, being implementers, prefer to give guidance and enforce their own or others' rules and laws. Compared to legislative thinkers, who like to do things their own way, executive ones are better collaborators.

Generally speaking, the majority of the participants enjoyed the experience with the online group activities designed by the researcher. People in the executive groups (75.7%) were satisfied with the online activities most, while those in the legislative ones (64.6%) were satisfied the least (see Figure 44). However, for each group nearly 20% of the students answered "not sure" with regard to their level of satisfaction. People in the high-structured groups (85.7%) were satisfied with the online activities most, whereas those in the low-structured ones were least satisfied, and had a much higher percentage (35.6%) of "not sure" compared to the high- (9.5%) and no-structured (18.9%) ones (see Figure 45).

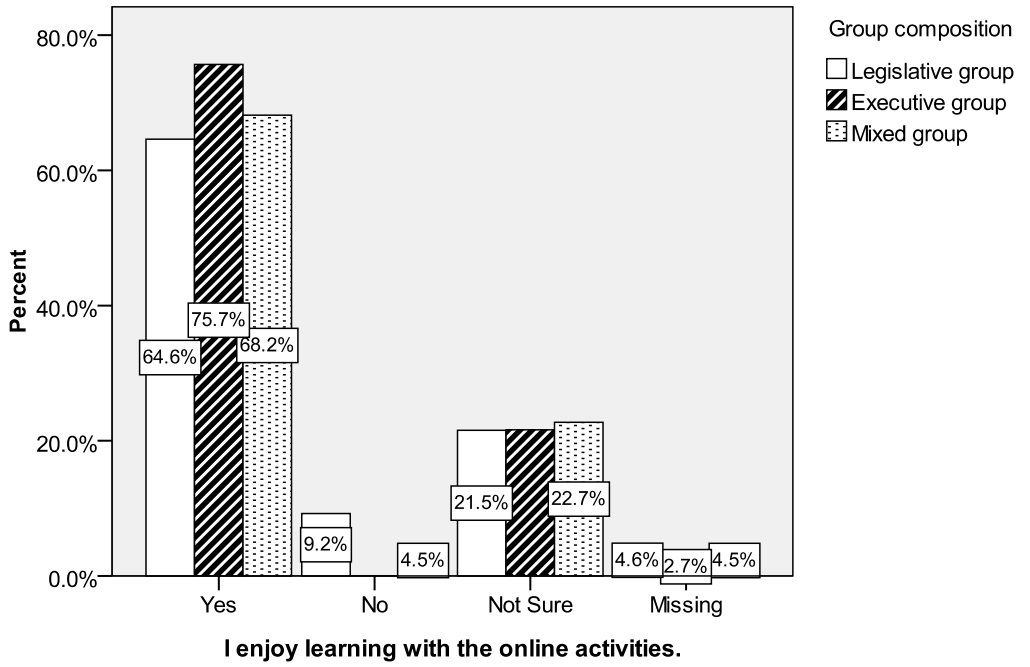

Figure 48: Summary of satisfaction with online activities by group composition

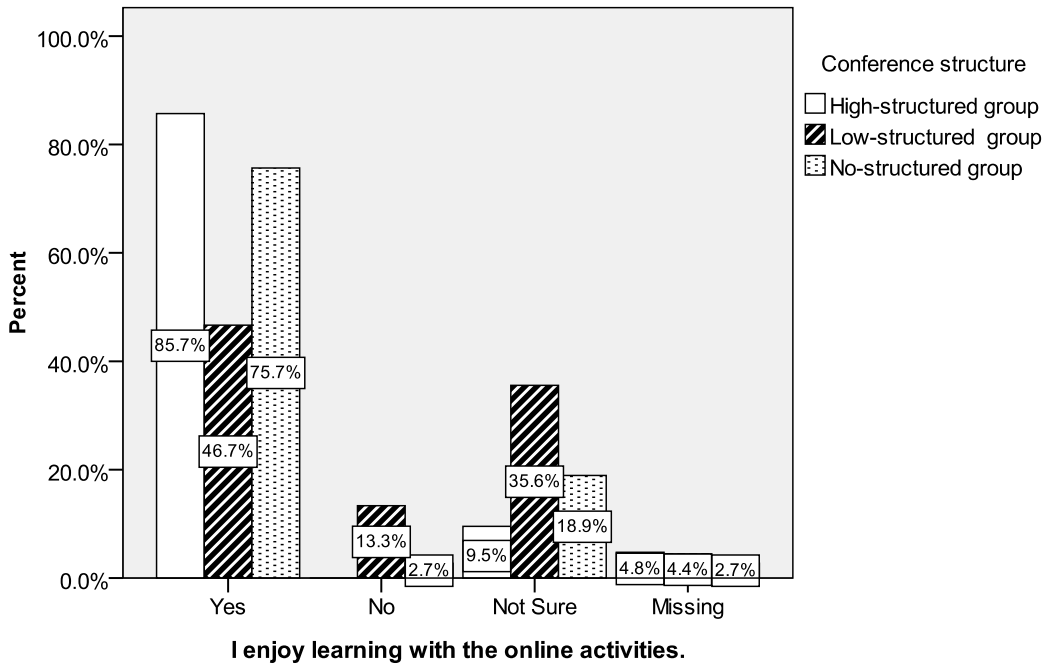

Figure 49: Summary of satisfaction with online activities by group composition

Question 5:

What are the relationships among the dimensions of interaction distance?

Hypothesis 53

Ho: The dimensions of interaction distance are not intercorrelated.

Ha: The dimensions of interaction distance are intercorrelated.

When the relationships of the dimensions of transactional distance were examined using Pearson's correlation coefficient, all the coefficients were found to be significant at the .01 level, with moderate to strong levels of positive relationships (see Table 49). These results suggest that high degrees of one dimension also implied high degrees of the other dimensions in transactional distance. In contrast to Moore's argument that the greater the structure the less the interaction, and thus the more autonomy a learner requires, in the context of the present study, using synchronous online conferencing, a high degree of interaction was associated with a high degree of conference structure, learner autonomy and interface.

Table 49: Intercorrelations among the dimensions of transactional distance (N=124)

Measure	**(2)**	**(3)**	**(4)**
(1) Interaction	.687**	.516**	.597**
(2) Conference structure	--	.463**	.713**
(3) Learner autonomy		--	.512**
(4) Interface			--

Note. **. Correlation is significant at the 0.01 level (two-tailed).

4.4. Summary of findings

The answers to the research questions are summarized below.

(1). What is the relationship among gender, thinking styles and creative ability?

- Male students preferred the legislative thinking style significantly more than their female counterparts.
- There was no significant difference in overall creative ability between male and female students. However, with regard to the subsets of creative ability, including fluency, originality, elaboration and flexibility, the male students had significantly higher scores for originality than the female ones.
- No significant relationships between thinking styles and creative abilities were found. Sternberg's argument that ability is different from style was thus supported in this study.
- When controlling for gender difference, no significant relationships between thinking styles and creative abilities were found for the male groups. However, for the female group, the executive thinking style was negatively correlated with originality. This means that female students who had relatively high executive thinking style scores were likely to have low originality scores.

(2). Is individual creative ability related to the overall group creative performance?

- There was no significant association between group member creative ability

and group creative performance. That is, group creativity was not determined by the group member's creative ability.

(3). Do group composition and conference structure have an effect on group creativity, and do group composition and conference structure interact?

- When controlling for the pre-existing group creativity, no significant effects were found for either the group composition or conference structure factor on group performance. Moreover, no significant interaction was found between these two factors.

(4). Do group composition and conference structure have an effect on individual perceptions of transactional distance, and do group composition and conference structure interact?

- No significant interaction was found between group composition and conference structure on any dimensions of transactional distance.
- Group composition had a significant effect on the learner autonomy dimension of transactional distance. The executive thinking style groups perceived significantly less transactional distance than the mixed ones in learner autonomy, but no significant differences were found between either the executive and the legislative thinking style groups, or the legislative and mixed ones.

- The level of conference structure had a significant effect on individual perceptions of interaction, structure and interface distance. Group members in high-structured conferences (M = 3.90, SD = .39) perceived significantly less transactional distance than those in the low-structured and the no-structured ones. In addition, no significant difference was found between the low-structured and the no-structured ones. The same trend was found for TD – conference structure and TD – interface among the groups.

(5). What are the relationships among the dimensions of interaction distance?

- Moderate to strong levels of positive relationships were found among the four dimensions of transactional distance. In the context of the present study, using synchronous online conferencing, a high degree of TD - interaction was associated with a high degree of TD - conference structure, TD - learner autonomy and TD - interface.

This chapter has presented the results of testing the reliability and validity of the research instruments used in the main study, the descriptive statistics of the collected data, and the findings of this study. The implications of these are discussed in more detail in the next chapter.

Chapter 5: DISCUSSIONS

The main purpose of this study was to investigate the effects of online collaborative activities based on the differences of individual students, in order to enhance the creativity expressed in small groups and reduce transactional distance in an online learning environment. Based on the thinking styles proposed in Sternberg's mental self-government theory and Moore's theory of transactional distance, different grouping and structuring strategies were developed and manipulated in this work. The 3 x 3 factorial quasi-experimental design employed a pre-test post-test comparison group, with two independent variables: thinking styles and conference structure. The dependent variables were group creativity and student perceptions of transactional distance.

The purpose of this chapter is to evaluate and interpret the research results and findings, and the related discussions are organized into five parts. The first part discusses various issues related to Sternberg's thinking styles. The second part discusses the issue of creativity at both the individual and group levels. The third part examines the related arguments, debates and revisions related to the theory of transactional distance. The fourth part presents the implications of this work with regard to online group conferencing. The fifth part discusses limitations of this work,

and suggestions for future research. Finally, a summary of this study is presented in the last part of the chapter.

5.1. Thinking styles

Some early theories presented style constructs which were not clearly distinguishable either from abilities (e.g., Kagan, 1966; Witkin, 1965; Witkin & Goodenough, 1977) or from personality traits (e.g., Myers, 1962). Over the past few decades, however, a diverse range of theories (e.g., field-dependent/independent, intuitive/thinking, reflection/impulsivity) and labels (e.g., cognitive style, learning style) related to styles were proposed, leading to some confusion with regard to how they these should be understood and measured.

In the 1970s, the decline of styles research was due to the fact that the literature failed to provide "any common conceptual framework and language for researchers to communicate either with one another or with psychologists in general" (Sternberg & Zhang, 2001, p. 250) However, in the mid-1980s there was renewed interest in this field in both academic and nonacademic settings, because that the approaches that focused on abilities and personality traits simply could not portray the full range of individual differences in human performance and behavior (Zhang, 2006). Sternberg (1988, 1997) conceptualized the variety of existing style theories into cognitive-,

personality- and activity-centered approaches, and proposed a notion of thinking styles in his theory of mental self-government. According to Sternberg, "Thinking styles might be used to characterize how one prefers to think about the information as one is learning it or after one already knows it…… Styles are not abilities; they are people's preferred ways of using the abilities that they have" (Zhang, 2006, p.7). In the original theory, no particular thinking style is better or worse than another. Later, Zhang and Sternberg (2005) proposed the threefold model of intellectual styles and, for the first time, used the term "intellectual styles" to encompass all existing style labels. This model provides a common conceptual framework for various styles, and enabled the use of a common language among scholars in the field (Zhang, 2011). Based on a series of systematic, empirical studies conducted by Sternberg, Zhang and their colleagues, there is now sufficient evidence to support the view that thinking styles make a unique contribution to individual differences in human performance, beyond what can be accounted for by abilities and personality traits.

Complex relationships have been shown to exist between abilities and styles. For example, Mehdi (1974) did not find a significant relationship between different thinking styles and intelligence, while Olive (1972) found a significant but modest one. In addition, Armstrong's (2000) findings indicated that cognitive styles and overall ability were not related among business and management students. In the

present study, the findings reveal that overall creative ability is not related to thinking styles, as those individuals preferring a legislative style of thinking, a style related to a propensity for creativity, did not in fact have any greater creative ability. The following subsections present a number of interesting ideas about thinking styles, based on the findings of this study.

5.1.1 Thinking styles and socialization

Whether thinking styles are traits or states remains a matter of debate with regard to malleability of styles. Zhang and Sternberg (2006, 2009b) argued that thinking styles that represent states are malleable and at least partially socialized, and thus they can be deliberately trained and modified. For example, social factors, such as culture and gender, are related to thinking styles.

In relation to culture, the results of the current study are accordance with those of previous studies (see Section 2.4.1.2) with regard to the factor of culture, since people in Taiwan, Hong Kong and mainland China share the same traditions and culture. For decades, formal education in Taiwan has been criticized for over-emphasizing preparation for standardized tests and other examinations, while largely neglecting other aspects of development, such as critical thinking and creative abilities (Chou et al., 2003). In Taiwan, a student's academic achievement is primarily

determined by their scores in standardized tests, and the most efficient strategy to achieve high academic performance is thus by adopting the transmission teaching approach, which is characterized by learning designed for the efficient transfer of information into the minds of supposedly receptive students (Garrison & Archer, 2000). For example, the most common teaching practice in higher education contexts in Taiwan is that a lecture given by a instructor to a large group of students is presented at a rapid pace, and the students have little need to utilize their critical thinking skills in this context, because they are expected to reproduce fragmented facts and information during an examination, and the most intelligent strategy is just to memorize such items. However, just like in Hong Kong, educational reforms have been carried out in Taiwan since the 1990s that have advocated the greater cultivation of student creativity and problem-solving abilities to face the challenges of globalization. It thus may be due to the influences of these educational reforms and the still prevalent authoritative teaching method, that, according to the average scores, the participants in the present study preferred the legislative thinking style the most, then the executive one, and the judicial one the least, and consequently no judicial groups were formed. In relation to gender, similar to the findings in Cheung (2002), the results of the present work showed that the male students preferred the legislative thinking style significantly more than the female ones. This study also found that the

executive thinking style was negatively correlated with originality for the female group.

5.1.2 Thinking styles and group composition

Sternberg and Zhang raised another controversial issue regarding thinking styles that of whether some styles are better or worse than are others. They argued that styles are value-laden and at times value-differentiated, and thus not value-free, with some more adaptive than others. Zhang and Sternberg (2005, 2006) classified all thinking styles into three types, and established the threefold model of intellectual styles. Individuals with a preference for Type I styles, including the legislative, judicial, hierarchical, global, and liberal thinking styles, prefer tasks with a low degree of structure and a high degree of complexity, and tasks that allow originality and a high level of freedom to do things in one's own way. Type II styles, including the executive, local, monarchic and conservative thinking styles, by contrast, suggest a norm-favoring tendency and relatively shallow processing of information and ideas, and indicate preferences for tasks that are high-structured. The remaining thinking styles (i.e., anarchic, oligarchic, internal, and external) belong to neither Types I nor II. These four thinking styles, known as Type III ones, may manifest the characteristics of the styles in both other groups, depending on the task demands and the level of engagement on the part of an individual. For instance, "one could use the anarchic

style in a sophisticated way – such as dealing with different tasks as they arise, but without losing sight of the central issue. Under this circumstance, the anarchic style manifests the characteristics of Type I thinking styles. On the contrary, one also could use the anarchic style in a simple-minded way – such as dealing with tasks as they come along without knowing how a task contributes to his or her ultimate goal. Under this circumstance, the anarchic style manifests the characteristics of Type II thinking styles" (Zhang & Sternberg, 2012, p.115). Type I styles suggest more creativity, denote higher levels of cognitive complexity, and thus are seen as more adaptive and related to desirable human characteristics. Type II styles tend to be norm-favoring, denote lower levels of cognitive complexity, and thus are considered as having less adaptive value and being related to less desirable characteristics. In contrast, Type III styles may be more or less adaptive, depending on the specific nature of the tasks being undertaken. Essentially, Sternberg and Zhang stated that Type I intellectual styles are the ones that should be nurtured, promoted and rewarded.

Do individual preferences with regard to thinking styles affect the overall group performance? According to Zhang and Sternberg (2006), the best way of grouping individuals is that each group contains people with different thinking styles, such as the so-called legislative, executive and judicial approaches, as this can lead to better cooperative results. Cooperative learning provides students with opportunities

"whereby they demonstrate their strengths and at the time learn from others about more effective ways of dealing with problems" (2006, p.178), and this interaction can help develop both cognitive and social skills. The ideal is when a team that is composed of members with different thinking styles, legislative individuals will generate creative and constructive ideas, which are then passed to judicial ones who evaluate them and organize the related procedures. Finally, executive members implement the structured task. Unfortunately, this rarely occurs in real life. In a collaborative team, tasks do not occur as on a factory production line. Besides, styles are not abilities: a legislative thinker does not necessarily have great creative abilities, a judicial thinker is not always a good evaluator or organizer, and an executive thinker may not be a good implementer.

There are also other problems related to thinking styles and group composition. First, thinking styles are not mutually exclusive, and one individual may exhibit the characteristics of more than one style. In different situations, a person may exhibit each thinking style to different degrees, or the styles they use may change from situation to situation, as well as over their lifetime. The results of the present study showed that some students got high scores in both legislative and executive thinking styles. It may be that what was originally supposed to be a homogeneous group became a heterogeneous one, and this might be the reason why no significant

differences were found between the homogeneous and heterogeneous groups with regard to group creativity in this work. Second, when working in groups, while a combination of thinkers with different styles can be a powerful tool to enhance collaboration, mismatched combinations of styles may produce undesirable results. As noted above, in the threefold model of thinking styles, Type I styles (e.g. legislative and judicial) are considered more adaptive and desirable, while Type II ones (e.g. executive) are considered less so. However, the present study found that executive thinkers in executive groups felt more emotionally satisfied with the online group activities in the learner autonomy dimension. This suggests that the executive thinkers were more adaptive to the online group conferencing used in this study. In contrast to the harmonious executive groups, it is possible that for a legislative group all the members would try and do things in their own way, while for a judicial group, the members would all criticize each other.

Since thinking styles are modifiable, no matter what values Types I, II and III have, it may be vital for a teacher to encourage the students to develop all the styles, so that they can respond effectively to a changing environment, and thus have a high level of flexibility to face a variety of challenges (Zhang & Sternberg, 2009b), especially in group collaboration. Collaborative learning focuses on the process of working together, and requires that group members take more active roles in their

own learning (Myers, 1991). Therefore, teachers should encourage students to develop different thinking styles, and provide them with opportunities to demonstrate their varied strengths by diversifying their teaching and assessment strategies, and designing a variety of group activities. Students' awareness of their own styles, as well as those of their partners, could be instrumental to the effectiveness of conflict resolution and group cohesiveness (Zhang & Sternberg, 2009b).

5.2. Creativity and performance

Creativity is influenced by the interactions that occur between an individual and the situation they are in. Moreover, the relationship between individual and group performance is determined not only by group members themselves, but also by the type of task they are attempting, and the way it is structured and divided among individuals (Pirola-Merlo & Mann, 2004). Therefore, putting a group of learners together and simply providing them with a platform for interaction will not automatically lead to productive collaboration, and environmental factors may increase or reduce the group's creative performance. The following subsections discuss the findings of this study with regard to creativity at both the individual and group levels.

5.2.1 Individual creative ability

Seitz (2003) asserted that social, cultural and political factors affect the development of individual creativity, by stating "Creative activity is the consequence of the confluence of cultural domains and political and social institutions that directly and indirectly influence the development of individual creative expression and not merely the result of intra individual factors" (2003, p.246). Similarly, Runco (2007) contended that creativity is related to various extra-personal influences, such as family, school and culture. The following paragraphs focus on cross-cultural differences in creative ability.

(1). Individual creative ability and extra-personal influences

Most cross cultural studies (e.g., Jellen & Urban, 1989; Jaquish & Ripple, 1984; Niu & Sternberg, 2003) that examine creativity test scores find that, as a whole, Western people tend to perform better than Asians with regard to divergent thinking. However, with regard to the traits associated with creative ability, studies show inconsistent results. For example, the results in Torrance and Sato (1979) indicated that American students scored higher in the TTCT on fluency, whereas their Japanese counterparts scored higher on originality, flexibility, and elaboration. Pornrungroj (1992), using the Torrance Figural tests, found that children born and raised in Thailand had higher divergent thinking scores than those born and raised in the United States on all traits on the ATTA (fluency, originality, flexibility, and elaboration). In addition, Rudowicz

et al., (1995) found that secondary school students in Hong Kong scored higher on all scales of the TTCT figural form than those in Germany, Singapore, Taiwan and America, but lower than American and German ones with regard to fluency, flexibility, and elaboration on the TTCT verbal form. The results of these earlier studies suggest that no one ethnic group performs better than the others all the time. Hofstede's (1980) theory, individualism (IDV) and uncertainty avoidance, may explain the mixed results in the literature (see Section 2.4.1.3).

Using the ATTA, individual creative ability was measured in this study on four dimensions: fluency, originality, flexibility, and elaboration. The sum of the four scaled scores and the criterion-referenced creativity indicators represent an individual's overall creative ability. According to Goff and Torrance (2002b), fluency assesses the ability to produce quantities of responses relevant to the task instruction. They argued that a creative person shows the ability to produce multiple alternative ideas and solutions to a problem, not a single one. Originality assesses the ability to generate responses that are novel and different from those offered by most others in the same situation. Elaboration assesses the ability to embellish ideas or products by adding details. Flexibility assesses the ability to process information or objects in non-traditional ways given the same stimulus, and involves switching from one conceptual field to another. A comparison of the ATTA test results from Taiwanese

and American samples within the last five years is presented in Table 50.

Table 50: A comparison on the ATTA test results using Taiwanese and the American samples

Trait / Sample	Fluency	Originality	Elaboration	Flexibility	C Level
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
Wang (2012)[a] / Major					
English (N=55)	15.41 (1.42)	16.33 (1.89)	17.24 (1.30)	15.13 (1.80)	5.63 (1.25)
Chinese (N=56)	14.63 (1.64)	16.30 (1.99)	16.64 (1.53)	15.00 (2.03)	5.05 (1.29)
Science (N=38)	14.24 (1.32)	16.37 (2.16)	16.00 (1.38)	15.08 (1.75)	4.50 (1.09)
Math (N=47)	14.23 (1.83)	15.32 (2.49)	15.32 (1.92)	14.17 (2.07)	4.09 (1.65)
Lin et al. (2011) [b,f]					
Taiwan (N=181)	12.11 (4.01)	3.22 (2.42)	5.36 (4.31)	7.78 (2.69)	
The main study (2008)/ Major					
Social science (N=127)	14.12 (1.51)	13.35 (2.17)	16.68 (1.98)	13.33 (1.39)	3.43(1.33)
Wang (2007)[c]					
Taiwan (N=125)	14.78 (2.08)	16.67 (1.85)	14.16 (1.72)	15.59 (2.24)	4.29 (1.35)
The US (N=133)	15.01 (2.07)	16.78 (1.94)	14.77 (1.93)	16.05 (2.44)	4.68 (1.51)
Aschenbrener et al. **(2007)**[d]					
The US (N=25)	14.80 (2.35)	14.60 (5.54)	15.64 (4.21)	14.04 (5.61)	
Su (2007)[e]					
Taiwan (N=246)	15.26 (1.65)	15.19 (1.86)	16.49 (1.81)	14.95 (1.82)	

Note: Scaled score for fluency, originality, elaboration and flexibility = 11-19. C Level = 1-7

[a] Creative performance of student teachers in Taiwan and the United States were compared.

[b] A total of 320 participants came from five universities in Taiwan.

[c] The participants were from 18 to 21 years old students in a university in Taiwan.

[d] Twenty-five second year agricultural education teachers in Missouri participated in the study.

[e] Data was collected from 313 university students in Taipei, including 118 boys and 195 girls. It included seven colleges.

[f] The results are presented as raw scores.

Table 50 shows mixed results among the various studies. Creative ability is affected by both individual differences and situational factors, such as family, school, culture, politics and society, as noted in the previous paragraphs. In this study, the average scores of the four traits of creative ability, from the highest to the lowest, are

elaboration (16.68), fluency (14.12), originality (13.35) and flexibility (13.33). As a whole, the participants in this study were found to have less creative ability compared to the norm referenced group established in 2005 provided by the Chinese version of the ATTA test (see Table 30). In addition, the main study sample only scored higher than those in other studies with regard to elaboration. Upon completion of their compulsory education, students in Taiwan may choose to continue studying along an academic track (i.e. general senior high and general university) or a vocational one, and high-achieving students prefer the former. Compared to general university students, the academic achievements of students taking vocational education courses are lower, and their awareness and cultivation of general education is rather inadequate. A creative personality has characteristics such as flexibility, a preference for complexity, openness to experience, tolerance of ambiguity, wide interests and greater curiosity (Runco, 2007). Creative students tend to be open-minded, not only with regard to efforts focused on their future careers, but also with a more holistic vision. Although educational reforms in Taiwan state that students in vocational education should be encouraged to pursue excellence in both technical fields and the humanities, and be more open-minded, such students usually do not pay much attention to subjects beyond their focal academic skills. The participants in this study were from a university offering vocational education, and this might explain why their

creative thinking abilities were lower than those in other studies. However, this conclusion is rather speculative, and requires more detailed investigation in future studies.

(2). Individual creative ability and gender

Like thinking styles, many previous studies obtained inconsistent results with regard to gender differences in creativity (Kaufman, 2006). In the present work, regarding the results of the ATTA from the male and female students, there was no significant difference in the overall creative ability between the two groups, and no differences were found between them in their abilities of fluency, flexibility, and elaboration. The only difference was with regard to originality, with the males scoring better than the females, and possible explanations for this may be found in Section 2.4.1.3.

5.2.2 Group creativity

Creativity is often defined as the development of original ideas that are useful or influential. Before the 1960's, most research and writing on creativity focused on individual cognitive and personal traits, with less attention being paid to group factors that influence the creative process (Paulus & Nijstad, 2003). In recent years, there has been increasing acknowledgment of a more complex view of creativity, highlighting the role of dynamic and interconnected social systems, such as mentoring and

collaboration, in creative work. Some group researchers claim that by providing many different perspectives for consideration, diversity within a group can help the creative process and promote more innovative outcomes (Austin, 1997; Bantel & Jackson, 1989; Kurtzberg & Amabile, 2001; Kurtzberg, 2005; Mamykina et al., 2002). A diverse group consists of members who are different from each other with regard to one or more characteristics (Milliken et al., 2003). However, in this study, there was no significant association between the average group member creative ability and the overall group creative performance. Furthermore, using an experimental method, no significant main effects were found for the group composition and conference structure factors on group creative performance, and no significant interaction was found between these two factors, either. That is, heterogeneous groups (mixed groups) did not demonstrate better creative performance than the homogeneous ones (legislative and executive groups). These findings reveal the complexity of group creative performance. Creativity is both a process and an outcome - if one can not understand the process that created it, and then the outcome is also not well understood (Milliken et al., 2003). What follows is a brief review of the literature on diversity and how it affects group processes and creative performance, as well as a discussion of some factors that could affect these processes and the related outcomes.

Torrance (1972) highlighted the importance of group composition in educational

settings. O'Reilly et al. (1997) noted that diversity can have positive or negative effects on group processes and performance, and stated that there are two ideas underlying the positive links between diversity and group performance. One is that a higher level of cognitive diversity within heterogeneous groups tends to produce more useful ideas for problems-solving than arise in more homogeneous ones. The other is that task-related tensions and conflict will contribute to a more careful review of various different viewpoints, leading to a more complete discussion of issues related to the task, and consequently better decisions and outcomes.

Nonetheless, empirical studies show that the impact of diversity on group performance may not be as positive as many would like to believe (Williams & O'Reilly, 1998). Sometimes, heterogeneity in group composition even decreases the initial degree of satisfaction of group members (Milliken & Martins, 1996), and some researchers (e.g. Jackson et al., 1991; Milliken et al., 2003; Milliken & Martins, 1996; Nemeth & Nemeth-Brown, 2003) indicate that perceived individual differences among group members may have negative effects on both emotional reactions (e.g. group identification, emotional conflict, psychological safety, and group satisfaction) and cognitive processes (e.g. thinking differently about an issue), and may make it difficult for individuals to identify themselves as belonging to the group. Therefore, in the early formative phases of group interaction, differences can induce conflict and

frustration among members, and this can carry over subsequent operational and performance phases (Paulus & Nijstad, 2003). "Diversity, thus, appears to be a double-edged sword that increases the opportunity for creativity as well as the likelihood that group members will be dissatisfied and fail to identify with the group" (Milliken & Martins, 1996, p.403). Milliken et al. (2003) believed that an important moderator of the relationship between diversity and a work group's affective reactions is the perception of a superordinate goal. When members perceive they are working toward a common goal, the negative effects of diversity on a group's initial affective reactions may be attenuated. A critical factor promoting the perceptions of a superordinate goal is the structure of a work group's task and reward system (Tjosvold, 1986). Tjosvold (1988) noted that a cooperative orientation, with the exchange of resources and information, and openness to each other's ideas, can be induced by creating a common task requiring group collaboration. Wageman (1995) also found that a group task that has a high level task interdependence leads to a greater sense of collective responsibility.

No significant correlation between average group member creative ability and the differences in overall group creative performance was found in this study, suggesting that variance in group performance can not be explained by that of its group members. Additionally, neither of the heterogeneous groups demonstrated

better creative performance than the homogeneous ones, and conference structure also had no significant influence on group performance. In spite of these results, there remain many accounts of successful collaborations by heterogeneous groups (Bennis & Beiderman, 1997). In considering possible explanations for the statistically insignificant findings of the current study, one possible reason might be attributed to the statistical and methodological approaches applied in this work, and specifically to the small sample size. The small sample size at the group level resulted in analyses that were less powerful than desirable. Another possible explanation might be related to affective reactions, such as group identification, emotional conflict, psychological safety, and group satisfaction, as noted earlier in this section, which Milliken et al. (2003) stated seem to play a critical role in a group's activities. Hinsz et al., (1997) also noted that group members' affective reactions affect how groups approach their tasks. Milliken et al. (2003) indicated that members who identify more strongly with the group will tend to be more willing to contribute to the collaborative product. In addition, group members with substantial psychological safety are more likely to feel positive about the group and its task. In contrast, group members with low psychological safety generally feel disinterested in the group and are less like to engage with it. Moreover, negative moods are associated with a high level of emotional conflict and low levels of group satisfaction, and such conflict may lead to

narrow and rigid thinking, thus reducing creativity. In contrast, a positive mood may enhance participation and increase members' capacity to generate unusual and creative ideas. An additional factor that may reduce group performance is conformity, the desire for social consensus, which induces agreement without reflection and limits the ability of individuals' to think in alternative ways (Nemeth & Nemeth-Brown, 2003). Due to fear of social sanctions or the assumption that the majority is probably correct, people in groups often agree, and this conformity harms creativity. All of these factors may affect creative processes and outcomes, and are worthy of further exploration in future research.

5.3. Transactional distance

Although Moore's concept of transactional distance is a powerful theoretical approach, its formulation is problematic, and may not apply to every situation (Dron, 2005). In addition, Moore's arguments have been challenged by some researchers, such as Stover (2002) and Gorsky and Caspi (2005), who have undertaken critical analyses of the theory to identify and clarify its gaps and inconsistencies. In the next subsection, based on the debates over Moore's transactional distance theory, the related arguments are examined and compared with the findings obtained in the present study.

5.3.1 Moore's arguments and related debates

Transactional distance refers to the communication and psychological gap between the learner and the teacher (Moore, 1993). The extent of transactional distance is not determined by geography, but by the function of two variables, dialogue and structure. According to Moore, transactional distance exists in all teaching and learning relationships, based on the amount of dialogue between the learner and teacher, and the amount of structure in the design of the instruction. Here, dialogue is defined as two-way communication towards improved understanding, and structure is defined as the level of responsiveness to the needs of the individual learner in terms of the rigidity or flexibility of course objectives, strategies and forms of evaluation or assessment (Hanson et al, 1997; White, 2009). The main relationships that have been proposed among these variables can be summarized as follows (Gorsky & Caspi, 2005; Moore, 2006):

(1). Dialogue and transactional distance are inversely related; as one increases, the other decreases.

(2). Increased program structure decreases the extent of dialogue, which in turn increases the extent of transactional distance.

(3). The greater the structure and the lower the dialogue in a program, the more autonomy the learner has to exercise.

(4). Learners with high autonomy imposing their own structure on their learning

program require less dialogue and less structure.

The weaknesses of Moore's arguments can be discussed from three aspects. Firstly, Moore does not provide clear operational definitions of dialogue, structure and autonomy, and whether or not they should be considered as independent or dependent variables. Stover (2002) highlighted some of the difficulties with this terminology. For example, when Moore states that in programs where there is a high degree of dialogue, the transactional distance is less he does not make it clear whether "dialogue" refers to the nature or amount of teacher-student communication, to the dialogue-monologue balance, or to a program's capabilities. When a highly-organized program is considered to be highly "structured", is this because it meticulously and formally planned or non-individualized? Is it possible that a program is both highly-organized and individualized, and thus permits autonomy? In addition, Gorsky and Caspi (2005) investigated various empirical studies that attempt to validate transactional distance theory, and found that the data only partially supported the theory (e.g., Chen & Willits, 1998; Chen, Y. -J., 2001a, 2001b). The reasons for the mixed results may be summarized as follows. Gorsky and Caspi (2005) contended that the relations among the variables in the theory are ambiguous, and that Moore (1993) did not define any of the theory's constructions operationally. Another reason for the inconsistent results is that different types of dialogue (i.e., in-class discussion, out-of-class face-to-face

interaction, and out-of-class electronic communication) lead to different indicators of transactional distance (i.e., learner-instructor, learner-learner, learner-content, and learner-interface). Furthermore, Gorsky and Caspi (2005) found that when operationalized, the theory is transformed into a tautology, wherein the dependent variable, namely transactional distance, becomes the inverse of the key independent variable, namely dialogue. The theory may thus be reduced to a single proposition, such as "as the amount of dialogue increases, the transactional distance decreases".

Secondly, some of the weaknesses of Moore's theory lie in several of its problematic propositions. According to Leslie (1987), Moore was entirely wrong in thinking of adult learners as "independent". Instead, Leslie claimed that students enrolling in formal distance education programs do not want "flexibility" or "learner choice" in their learning materials, but want clear objectives, unambiguous instructions and step-by-step directions. Stover (2002) also pointed out the bias in Moore's postulation that "the more distant a program, the greater the learner autonomy," since "independent study on campus" is an opportunity that is only extended to a small number of students capable of engaging in largely self-directed study. In contrast, the youngest children at primary school or illiterate adults trying to learn reading are totally dependent on the teacher for educational transactions, and although their study may be highly individualized and contain a lot of dialogue, they

are by no means autonomous learners. Stover (2002) also described another anomaly in Moore's theory, as follows. According to Moore, having no dialogue and being highly structured are associated with high transactional distance, and therefore the need for a high degree of learner autonomy, while a low level of autonomy is required where the structure is flexible enough to respond to individual needs. Nevertheless, Stover noted that experience reveals that it is the dependent learners who need a highly structured program, and it requires a learner with high level of autonomy to create their own understanding of an unstructured one. Therefore, a low transactional distance program may in fact need to be highly organized to provide all of the help and guidance needed by a less autonomous learner. Moreover, Stover questioned the linear relationship between transactional distance and learner autonomy in Moore's theory, arguing that in classifying teaching methods, we can only measure their capacity for individualization and dialogue, and that only when examining a specific program in progress with an actual teacher and students can we assess what the actual level of individualization and dialogue might be. In addition, different teaching methods can accommodate a range of learner autonomy. A lower level of transactional distance, requiring students to give up some autonomy to engage in a dialogue with the teacher, can accommodate the most and least dependent learners. On the other hand, a higher level of transactional distance requires high learner autonomy to cope

with minimal dialogue and individualization.

Third, there are a number of logical inconsistencies in Moore's statements. For example, when he states that a highly structured program is linear, nonbranching programmed texts that allow no variation in the program, Stover (2002) noted that this phrasing creates a logical inconsistency: a highly-structured course allows for little autonomy, and represents a high level of transactional distance. However, if Moore's other argument "the more transactional distance, the more learner autonomy" is true, and then a more transactionally distant course should require or permit a higher degree of autonomy, not a lower one.

5.3.2 Transactional distance and online collaboration

The theory of transactional distance was developed in the age of correspondence study, and thus it needs to be revised suit the needs of online learning environments. In this study, the results suggest that high degrees of one dimension of transactional distance also imply high degrees of the others. In contrast to Moore's argument that the greater the structure the less the interaction, and thus the more autonomy a learner requires, in the context of the present study, using synchronous online conferencing, a high degree of interaction was associated with a high degree of conference structure, learner autonomy and interface. So for small group collaborations using synchronous

computer conferencing to complete group tasks, it is evident that an online activity can be both highly-organized and autonomous, and at the same time permit a high degree of interaction among learners and between the learner and interface. Moreover, the executive thinking style groups perceived significantly less transactional distance than the mixed ones in learner autonomy. Group members in high-structured conferences perceived significantly less TD – interaction than those in the low-structured and no-structured ones. The same trend was found for TD – conference structure and TD – interface among the groups. No matter how the group performance in the creative tasks was, the overall results of this study revealed that online group discussions that are more pre-structured and directed are more attractive, and can thus increase learner interest and satisfaction.

Online interactions among group members must thus be structured and cohesive. It is necessary for teachers to provide online students with clear communication protocols and requirements for posting and reading discussion entries to prevent the potential pitfalls of such communication. The findings of this study support the previous studies' argument (e.g. Brannon & Essex, 2001; Garrison & Cleveland-Innes, 2005; Wu & Hiltz, 2004) that structured activities and guidance are especially important in the collaborative e-learning context, due to difficulties in organizing large amounts of information, in structuring the discussion, and in developing a group

identity in a diverse group. Teleconferencing allows inter-learner dialogues to occur, which arise between learners and other learners, alone or in groups, with or without the real-time presence of an instructor (Gorsky & Caspi, 2005). With advances in delivery technologies, it is possible to achieve high levels of structure and dialogue simultaneously (Dron, 2005). This means that a program can be both highly structured and interactive, and thus reducing transactional distance. In the results of this study using synchronous conferencing for group discussions, as discussed above, has demonstrated that more online guidance and more structured discussion topics will lead to less transactional distance and more satisfaction with online activities.

5.3.3 Open-ended comments from the questionnaire survey

Qualitative data obtained from the open questions in the transactional distance questionnaire are summarized below:

(1). A number of participants in this study stated that the exchange of ideas and experiences was more comfortable when they felt more socially connected to the group, and that this lead to the creation of new knowledge.

(2). Student opinions related to interaction via computer conferencing included the following: (a) Interaction with group members helped clarify certain issues and find support when needed. (b) Interaction with group members decreased the

feeling of isolation. (c) MSN group meetings encouraged group members to share ideas and search for online information immediately from various locations.

(3). Based on the student responses, the elements needed to improve learning autonomy include responsibility, hard work, perseverance, pre-planning, independent thinking, personality adjustment and self control.

(4). Most students in the Six Thinking Hats groups (highly structured) felt satisfied with the structure of their discussions and the questions they were given. They described their discussions as being well-organized, efficient, effective and constructive. Most of the negative feedback about conference structure came from groups with no structure, such as the complaint that text and instant messages produced confusion and misunderstandings.

5.4. Implications for practice

The greatest strengths of online collaborative learning are its flexibility, independence, cost efficiency, as well as its powerful capability to enable direct interaction and communication. It is a challenge for the teacher to create an online environment that not only emphasizes the importance of learner autonomy, but also encourages distance students to participate in non-contiguous discussions. Advances in computer

conferencing systems are facilitating new opportunities for two-way communication by which groups of students can practice reflection, critical thinking and problem solving (Sumner, 2000). In addition, the potential for greater enjoyment and relaxation when taking part in computer conferencing might help learners who had previously felt frustrated to overcome their fears, and thus build a more productive and structured learning environment with a social and subject-related consensus (Nipper, 1989). Besides, the implementation of computer conferencing, an open and democratic medium, will move the locus of control from the teacher to the group and the processes generated by it, and consequently contribute to less authoritarian concepts of learning and teaching.

This research aims to uncover whether grouping and structuring are related to group creativity, and individual perceptions of transactional distance. Specifically, it examines the effects of group composition based on thinking styles and conference structure based on transactional distance theory through innovative uses of Internet technology, specifically synchronous computer conferencing. The descriptive results show that most of the respondents had positive perceptions and attitudes toward their online learning experience. In light of the findings discussed in this chapter, as well as the open-ended comments pulled from the transactional distance questionnaire, the findings of this work can assist practitioners in guiding their efforts to develop more

effective collaborative activities connecting distance learners, thus reducing transactional distance in an online learning environment. They can also inspire practitioners to consider how to use synchronous computer conferencing to encourage and promote student creativity.

5.5. Limitations and suggestions for future research

This study has a number of limitations, as follows.

First, for the present study, it was impossible to sample students randomly, and thus a convenience sample was employed. This study was also based on a fairly small sample of students from a single university, and such a homogeneous sample of participants may not represent the population at large. Moreover, the sample size at the group level may not have been large enough to have sufficient power to detect group differences. Therefore, the data collected in this study may not be generalizable across majors, universities and countries, and the results should be treated cautiously when deriving conclusion about university students in other contexts and with different backgrounds.

Second, not all 13 subscales of thinking styles were used, but only the legislative, executive and judicial ones. In addition, in the experimental treatment, only two

strategies were used (Brainstorming and Six Thinking Hats). Further weaknesses of the experiment included the limited time available for the intervention, and inability to control for emotional variables, such as group identification, group conflict, psychological safety, and group satisfaction. It should thus be remembered that group creativity and perceptions of transactional distance may be the result of interactions with other factors that were not studied in this work.

Third, this study used self-reporting questionnaires, which can be subject to contamination. This is because people may be not honest and instead give what they feel are socially desirable responses, answering in a manner that is consistent with cultural expectations and values.

Fourth, by adopting a mixed research method, in addition to quantitative data, the researcher also collected large qualitative data sets including open ended comments from the questionnaire survey and the complete transcripts of all messages exchanged in every group online meeting. To avoid possible threats of contamination, such as the Hawthrone effect, which may influence participants behavior to the extent that they perceive special treatment, or the John Henry effect, in which control group participants may feel they have been left out and try to outperform themselves, students were not informed that they were participating in an experiment and the

students from the same class were assigned to the same or no treatment in order to minimize unwanted interaction and communication among individuals from different treatment groups. When the contents of all online meeting were examined, no treatment contamination was found among the experimental and comparison groups. However, even though treatment contamination was well controlled, extraneous variables might have remained a threat to internal validity. For example, group members might have engaged in off-line, face-to-face discussions.

Finally, this study used MSN Messenger as the research interface, and thus the results may not apply to other kinds of online group conferencing, such as via Skype or Facebook. Communication patterns among instructors and learners may have radically changed with the adoption of new technologies, and it should be noticed that the use of social networking services, such as Facebook, has expanded dramatically since the researcher began her work. The most important development has been the development of online discussion tools. Microsoft has recently announced that it will be migrating all users of its MSN service, the one used in this work, to Skype, and shutting down MSN on 15th March 2013. In addition, mobile internet use, via smart phones and tablets, is becoming more popular than desktop computer use among many teens and young adults. It is thus very likely that mobile learning will only become more important in the future.

Some recommendations for future research are as follows:

(1). Replication of the research design in other contexts, with other populations, and using larger samples, is needed.

(2). To extend the current analysis, additional research using other grouping methods or other types of online group conferencing as independent variables is needed to examine the effects of these with regard to promoting group creativity, as well as the efficacy of Moore's transactional distance theory in these other contexts.

(3). Instead of blogs, it is suggested that researchers choose other ways of performance to assess creativity. One reason for this is that there is no direct creativity measure for blogger-based comparisons at the moment. The other reason is that although it is easy to set up a free blog, the blogging provider has the power to delete any and all material that is posted. For example, if the provider goes out of business then the blog will be lost, and the process will need to start again.

(4). For the research instruments, instead of CPSS, other existing standardized instruments could be used to assess the creative outcomes. It is also suggested that more items be added or the dimensions used in the questionnaire be modified in

order to measure transactional distance in another way.

(5). For the research interface, instead of a desktop computer, it is recommended that future researchers use a mobile device, such as a smartphone. Based on the findings of the present study, a researcher could compare the similarities and differences between mobile-mediated and computer-mediated communications, and make hypotheses or predictions based on these that can be tested in future work.

(6). Future research should seek to investigate if differences in thinking styles, individual creative abilities, group creative performance and perceptions of transactional distance are based upon emotional variables such as group identification, group conflict, psychological safety, and group satisfaction.

(7). Due to the limitations of time and thesis length, the researcher did not fully analyze and make a rich description of the qualitative data. Qualitative research methods, such as content analysis, case studies, focus groups and interviews, are thus recommended for future research in order to explore the collected data in as much detail as possible to achieve a deeper interpretation of it.

5.6. Summary

The last several decades have witnessed an acceleration of the process of globalization, as well as educational reforms in many countries in order to meet the challenges of the new millennium (Law, 2004). Since 1994, Taiwan has been participating in this wave of educational reform to enhance its national competitiveness. Both the government and policy makers have repeatedly stated that creativity is critical in today's fast changing world, with its continuous launch of new concepts and technologies. However, one of the most serious problems higher education in Taiwan now faces is how to raise standards without increasing pressure on students, so that they are able to have positive experiences of learning, while at the same time increasing access to colleges and universities (Ministry of Education, 1999). The university admission rate is now almost 100%, which means any student can be admitted into a university, even if they get extremely low scores in their examinations. This has lead to a decline in quality of higher education, as well as reductions in student low motivation and interest. Moreover, under the quickening pace of technological and societal changes, education is faced with the increasingly formidable task of preparing students for a highly challenging and uncertain future. The problem of unemployment has become more and more serious in recent years, and many people now think that graduation means unemployment. This reality makes

it even more important for teachers to help foster students' practical and competitive abilities.

With the rise of the Internet, online learning combined with computer-mediated communication has increased the chances for interaction and collaborative work among students. Nevertheless, just placing students in groups and assigning them tasks can never ensure that the group members will successfully display effective collaborative learning behaviors. The main purpose of this study was to investigate the effectiveness of group composition and conference structure on group creativity and individual perceptions of transactional distance in an online learning environment. By using different grouping methods based on thinking styles, and by structuring collaborative processes based on the theory of transactional distance, in this work researcher sought to create collaborative, contextual and constructivist group activities using online synchronous conferencing, without sacrificing the independence and autonomy of learners.

In this study, the 3 x 3 factorial quasi-experimental design employed a pre-test post-test comparison group to investigate how group composition and task structure influence collaboration outcomes. Quantitative data were collected to examine the hypotheses. Even though there are some limitations in this research, the findings are deemed to be valid and reliable for the following reasons. First, the research

instruments were carefully developed, either in consultation with experts or pilot-tested with target students. The reliability and validity of each instrument were thus well tested. Besides, doing a quasi-experiment, the research made considerable efforts to maintain the comparability of the comparison and experimental groups. There was sufficient control of the demographic variables to increase the internal validity of this work, and thus for the researcher to draw reliable conclusions. Moreover, the researcher conducted a pilot parallel study to explore unexpected issues before undertaking the main one, and after the pilot study some refinements were made to increase the accuracy of the measures. Finally, the study was conducted in a real-life setting, which enhanced its external validity.

The findings of this research contribute to the growing body of knowledge on online collaborative group learning in the following ways:

First, in relation to Sternberg's theory of self-mental government, the findings support his argument that ability is different from style. Male students tended to prefer the legislative thinking style more than the female ones. The male students had significantly higher creative ability with regard to originality. Besides, in Sternberg's threefold model of thinking styles, Type I styles (e.g. legislative and judicial) are considered more adaptive and desirable, while Type II ones (e.g. executive) are considered less so. However, the present study found that executive thinkers in

executive groups felt more emotionally satisfied with the online group activities. This suggests that the executive thinkers were more adaptive to the online group conferencing. In contrast, it is possible that in a legislative group all the members would try and do things in their own way, while in a judicial one the members would all criticize each other. It is thus suggested that teachers should encourage students to develop different thinking styles and design a variety of group activities that suit each of these.

Second, in relation to group composition, Sternberg argued that heterogeneous groups would produce better outcomes than homogeneous ones. However, in this study there were no significant differences between the homogeneous and heterogeneous groups with regard to group creativity. Moreover, no significant correlation between average group member creative ability and the differences in overall group creative performance was found, thus revealing the complexity of group creative performance. Compared to a homogeneous group, while diversity within a heterogeneous one can help the creative process and promote more innovative outcomes, a higher level of perceived individual differences among group members may have negative effects on both emotional reactions and cognitive processes. Based on the non-significant results in this study with regard to group creativity, it is suggested that in addition to diversity, emotional factors, such as group identity

psychological safety, and group satisfaction, may also affect group outcomes, and thus are worthy of attention in future research.

Third, in relation to structure, according to Moore's theory of transactional distance, the relationship between dialogue and structure is immutable, and it is impossible to achieve high levels of both at the same time. When dialogue increases, transactional distance decreases, and *vice versa*; and when structure increases, transactional distance increases. He contended that greater transactional distance occurs when an educational program has more structure and less dialogue. Moreover, when considering the interaction of thinking styles and conference structure, it was postulated that students with a legislative thinking style using the Six Hats method (the most structured) and students with executive thinking style (no structure) in the comparison group will perceive more transactional distance and negative online experiences. On the other hand, legislative students in the comparison group and executive students using the Six Hats method will perceive less transactional distance and more positive online experiences. In the context of the present study, using synchronous online conferencing, the results suggest that high degrees of one dimension of transactional distance also imply high degrees of the others. This is to say that the higher the structure, the greater the interaction, and the better perceptions of learner autonomy and interface usage. For interaction effects, the results show that

students in the high-structured conference group, no matter whether in homogeneous or heterogeneous groups, always felt less transactional distance than those in the low- and no-structured conference groups. So for small group collaborations using synchronous computer conferencing to complete group tasks, the overall results of this study reveal that a group activity can be highly structured and highly interactive, and thus transactional distance can be reduced. As the Internet has become more widely applied, online group discussions that are more pre-structured and directed are more attractive, and can thus increase learner interest and satisfaction. Accordingly, the refinement and verification of the theory of transactional distance is likely to continue in order to meet the changing needs of the changing distance learning environment.

Due to the separation of the learners and teacher, planning is particularly important in distance learning activities. For reasons such as the difficulty of receiving adequate support, lack of face-to-face social interaction, feelings of isolation, and low levels of autonomy, distance learners may be more likely to drop out or fail to complete a program. Hopefully the findings contained in this work will inspire new directions for future research, and provide teachers with creative teaching strategies to enhance student learning motivation and attitudes. If this occurs, then the aim of enhancing the quality of higher education will be achieved, students will be more

satisfied with online group activities, and they will also have greater creative performances, at both the individual and group levels.

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Appendix A: Styles of Mental Self-Government Model and Examples

Style	Key characteristics	Example
DIMENSION: FUNCTION		
Legislative	Work on tasks that require creative strategies; Choose one's own activities.	Likes doing science projects, writing poetry, stories, or music, and creating original artworks.
Executive	Work on tasks with clear instructions and structures; Implement tasks with established guidelines.	Likes to solve problems, write papers on assigned topics, do artwork from models, build from designs, learn assigned information.
Judicial	Work on tasks that allow for one's evaluation; Evaluate and judge the performance of other people.	Likes to critique work of others, write critical essays, give feedback and advice.
DIMENSION: FORM		
Monarchic	Work on tasks that allow complete focus on one thing at a time.	Likes to immerse self in a single project, whether art, science, history, business.
Hierarchic	Distribute attention to several tasks that are prioritized according to one's valuing of the tasks.	Likes to budget time for doing homework so that more time and energy is devoted to important assignments.
Oligarchic	Work on multiple tasks in the service of multiple objectives, without setting priorities.	Likes to devote sufficient time to reading comprehension items, so may not finish standardized verbal-ability tests.
Anarchic	Work on tasks that would allow flexibility as to what, where, when, and how one works.	Writes an essay in stream-of-consciousness form; in conversations, jumps from one point

		to another; starts things but doesn't finish them.
DIMENSION: LEVEL		
Global	Pay more attention to the overall picture of an issue and to abstract ideas.	Writes an essay on the global message and meaning of a work of art.
Local	Work on tasks that require working with concrete details.	Writes an essay describing the details of a work of art and how they interact.
DIMENSION: SCOPE		
Internal	Work on tasks that allow one to work as an independent unit.	Prefers to do science or social studies project on his or her owns.
External	Likes to work with others, focus outward, be interdependent.	Prefers to do science or social studies project with other members of a group.
DIMENSION: LEANING		
Liberal	Work on tasks that allow for collaborative ventures with other people.	Prefers to figure out how to operate new equipment even if it is not the recommended way; prefers open-classroom setting.
Conservative	Work on tasks that allow one to adhere to the existing rules and procedures in performing tasks.	Prefers to operate new equipment in traditional way; prefers traditional classroom setting.

Source: R. J. Sternberg（1994a, p.36-37）; Zhang & Sternberg (2005, p.12)

Appendix B: Informed Consent Form

You are being asked to participate in a study of thinking styles, creativity and collaborated learning. Please read this form and ask any question you may have before agreeing to be in the study.

Purpose of Study: The purposes of this study are, first, to investigate the relationship between the thinking styles and creative thinking abilities of university students, and to facilitate group formation for online group activities. Second, this study also wants to investigate the effects of group composition and online group discussion on group creativity and your online discussion experiences.

Description of Procedures: You will be asked to complete two tests and one questionnaire.

2 Thinking Styles Inventory (TSI): There are seven scales for thinking styles and you are to read each statement carefully and circle a number that indicates how well it represents your way of thinking. This test will take about 20 minutes.

3 Abbreviated Torrance Test for Adults (ATTA): There are three tasks for creative thinking ability and you are required to respond to each task in three minutes by presenting your ideas with texts or drawings. This test will take about 15 minutes.

4 The questionnaire asking about online group conference will be conducted at the end of the semester.

Risks: There are no known risks associated with this study.

Benefits: Participation in this study may 1) give you an opportunity to learn about your thinking styles and creative thinking abilities that could enhance your academic performance, and 2) provide information leading to refinement of course design in our university.

Compensation: You will earn one extra credit in your course for participating in the study.

Confidentiality: All data collected during the course of this study will be kept confidential. All information connected to this study will be coded by numbers instead of by name, and you will not be identified in the research records. Access to data will be limited to the primary researcher.

Voluntary Participation: Your participation in this study is voluntary and you can withdraw at any point. If you complete the tests, you are consenting to participate. There are no penalties if you decide that you do not want to participate.

Contact Information: If you have any questions about this study, you may contact me (Pi-Yu Kao) at pykao@mail.stut.edu.tw or phone (06)2533131 ext. 8447.

If you agree to participate, please sign below with full knowledge of the nature and purpose of the procedures, and I hope that you understand the value and impact of your responses.

Signature _____ Date_____

Appendix C: Sternberg-Wagner Thinking Styles Inventory (adapted from Sternberg, 1999)

Instructions: Read each statement carefully and decide how well it describes you. Use the scale provided to indicate how well the statement fits the way you typically do things on the job, at home, or at school. Write 1 if the statement does *not* fit you at all, that is, you almost never do things this way. Write 7 if the statement fits you extremely well, that is, you almost always do things this way. Use the values in between to indicate that the statement fits you in varying degrees:

1 = Not at all well
2 = Not very well
3 = Slightly well
4 = Somewhat well
5 = Well
6 = Very well
7 = Extremely well

There are, of course, no right or wrong answers. Please read each statement and write next to the statement the scale number that best indicates how well the statement describes you.

Proceed at your own pace, but do not spend too much time on any one statement.

If you have any questions, fell free to ask now.

Functions of thinking styles

The legislative style

___1. When making decisions, I tend to rely on my own ideas and ways of doing things.
___2. When faced with a problem, I use my own ideas and strategies to solve it.
___3. I like to play with my ideas and see how far they go.
___4. I like problems where I can try my own way of solving them.
___5. When working on a task, I like to start with my own ideas.
___6. Before starting a task, I like to figure out for myself how I will do my work.
___7. I feel happier about a job when I can decide for myself what and how to do it.
___8. I like situations where I can use my own ideas and ways of doing things.

The executive style

___1. When discussing or writing down ideas, I follow formal rules of presentation.

___2. I am careful to use the proper method to solve any problem.
___3. I like projects that have a clear structure and a set plan and goal.
___4. Before starting a task or project, I check to see what method or procedure should be used.
___5. I like situations in which my role or the way I participate is clearly defined.
___6. I like to figure out how to solve a problem following certain rules.
___7. I enjoying working on things that I can do by following directions.
___8. I like to follow definite rules or directions when solving a problem or doing a task.

The judicial style

___1. When discussing or writing down ideas, I like criticizing others' ways of doing things.
___2. When faced with opposing ideas, I like to decide which is the right way to do something.
___3. I like to check and rate opposing points of view or conflicting ideas.
___4. I like projects where I can grade different views and ideas.
___5. I prefer tasks or problems where I can grade the design or methods of others.
___6. When making a decision, I like to compare the opposing points of view.
___7. I like situations where I can compare and rate different ways of doing things.
___8. I enjoy work that involves analyzing, grading, or comparing things.

Forms of thinking styles

The monarchic style

___1. When talking or writing about ideas, I stick to one main idea.
___2. I like to deal with major issues or themes, rather than details or facts.
___3. When trying to finish a task, I tend to ignore problems that come up.
___4. I use any means to reach my goal.
___5. When trying to make a decision, I tend to see only one major factor.
___6. If there are several important things to do, I do the one most important to me.
___7. I like to concentrate on one task at a time.
___8. I have to finish one project before starting another one.

The hierarchic style

___1. I like to set priorities for the things I need to do before I start doing them.
___2. In talking or writing down ideas, I like to have the issues organized in order of importance.
___3. Before starting a project, I like to know the things I have to do and in what order.
___4. In dealing with difficulties, I have a good sense of how important each of them is and

what order to tackle them in.

___5. When there are many things to do, I have a clear sense of the order in which to do them.

___6. When starting something, I like to make a list of things to do and to order the things by important.

___7. When working on a task, I can see how the parts relate to the overall goal of the task.

___8. When discussing or writing down ideas I stress the main idea and how everything fits together.

The oligarchic style

___1. When I under some task, I am usually equally open to starting by working on any of several things.

___2. When there are competing issues of important to address in my work, I somehow try to address them simultaneously.

___3. Usually when I have many things to do, I split my time and attention equally among them.

___4. I try to have several things on at once, so that I can shift back and forth between them.

___5. Usually I do several things at once.

___6. I sometimes have trouble setting priorities for multiple things that I need to get done.

___7. I usually know what things to be done, but I sometimes have trouble deciding in what order to do them.

___8. Usually when working on a project, I tend to view almost all aspects of it as equally important.

The anarchic style

___1. When I have many things to do, I do whatever occurs to me first.

___2. I can switch from one task to another easily, because all tasks seem to me to be equally important.

___3. I like to tackle all kinds of problems, even seemingly trivial ones.

___4. When discussing or writing down ideas, I use whatever comes to mind.

___5. I find that solving one problem usually leads to many other ones, that are just as important.

___6. When trying to make a decision, I try to take all points of view into account.

___7. When there are many important to do, I try to do as many as I can in whatever time I have.

___8. When I start on a task, I like to consider all possible ways of doing it, even the most ridiculous.

Level of thinking styles

The global style

___1. I like situations or tasks in which I am not concerned with details.
___2. I care more about the general effect than about the details of a task I have to do.
___3. In doing a task, I like to see how what I do fits into the general picture.
___4. I tend to emphasize the general aspect of issues or the overall effect of a project.
___5. I like to situations where I can focus on general issues, rather than on specifics.
___6. In talking or writing down ideas, I like to show the scope and context of my ideas, that is, the general picture.
___7. I tend to pay little attention to details.
___8. I like working on projects that deal with general issues and not with nitty-gritty details.

The local styles

___1. I prefer to deal with specific problems rather than with general questions.
___2. I prefer tasks dealing with a single, concrete problem, rather than general or multiple ones.
___3. I tend to break down a problem into many smaller ones that I can solve, without looking at the problem as a whole.
___4. I like to collect detailed or specific information for projects I work on.
___5. I like problems where I need to pay attention to detail.
___6. I pay more attention to the parts of a task than to its overall effect or significance.
___7. In discussing or writing on a topic, I think the details and facts are more important than the overall picture.
___8. I like to memorize facts and bits of information without any particular content.

Scope of thinking styles

The internal style

___1. I like to control all phase of a project, without having to consult others.
___2. When trying to make a decision, I rely on my own judgment of the situation.
___3. I prefer situations where I can carry out my own ideas, without relying on others.
___4. When discussing or writing down ideas, I only like to use my own ideas.
___5. I like projects that I can complete independently.
___6. I prefer to read reports for information I need, rather than ask others for it.
___7. When faced with a problem, I like to work it out by myself.
___8. I like to work alone on a task or problem.

The external style

___1. When starting a task, I like to brainstorm ideas with friends or peers.

___2. If I need more information, I prefer to talk about it with others rather than to read reports on it.

___3. I like to participate in activities where I can interact with others as a part of a team.

___4. I like projects in which I can work together with others.

___5. I like situations where I interact with others and everyone works together.

___6. In a discussion or report, I like to combine my own ideas with those of others.

___7. When working on a project, I like to share ideas and get input from other people.

___8. When making a decision, I try to take the opinions of others into account.

Leanings of thinking styles

The liberal style

___1. I enjoy working on projects that allow me to try novel ways of doing things.

___2. I like situations where I can try new ways of doing things.

___3. I like to change routines in order to improve the way tasks are done.

___4. I like to challenge old ideas or ways of doing things and to seek better ones.

___5. When faced with a problem, I prefer to try new strategies or methods to solve it.

___6. I like projects that allow me to look at a situation from a new perspective.

___7. I like to find old problems and find new methods to solve them.

___8. I like to do things in new ways not used by others in the past.

The conservative style

___1. I like to do things in ways that have been used in the past.

___2. When I'm in charge of something, I like to follow methods and ideas used in the past.

___3. I like tasks and problems that have fixed rules to follow in order to complete them.

___4. I dislike problems that arise when doing something in the usual, customary way.

___5. I stick to standard rules or ways of doing things.

___6. I like situations where I can follow a set routine.

___7. When faced with a problem, I like to solve it in a traditional way.

___8. I like situations where the role I play is a traditional ones.

Appendix D: Sternberg-Wagner Thinking Styles Inventory (Chinese version)

思考風格量表

同學你好:

這份問卷目的在了解當你做決定、擬定計畫或解決問題時，習慣運用的策略或方式，以利分組合作學習。量表中的數字代表與你的情況相符程度，當**數字越大**(例如‘7’)表示題目描述的情形與你**愈相像**；**數字越小**(例如‘1’)表示題目描述的情形與你**愈不像**。請仔細閱讀句子，依實際狀況圈選適當的數字。答案沒有對錯之分，也沒有時間限制，但每題不用花太多時間思考。

題號	問題描述	非常不符合	大部分不符合	些微不符合	尚符合	些微符合	大部分符合	非常符合
1.1	做決定時，我大多以自己的想法和行事習慣為依據。	1	2	3	4	5	6	7
1.2	面臨困難時，我用自己的想法和策略來解決問題。	1	2	3	4	5	6	7
1.3	我喜歡嘗試自己的想法，看這些想法能發揮到什麼程度。	1	2	3	4	5	6	7
1.4	我喜歡能用自己方式去解決的問題。	1	2	3	4	5	6	7
1.5	進行一項工作時，我喜歡從自己的想法做起。	1	2	3	4	5	6	7
1.6	工作之前，我喜歡為自己想出該如何進行我的工作。	1	2	3	4	5	6	7
1.7	我比較喜歡可以自己決定做什麼和如何去做的工作。	1	2	3	4	5	6	7
1.8	我喜歡能運用自己想法及處事方式的環境。	1	2	3	4	5	6	7
2.1	在討論或寫下想法時，我依照制式化的表達方式。	1	2	3	4	5	6	7
2.2	我會小心謹慎地使用適當的方法來解決任何問題。	1	2	3	4	5	6	7
2.3	我喜歡架構明確、計畫完備及目標清楚的工作。	1	2	3	4	5	6	7
2.4	在開始一項任務或計劃之前，我會先確認該使用什麼方法和步驟。	1	2	3	4	5	6	7

2.5	我喜歡角色定位或參與方式規範明確的工作環境。	1	2	3	4	5	6	7
2.6	我喜歡弄清處如何依照規則去解決問題。	1	2	3	4	5	6	7
2.7	我喜歡做有規則可循的事情。	1	2	3	4	5	6	7
2.8	解決問題或執行任務時，我喜歡遵循明確的規則或指示。	1	2	3	4	5	6	7
3.1	討論或寫下想法時，我喜歡評論別人的做事方法。	1	2	3	4	5	6	7
3.2	面對正反兩種不同意見時，我喜歡判定何者才是正確的作法。	1	2	3	4	5	6	7
3.3	我喜歡檢驗和評比對立的觀點和衝突的想法。	1	2	3	4	5	6	7
3.4	我喜歡可以讓我評判不同的觀點和想法的工作。	1	2	3	4	5	6	7
3.5	我偏好可以讓我給別人打分數的事務。	1	2	3	4	5	6	7
3.6	做決定時，我喜歡比較相互對立的觀點。	1	2	3	4	5	6	7
3.7	我喜歡可以讓我比較和評判不同作法的情境。	1	2	3	4	5	6	7
3.8	我樂於做需要分析、評分或綜合比較事物的工作。	1	2	3	4	5	6	7
4.1	談論或寫下想法時，我會堅持某一個主要的想法。	1	2	3	4	5	6	7
4.2	我喜歡處理主要議題，不喜歡處理細節或零碎的事項。	1	2	3	4	5	6	7
4.3	試著完成一項工作時，我比較容易忽略所引發的問題。	1	2	3	4	5	6	7
4.4	我會用盡一切方法以達成自己的目標。	1	2	3	4	5	6	7
4.5	試著做決定時，我傾向只考慮一個主要的因素。	1	2	3	4	5	6	7
4.6	若同時有好幾件重要的事要做，我只做對我而言最重要的一件。	1	2	3	4	5	6	7
4.7	我喜歡一次只專心做一件事。	1	2	3	4	5	6	7
4.8	我必須先完成一件事，才能開始做另外一件事。	1	2	3	4	5	6	7
5.1	開始做事之前，我喜歡對需要做的事情排定先後順序。	1	2	3	4	5	6	7
5.2	討論或寫下想法時，我喜歡依重要性組織議題的順序。	1	2	3	4	5	6	7
5.3	著手一項計畫前，我喜歡弄清楚自己該做哪些事，及其先後次序。	1	2	3	4	5	6	7
5.4	處理難題時，我能拿捏每個問題的重要程度及解	1	2	3	4	5	6	7

決順序。

5.5	許多事情同時要做時，我可以清楚地知道處理這些事情的先後順序。	1	2	3	4	5	6	7
5.6	開始做事情時，我喜歡列出工作清單，並依重要程度排序。	1	2	3	4	5	6	7
5.7	執行任務時，我能釐清各細部與整體目標的關聯性。	1	2	3	4	5	6	7
5.8	討論或寫下想法時，我會強調主要的想法以及其各部分的關連度。	1	2	3	4	5	6	7
6.1	當進行某個任務時，我通常是同時做其中的好幾件事情。	1	2	3	4	5	6	7
6.2	當工作出現多項同等重要的問題需要解決時，我會設法同時進行。	1	2	3	4	5	6	7
6.3	通常有很多事情要處理時，我會將時間與注意力平均分配於每一件事情上。	1	2	3	4	5	6	7
6.4	我試著同時做好幾件事，這樣我就可以輪番進行於各項工作之間。	1	2	3	4	5	6	7
6.5	我通常會同時進行好幾件事情。	1	2	3	4	5	6	7
6.6	有時候我無法為眾多需要完成的事情設定優先順序。	1	2	3	4	5	6	7
6.7	我通常知道哪些事情該完成，但是有時候就是難以決定事情進行的先後順序。	1	2	3	4	5	6	7
6.8	通常進行一項計畫時，我傾向把所有環節都視為同等重要。	1	2	3	4	5	6	7
7.1	同時有很多事要做時，我想到哪件事就做哪件事。	1	2	3	4	5	6	7
7.2	我可以輕易地轉換手邊的工作，因為每件事看起來都一樣重要。	1	2	3	4	5	6	7
7.3	我喜歡處理各類型的問題，即使是很瑣碎的事。	1	2	3	4	5	6	7
7.4	討論或寫下想法時，我想到什麼就說什麼。	1	2	3	4	5	6	7
7.5	我發現在解決一項問題時，通常會引發許多別的問題，而這些問題也同樣重要。	1	2	3	4	5	6	7
7.6	做決定時，我會試著把所有觀點都列入考慮。	1	2	3	4	5	6	7
7.7	當有許多重要的事情要做時，只要有時間，我會試著盡可能地多做一些。	1	2	3	4	5	6	7
7.8	當開始一項任務時，我喜歡考慮所有可能的作法，即使是最荒謬的也不排除。	1	2	3	4	5	6	7

8.1	我喜歡不需要花心思去關注細節的工作環境或任務。	1	2	3	4	5	6	7
8.2	對於工作，我比較在意的是整體效果，而不是細節。	1	2	3	4	5	6	7
8.3	從事一項工作時，我喜歡去了解自己所做的部分如何與整體架構相配合。	1	2	3	4	5	6	7
8.4	我比較強調問題的全貌或是計畫的整體效果。	1	2	3	4	5	6	7
8.5	我喜歡的情境是能讓我把焦點放在一般性的議題上，而非鑽研特例。	1	2	3	4	5	6	7
8.6	討論或寫下意見時，我喜歡呈現自己想法的範圍和背景，也就是想法的全貌。	1	2	3	4	5	6	7
8.7	我比較不注意事情的細節。	1	2	3	4	5	6	7
8.8	我喜歡從事的工作是處理整體性問題，而非處理瑣碎細節。	1	2	3	4	5	6	7
9.1	我偏好喜歡處理特定的問題，而非一般性問題。	1	2	3	4	5	6	7
9.2	我喜歡的工作是處理單一而且具體的問題，而不是概括性或複合性的問題。	1	2	3	4	5	6	7
9.3	我傾向把一個問題拆成許多比較能解決的小問題，而不把它當成一個整體來看。	1	2	3	4	5	6	7
9.4	我喜歡為自己所從事的計畫收集詳細或特定資訊。	1	2	3	4	5	6	7
9.5	我喜歡需要留意細節的問題。	1	2	3	4	5	6	7
9.6	我會花比較多的注意力在工作的各個部份，而較少注意其整體影響或重要性。	1	2	3	4	5	6	7
9.7	討論或撰寫某個主題時，我認為細節和事實比整體意像還重要。	1	2	3	4	5	6	7
9.8	我喜歡把各種不同事件或片段資訊記在腦海裡。	1	2	3	4	5	6	7
10.1	執行計畫時我喜歡掌控全局，而不需要與他人商議。	1	2	3	4	5	6	7
10.2	我會依據自己對情境的判斷去做決定。	1	2	3	4	5	6	7
10.3	我偏好能夠實行自己的想法，不需依靠他人的做事環境。	1	2	3	4	5	6	7
10.4	討論或寫下想法時，我只喜歡採用自己的想法。	1	2	3	4	5	6	7
10.5	我喜歡可以自己獨立完成的計畫。	1	2	3	4	5	6	7
10.6	我偏好以閱讀方式獲得所需資訊，而不是靠詢問他人。	1	2	3	4	5	6	7

10.7	面對問題時，我喜歡自己解決。	1	2	3	4	5	6	7
10.8	我喜歡獨自工作或解決問題。	1	2	3	4	5	6	7
11.1	開始執行一件任務時，我喜歡和朋友或同儕腦力激盪。	1	2	3	4	5	6	7
11.2	假如我需要更多資訊，我偏好和別人討論，而不是靠自己閱讀相關資料。	1	2	3	4	5	6	7
11.3	我喜歡參與可以和他人互動的團體活動。	1	2	3	4	5	6	7
11.4	我喜歡參與可以和別人一起工作的計畫。	1	2	3	4	5	6	7
11.5	我喜歡能和大家互動、並且合作的環境。	1	2	3	4	5	6	7
11.6	討論或做報告時，我喜歡整合他人與自己想法。	1	2	3	4	5	6	7
11.7	從事一項計畫時，我喜歡與別人分享彼此的想法，並聽取別人意見。	1	2	3	4	5	6	7
11.8	做決定時，我會設法把別人的意見也列入考量。	1	2	3	4	5	6	7
12.1	我樂於從事可以讓自己嘗試新方法的工作。	1	2	3	4	5	6	7
12.2	我喜歡可以讓自己嘗試新作法的環境。	1	2	3	4	5	6	7
12.3	我喜歡打破常規，以增進工作效率。	1	2	3	4	5	6	7
12.4	我喜歡挑戰舊有的想法或做事方法，並找尋更好的方法。	1	2	3	4	5	6	7
12.5	面對問題時，我偏好嘗試新的策略或方法來解決問題。	1	2	3	4	5	6	7
12.6	我喜歡從事能讓我用新觀點看事情的工作。	1	2	3	4	5	6	7
12.7	我喜歡找出舊問題，並且用新方法來解決。	1	2	3	4	5	6	7
12.8	我喜歡用別人沒用過的新方法做事情。	1	2	3	4	5	6	7
13.1	我喜歡按照過去別人用過的方法做事。	1	2	3	4	5	6	7
13.2	當我負責某件事時，我喜歡遵循既往的想法和做法。	1	2	3	4	5	6	7
13.3	我喜歡有既定規則可循的事務或問題，以便完成工作。	1	2	3	4	5	6	7
13.4	當依循慣例做事時，我不喜歡出現其他問題。	1	2	3	4	5	6	7
13.5	我堅持做事情的標準規則或方法。	1	2	3	4	5	6	7
13.6	我喜歡有常規可以遵循的環境。	1	2	3	4	5	6	7
13.7	面對問題時，我喜歡依照慣例解決。。	1	2	3	4	5	6	7
13.8	我喜歡可以讓我扮演符合傳統角色的環境。	1	2	3	4	5	6	7

問卷到此結束,感謝你辛苦的作答!

班級: 學號： 姓名：

Appendix E: The Shortest Version of the Creative Product Semantic Scale (CPSS; Besemer, 1998；Besemer, 2006)

(1) Novelty is the extent of newness in the product. It is in terms of the number and extent of the new processes, new techniques and new concepts included in the product. It also refers to the newness of the product both in and out of the field (Besemer, 2006). Within Novelty are two facets:

A. *Surprising*: The product presents unexpected or unanticipated information to the user, listener, or viewer.

B. *Original*: The product is unusual or infrequently seen in the universe of products made by people with similar experience and training.

(2) Resolution refers to how well the product works, functions, does what it is supposed to do the degree to which the product fits or meets the needs of the problematic situation (Besemer, 2006). Within Resolution are four facets:

A. *Logical*: The product or solution follows the acceptable and understood rules for the discipline.

B. *Useful:* The product has clear practical applications.

C. *Valuable:* The product is judged worthy because it fills a financial, physical, social, or psychological need.

D. *Understandable:* The product is presented in a communicative, self-disclosing way, which is ‘user-friendly’.

(3) Elaboration and Synthesis is the degree to which the product combines unlike elements into a refined, developed, coherent whole, statement or unit. It is in terms of how the product presents itself and the product’s personality (Besemer, 2006). Within Elaboration and Synthesis are three facets:

A. *Organic*: The product has a sense of wholeness or completeness about it. All the parts work well together.

B. *Well-Crafted*: The product has been worked and reworked with care to develop it to its highest possible level for this point in time.

C. *Elegant*: The product shows a solution that is expressed in a refined, understated way.

Appendix F: Group Creativity Assessment Booklet

Informed Consent

We would like you to participate in a research study. One of the purposes of this study is to gain a better understanding of the effect of group composition and conference structure on group creativity. If you decide to participate in the study, your involvement should typically require no more than 3 hours of your time. We will ask you to evaluate a number of group websites. There are no foreseeable risks from this study, other than perhaps task fatigue. The benefits lie in the experience that you can gain in participating in research into creativity, and you will be given a small gift for taking part in the study.

Participation is voluntary. You are free to withdraw at any time without negative consequences. All information will be treated as confidential, and evaluators will stay anonymous.

Contact Information: If you have any further questions about this study, you may contact the researcher (Pi-Yu Kao) at pykao@mail.stut.edu.tw or phone (06)2533131 ext. 8447.

……

I hereby declare that the above information is clear to me and that I am willing to participate in the research study.

Signature _____ Date_____

Instructions

Please read each the following instructions carefully, and then complete your evaluation. You will have much time as you need to complete the evaluation. When you have completed all your evaluation, please return the assessment form to the researcher. **Thanks for your participation**.

Please consider the group websites in relation to the following three dimensions:

1 **Novelty** considers the newness in materials, links, concepts, and constructions of making the website, consisting of the scales of "Surprising" and "Original"

2 **Resolution** considers aspects of how well the website works or functions with regard to its topics and goals, consisting of the scales of "Logical", "Valuable", "Useful" and "Understandable"

3 **Elaboration and Synthesis** considers the stylistic components of the website that are used to represent its materials, links and concepts based on its topics and subtopics, consisting of the scales of "Well-crafted", "Organic", and "Elegant".

You will be rating a number of websites on a series of seven-point scales. On each scale, please, give a score that best reflects your perceptions of the website. There are no right or wrong answers, only personal opinions. Give careful thought to how each scale relates to the group websites, but do not spend too much time to respond to each scale.

Please rate the website on all scales. Do not leave any blanks.

Group Product Assessment Form

Using the 7-point scale to evaluate the group websites (1-7): 7-extremely good; 6-very good; 5-good; 4-neutral; 3-poor; 2-very poor; 1-extremely poor

	Novelty		**Resolution**				**Elaboration and Synthesis**		
Team	Surprising	Original	Logical	Valuable	Useful	Understandable	Well-crafted	Organic	Elegant
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
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Appendix G: Group Creativity Assessment Booklet (Chinese version)

同意書

同學你好:

歡迎加入這次的研究，本研究主要目的之一是了解小組類型和會議結構對小組創造力的影響。如果你決定要參與本研究，基本上為時不會超過三個小時。你的任務是對一些小組設計的網頁給予評分，除了可能感到疲勞之外，本研究不會對你造成任何的危害。經由參與本研究，你將獲得創造力研究的經驗，並且獲贈精美小禮物。

本研究的參與是屬於自願性質的，你可以選擇在任何時後退出，不會對你造成任何負面的後果。評分結果僅供學術研究之用，並不對外公布，評分者的姓名也不會曝光。

聯絡資訊： 假如你對本研究有任何問題，你可以寄電子郵件給研究者(高碧玉) pykao@mail.stut.edu.tw 或是打電話 (06)2533131 ext. 8447.

……

特此聲明如下，本人對以上敘述的內容已經充分理解，並且願意參與此項研究。

簽名 _____ 日期_____

說明：

請仔細閱讀下列說明，並完成對各小組網頁的評分。你會有充裕的評量時間，當你完成所有的評量工作，請將評量表繳交給在場的研究人員。**感謝您的參與**。

請思考小組網頁和下列三個向度的關連：

1. **新奇**：網頁作品的「新奇」向度由網站內容、連結、概念與建置方式的新奇程度來判定，包含「驚奇性」和「獨創性」等二個評分項目。

2. **問題解析**： 網頁作品的「問題解析」向度，從網站主題和建置目標的切合程度來判定該網站功能，包含「合理性」、「價值性」、「實用性」和「可理解性」等四個評分項目。

3. **細節與綜合**：網頁作品的「精密與綜合」向度，從網站為了呈現主題或次主題所使用之相關內容、連結的精細程度來判定，包含「技巧性」、「組織性」和「精美性」等三個評分項目。

接下來，你將採7點量表評分方法，給各小組網頁作品評分。根據你對各小組網頁的理解，給予每一個評分項目最合適的分數。分數沒有對錯之分，純粹只是反映你個人的意見。請仔細思考各小組網頁作品在每個項目的符合程度，但不必對單一項目花太多時間思考。

請完成小組網頁全部的評分項目，不要留下空格。

小組作品評量表

請根據下列各項表現為各組網頁作品評分(1-7)：7 分-非常好、6 分-很好、5 分-有點好、4 分-普通、3 分-有點不好、2 分-很不好、1 分-非常不好

組別	新奇		問題解析				細節與綜合		
	驚奇性	獨創性	合理性	價值性	實用性	可理解性	技巧性	組織性	精美性
1									
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6									
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Appendix H: Questionnaire used for the pilot study

Perceptions of Transactional Distance

Thank you for taking the time and effort to respond to this questionnaire. It is designed to measure your perceptions of the interaction, structure, learner autonomy and interface when participating in computer conferencing. Your participation is very important to the representativeness of the survey. The survey results will be used to help plan online activities to increase learning achievement. The responses to this questionnaire will not be used for any reasons other than to meet the aims of this research.

Tick the appropriate box

D1. Your gender ☐ Female ☐ Male

D2. Your thinking style ☐ Executive ☐ Legislative ☐ Judicial

D3. Internet accessibility ☐Very easy ☐Easy ☐Neutral ☐Difficult ☐Very Difficult

D4. In a typical week, approximately how many hours do you spend using the Internet (including using e-mail, gopher, ftp, etc.)? ☐1-5 ☐6-10 ☐11-15 ☐16-20 ☐over 20

D5. Do you have online learning experience before? ☐ Yes ☐ No

If yes, please rate your overall previous experience

☐Very Satisfactory ☐Satisfactory ☐Neutral ☐Unsatisfactory ☐Very Unsatisfactory

Directions: Please respond to the following items as accurately and honestly as possible. **CIRCLE** the number after each item that best describes your level of agreement with the statement using the 5-point scale. (5=Strongly Agree; 4=Agree; 3=Neither Agree or Disagree; 2=Disagree; 1=Strongly Disagree)

Section 1:

(*The items 1a-1o are asking about your experience with online interaction.)*

Interaction between you and your teacher	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
1a. I interact with my teacher as often as I need to.	5	4	3	2	1	8
1b. I receive feedback from my teacher as often as I need to.	5	4	3	2	1	8
1c. Interaction with my teacher *doesn't* help my understanding.	5	4	3	2	1	8
1d. My teacher encourages me to take part in the group task.	5	4	3	2	1	8
1e. I would hesitate to have an *informal* conversation with teachers if I had the chance to do so.	5	4	3	2	1	8
1f. I feel there is a distance between my teacher and myself.	5	4	3	2	1	8

Interaction between you and other group members	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
1g. I like to share information and ideas with other group members.	5	4	3	2	1	8
1h. I receive feedback from other group members as often as I need to.	5	4	3	2	1	8
1i. Interaction with other group members *doesn't* help my understanding.	5	4	3	2	1	8
1j. The group size is appropriate for general discussion.	5	4	3	2	1	8
1k. I would hesitate to have an *informal* conversation with other group members if I had the chance to do so.	5	4	3	2	1	8
1l. I feel there is a distance between other group members and myself.	5	4	3	2	1	8

Interaction between you and task content	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
1m. I understand the task content.	5	4	3	2	1	8
1n. I can get help to understand the task content.	5	4	3	2	1	8
1o. The task content *doesn't* help me learn more.	5	4	3	2	1	8

T1. Would you please provide comment on what (i.e. teacher/group member/content) you interact with best and why?

Section 2:

(*The items 2a-2j concern your perceptions of online conference structure.)*

Group work organization	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
2a. I believe the group discussion format is well presented.	5	4	3	2	1	8
2b. I believe the group discussion format meets my needs.	5	4	3	2	1	8
2c. I believe the group work requirements are reasonable.	5	4	3	2	1	8
2d. I feel the group discussion format *constrained* interaction with my teacher.	5	4	3	2	1	8
2e. I feel the group discussion format *constrained* interaction with group members.	5	4	3	2	1	8
2f. I feel the group discussion style is *not* a valid way of learning.	5	4	3	2	1	8

Group work delivery	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
2g. I am able to participate in group discussions at any time.	5	4	3	2	1	8
2h. I am confident with online learning tools.	5	4	3	2	1	8
2i. I find it is *difficult* to actively participate in the discussion process.	5	4	3	2	1	8
2j. I need more guidance to complete group work.	5	4	3	2	1	8

T2. Would you please provide your experience with online group work in this project, either positive or negative? What impressed you most and why? What disappointed you most and why?

Section 3:

(The items 3a-3g are asking about your perceptions of learner autonomy)

Independent	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
3a. I like to learn at my own pace.	5	4	3	2	1	8
3b. I am able to direct my own learning.	5	4	3	2	1	8
3c. I feel it is *difficult* to find resources for my task.	5	4	3	2	1	8
3d. I feel it is *difficult* to complete my task on time.	5	4	3	2	1	8

Interdependent	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
3e. I appreciate the instructor's contribution to the task.	5	4	3	2	1	8
3f. I feel that discussion with other group members is a vital part of the learning experience.	5	4	3	2	1	8
3g. I have *no* intention to actively participate in group discussion.	5	4	3	2	1	8

T3. If you could suggest *two* things to improve learning autonomy, what would they be?

Section 4:

(The items 4a-4f are asking about your perceptions of the technological effectiveness of this method)

Interface	SA	A	N	D	SD	Don't know
4a. I believe computer conferencing provides an efficient way for interactive learning.	5	4	3	2	1	8
4b. I believe all the information is well presented on each page.	5	4	3	2	1	8
4c. I believe computer conferencing provides a good learning environment.	5	4	3	2	1	8
4d. The tools used in computer conferencing are *not* easy to use.	5	4	3	2	1	8
4e. A great deal of time can be wasted just searching for information when using the internet.	5	4	3	2	1	8
4f. Computer conferencing does *not* enhance my interest in learning.	5	4	3	2	1	8

T4. What things can be done to improve the usability of computer conferencing?

Tick the appropriate box

5. Learning online is better than traditional classroom experiences. ☐ Yes ☐ No ☐Not Sure
6. I am confident taking part in online discussions. ☐ Yes ☐ No ☐Not Sure
7. I like to receive an immediate response when working on the Internet. ☐ Yes ☐ No ☐Not Sure
8. I enjoy learning with the online activities. ☐ Yes ☐ No ☐Not Sure

T5. In general, do you have any another comments or suggestions about online activities in this project?

□ **Please write down the number of any items that you had difficulty understanding, and why you think you had problems with them.**

□ **Please write any comments you would like to make about the questionnaire or the research in general.**

Appendix I: Questionnaire used for the pilot study (Chinese version)

互動性距離問卷調查

感謝您撥空填寫這份問卷，這份問卷的目的是為了解參與線上小組討論版的活動，您對人際互動、小組會議型態和自主性學習的認知。您的作答不會影響學期成績，將用來改進日後的線上學習活動，以提升學習成效。

勾選適合你的選項

D1. 性別 □男 □女

D2. 思考風格 □行政 □立法 □司法

D3. 上網 □非常容易 □容易 □沒有意見 □不容易 □非常不容易

D4. 平均一週上網的時數 (包括收發電子郵件, ftp, etc.)? □1-5 □6-10 □11-15 □16-20 □超過 20 小時

D5. 修習本課程之前是否有網路學習的經驗? □有 □沒有

D6. 如果有過網路學習的經驗,對先前的經驗感到 □非常滿意 □滿意 □沒有意見 □不滿意 □非常不滿意

注意事項: 請盡可能正確和誠實地回答問題，量表中的數字代表與你的情況相符程度，當數字越大(例如 5)表示題目描述的情形與您越相像；數字越小(例如 1)表示題目描述的情形與您越不像。請仔細閱讀句子，依實際狀況圈選適當的數字。 (5=非常同意; 4=同意; 3=普通; 2=不同意; 1=非常不同意；8=不知道).

Section 1:

(*問題 1a-1o 是關於線上互動.)*

和任課教師的互動	**非常同意**	**同意**	**普通**	**不同意**	**非常不同意**	**不知道**
1a. 我常和老師線上互動。	5	4	3	2	1	8
1b. 我常在線上獲得老師的回應。	5	4	3	2	1	8
1c. 和老師線上互動對我的理解能力沒有幫助。	5	4	3	2	1	8
1d. 老師會鼓勵我參與小組活動。	5	4	3	2	1	8
1e. 即使有機會，我會遲疑和老師在線上有非學習性質的交談。	5	4	3	2	1	8
1f. 我覺得在線上討論版和老師有距離感。	5	4	3	2	1	8

和小組成員的互動	非常同意	同意	普通	不同意	非常不同意	不知道
1g. 我喜歡和組員線上分享資訊和點子。	5	4	3	2	1	8
1h. 我常在線上獲得組員的回應。	5	4	3	2	1	8
1i. 和組員線上互動對我的理解能力沒有幫助。	5	4	3	2	1	8
1j. 小組的人數多寡對線上討論是合適的.	5	4	3	2	1	8
1k. 即使有機會，我會遲疑和組員在線上有非學習性質的交談。	5	4	3	2	1	8
1l. 我覺得在線上討論版和組員有距離感。	5	4	3	2	1	8
和小組線上討論內容的互動	**非常同意**	**同意**	**普通**	**不同意**	**非常不同意**	**不知道**
1m. 我瞭解小組任務的內容.	5	4	3	2	1	8
1n. 我可以找到支援以瞭解小組任務的內容.	5	4	3	2	1	8
1o. 小組線上會議內容對學習的增加沒有幫助。.	5	4	3	2	1	8

T1. 請寫下任何相關事物你認為互動性最佳的(例如：老師、組員或是線上會議內容)和理由。

Section 2:

(*問題 2a-2j 是關於線上小組會議的型態.)*

線上小組會議的型態	非常同意	同意	普通	不同意	非常不同意	不知道
2a. 我相信小組線上會議型態很好。	5	4	3	2	1	8
2b. 我相信小組線上會議型態符合我的需求。	5	4	3	2	1	8
2c. 我相信設立小組線上會議型態的要求是合理的。	5	4	3	2	1	8
2d. 我覺得小組線上會議型態限制了我和教師互動。	5	4	3	2	1	8
2e. 我覺得小組線上會議型態限制了我和組員互動。	5	4	3	2	1	8
2f. 我覺得小組線上會議型態不是有效的學習方式。	5	4	3	2	1	8

線上小組討論版的使用	非常同意	同意	普通	不同意	非常不同意	不知道
2g. 我在任何時間都可以參與小組線上討論。	5	4	3	2	1	8
2h. 我對使用線上討論工具沒有問題。	5	4	3	2	1	8
2i. 我發現在小組線上討論過程中積極參與是有困難的。	5	4	3	2	1	8
2j. 我需要更多的指引來完成小組作業。	5	4	3	2	1	8

T2. 不管是正面或是負面，請寫下對線上小組會議的經驗心得? 印象最深刻的是什麼?請說出理由。

Section 3:

(問題 3a-3g 是有關自主性學習的經驗)

自主性	非常同意	同意	普通	不同意	非常不同意	不知道
3a. 我喜歡依自己的步調來學習。	5	4	3	2	1	8
3b. 我抓得住學習方向。	5	4	3	2	1	8
3c. 我覺得任務的資料收集有困難。	5	4	3	2	1	8
3d. 我覺得準時完成自己的任務有困難.	5	4	3	2	1	8
交互自主性	**非常同意**	**同意**	**普通**	**不同意**	**非常不同意**	**不知道**
3e. 我感激教師對指導小組作業的貢獻。	5	4	3	2	1	8
3f. 我覺得和組員線上討論是重要的學習經驗。	5	4	3	2	1	8
3g. 我對積極參與小組線上討論沒有意願。	5	4	3	2	1	8

T3. 如果有什麼能增加學習自主性的東西，你能建議兩樣嗎?

Section 4:

(問題 4a-4f 是有關科技效率的經驗)

科技介面	非常同意	同意	普通	不同意	非常不同意	不知道
4a. 我相信小組線上會議提供了有效的互動學習。	5	4	3	2	1	8
4b. 我相信小組討論版每個網頁的資訊都呈現的很好。	5	4	3	2	1	8
4c. 我相信小組線上會議提供了好的學習環境。	5	4	3	2	1	8
4d. 小組討論版的工具不容易使用。	5	4	3	2	1	8
4e. 使用網路時，有很多時間都浪費在搜尋資料。.	5	4	3	2	1	8
4f. 小組線上會議並沒有提升我的學習興趣。	5	4	3	2	1	8

T4. 有哪些方法可以用來增加小組討論版的使用率?

選適合你的選項

5. 網路教室的學習經驗比傳統教室好。 □是 □否 □不確定

6. 我可以自在的參與線上討論。 □是 □否 □不確定

7. 上網工作時，我傾向接收立即性的回應。. □是 □否 □不確定

8. 從網路活動中我愉快地學習。 □是 □不是 □不確定

T5. 大體而言, 對小組線上會議的活動有任何建議或評論嗎?

☐ 你對以上哪些題目的敘述在理解上有困難？請各別寫出它們的題號和問題所在。

☐ 整體而言，請你寫出對這份問卷和研究的任何意見。

Appendix J: Questionnaire used for the main study

Perceptions of Transactional Distance

Thank you for taking the time and effort to respond to this questionnaire. It is designed to measure your perceptions of the interaction, structure, learner autonomy and interface when participating in computer conferencing. Your participation is very important to the representativeness of the survey. The survey results will be used to help plan online activities to increase learning achievement. The responses to this questionnaire will not be used for any reason other than to achieve the research purposes.

Part 1: Tick the appropriate box

QD1. Your gender □ Female □ Male

QD2. Your thinking style □ Executive □ Legislative □ Judicial

QD3. Internet accessibility □Very easy □Easy □Neutral □Difficult □Very Difficult

QD4. In a typical week, approximately how many hours do you spend using the Internet (including using e-mail, gopher, ftp, etc.)? □1-5 □6-10 □11-15 □16-20 □over 20

QD5. Do you have online learning experience before? □ Yes □ No

QD6 If yes, please rate your overall previous experience

□Very Satisfactory □Satisfactory □Neutral □Unsatisfactory □Very Unsatisfactory

Directions: Please respond to the following items as accurately and honestly as possible. **CIRCLE** the number after each item that best describes your level of agreement with the statement using the 5-point scale. (5=Strongly Agree; 4=Agree; 3=Neither Agree or Disagree; 2=Disagree; 1=Strongly Disagree)

Part 2:

(*The items 1a-1h are asking about your experience with online interaction.)*

Interaction between you and other group members	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
Q1a. I like to share information and ideas with other group members.	5	4	3	2	1	8
Q1b. I receive feedback from other group members as often as I need to.	5	4	3	2	1	8
Q1c. Interaction with other group members *doesn't* help my understanding.	5	4	3	2	1	8
Q1d. I would like to have a chat with other group members if I had the chance to do so.	5	4	3	2	1	8
Q1e. I feel there is a psychological distance between other group members and myself.	5	4	3	2	1	8

Interaction between you and task content	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
Q1f. I understand the task content.	5	4	3	2	1	8
Q1g. I can get help to understand the task content.	5	4	3	2	1	8
Q1h. The task content *doesn't* help me learn more.	5	4	3	2	1	8

T1. Would you please provide comment on what (i.e. teacher/group member/content) you interact with best and why?

Part 3:

(*The items 2a-2i concern your perception of online conference structure.)*

Group work organization	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
Q2a. I believe the group discussion format is well presented.	5	4	3	2	1	8
Q2b. I believe the group discussion format meets my needs.	5	4	3	2	1	8
Q2c. I believe the group work requirements are reasonable.	5	4	3	2	1	8
Q2d. I feel the group discussion format increase interaction with group members.	5	4	3	2	1	8
Q2e. I feel the group discussion style is *not* a valid way of learning.	5	4	3	2	1	8

Group work delivery	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
Q2f. I am able to participate in group discussions at any time.	5	4	3	2	1	8
Q2g. I am confident with online discussion tools.	5	4	3	2	1	8
Q2h. I find it is *difficult* to actively participate in the discussion process.	5	4	3	2	1	8
Q2i. I need more guidance to complete group work.	5	4	3	2	1	8

T2. Would you please provide your perceptions of the online group work in this project, either positive or negative? What impressed you most and why? What disappointed you most and why?

Part 4:

(The items 3a-3f are asking about your perceptions of learner autonomy)

Independent	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
Q3a. I like to take part in a group task at my own pace.	5	4	3	2	1	8
Q3b. I am able to direct my own task.	5	4	3	2	1	8
Q3c. I feel it is *difficult* to find resources for my task.	5	4	3	2	1	8
Q3d. I am able to complete my task on time.	5	4	3	2	1	8

Interdependent	**SA**	**A**	**N**	**D**	**SD**	**Don't know**
Q3e. I feel that discussion with other group members is a vital part of the learning experience.	5	4	3	2	1	8
Q3f. I have *no* intention to actively participate in group discussion.	5	4	3	2	1	8

T3. If you could suggest *two* things to improve learning autonomy, what would they be?

Part 5:

(The items 4a-4f are asking about your perceptions about the technological effectiveness of this system)

Interface	SA	A	N	D	SD	Don't know
Q4a. I believe computer conferencing provides an efficient way for interactive learning.	5	4	3	2	1	8
Q4b. I believe all the information is well presented on each page.	5	4	3	2	1	8
Q4c. I believe computer conferencing provides a good learning environment.	5	4	3	2	1	8
Q4d. The tools used in computer conferencing are easy to use.	5	4	3	2	1	8
Q4e. A great deal of time can be wasted just searching for information when using the Internet.	5	4	3	2	1	8
Q4f. Computer conferencing does *not* enhance my interest in learning.	5	4	3	2	1	8

T4. What things can be done to improve the usability of computer conferencing?

Part 6: Tick the appropriate box

Q5. Learning online is better than traditional classroom experiences. □ Yes □ No □Not Sure

Q6. I am confident taking part in online discussions. □ Yes □ No □Not Sure

Q7. I like to receive an immediate response when working on the Internet. □ Yes □ No □Not Sure

Q8. I enjoy learning with the online activities. □ Yes □ No □Not Sure

T5. In general, do you have any another comments or suggestions about learning using online activities in this project?

Do not leave any blanks. Thank you very much for your cooperation.

Appendix K: Questionnaire used for the main study (Chinese version)

互動性距離問卷調查

感謝您撥空填寫這份問卷，這份問卷的目的是為了解參與小組線上討論的活動，您對人際互動、小組會議型態和自主性學習的認知。您的作答不會影響學期成績，將用來改進日後的線上學習活動，以提升學習成效。

Part 1：勾選適合你的選項

QD1. 性別 □男 □女

QD2. 思考風格 □行政 □立法 □司法

QD3. 上網 □非常容易 □容易 □沒有意見 □不容易 □非常不容易

QD4. 平均一週上網時數(包括收發電子郵件, ftp, etc.)?

□1-5 □6-10 □11-15 □16-20 □超過 20 小時

QD5. 修習本課程之前是否有網路學習的經驗? □有 □沒有

QD6 如果有過網路學習的經驗,對先前的經驗感到

□非常滿意 □滿意 □沒有意見 □不滿意 □ 非常不滿意

注意事項: 請盡可能正確和誠實地回答問題，量表中的數字代表與你的情況相符程度，當數字越大(例如 5)表示題目描述的情形與您越相像；數字越小(例如 1)表示題目描述的情形與您越不像。請仔細閱讀句子，依實際狀況圈選適當的數字。 (5=非常同意; 4=同意; 3=普通; 2=不同意; 1=非常不同意；8=不知道).

Part 2：

(*問題 1a-1h 是關於線上互動.)*

和小組成員的互動	非常同意	同意	普通	不同意	非常不同意	不知道
Q1a. 我喜歡和組員分享資訊和點子。	5	4	3	2	1	8
Q1b. 我常常獲得組員的回應。	5	4	3	2	1	8
Q1c. 和組員互動對我的理解能力*沒有*幫助。	5	4	3	2	1	8
Q1d. 如果有機會，我喜歡和組員在線上聊天。	5	4	3	2	1	8
Q1e. 我覺得和組員有心理距離感。	5	4	3	2	1	8

和小組線上討論內容的互動	非常同意	同意	普通	不同意	非常不同意	不知道
Q1f. 我瞭解小組任務內容.	5	4	3	2	1	8
Q1g. 我可以找到支援以瞭解小組任務的內容.	5	4	3	2	1	8
Q1h. 小組任務的內容對學習的增加沒有幫助。.	5	4	3	2	1	8

T1. 請寫下任何相關事物你認為互動性最佳的(例如：老師、組員或是線上會議內容)和理由。

Part 3：

(*問題 2a-2i 是關於線上小組會議的型態.)*

線上小組會議的型態	非常同意	同意	普通	不同意	非常不同意	不知道
Q2a. 我相信小組線上會議型態很好。	5	4	3	2	1	8
Q2b. 我相信小組線上會議型態符合我的需求。	5	4	3	2	1	8
Q2c. 我相信設立小組線上會議型態的要求是合理的。	5	4	3	2	1	8
Q2d. 我覺得小組線上會議增加了我和組員互動。	5	4	3	2	1	8
Q2e. 我覺得小組線上會議型態*不是*有效的學習方式。	5	4	3	2	1	8

線上小組討論版的使用	非常同意	同意	普通	不同意	非常不同意	不知道
Q2f. 我在任何時間都可以參與小組線上討論。	5	4	3	2	1	8
Q2g. 我對使用線上討論工具沒有問題。	5	4	3	2	1	8
Q2h. 我發現在小組線上討論過程中積極參與是有*困難*的。	5	4	3	2	1	8
Q2i. 我需要更多的指引來完成小組作業。	5	4	3	2	1	8

T2. 不管是正面或是負面，請寫下對線上小組會議的經驗心得? 印象最深刻的是什麼? 請說出理由。

Part 4：

(問題 3a-3f 是有關自主性學習的經驗)

自主性	非常同意	同意	普通	不同意	非常不同意	不知道
Q3a. 我喜歡依自己的步調來執行小組任務。	5	4	3	2	1	8
Q3b. 我能夠自行執行任務。	5	4	3	2	1	8
Q3c. 我覺得任務的資料收集有*困難*。	5	4	3	2	1	8
Q3d. 我可以準時完成自己的任務.	5	4	3	2	1	8
交互自主性	**非常同意**	**同意**	**普通**	**不同意**	**非常不同意**	**不知道**
Q3f. 我覺得和組員線上討論是重要的學習經驗。	5	4	3	2	1	8
Q3g. 我對積極參與小組線上討論沒有意願。	5	4	3	2	1	8

T3. 如果有什麼能增加學習自主性的東西，你能建議兩樣嗎?

Part 5：

(問題 4a-4f 是有關科技效率的經驗)

科技介面	非常同意	同意	普通	不同意	非常不同意	不知道
Q4a. 我相信小組線上會議提供了有效的互動學習。	5	4	3	2	1	8
Q4b. 我相信小組線上會議每個網頁的資訊都呈現的很好。	5	4	3	2	1	8
Q4c. 我相信小組線上會議提供了好的學習環境。	5	4	3	2	1	8
Q4d. 小組線上會議的工具容易使用。	5	4	3	2	1	8
Q4e. 使用網路時，有很多時間都*浪費*在搜尋資料。.	5	4	3	2	1	8
Q4f. 線上小組會議並沒有提升我的學習興趣。	5	4	3	2	1	8

T4. 有哪些方法可以用來增加非即時小組討論版的使用率?

Part 6：勾選適合你的選項

Q5. 網路教室的學習經驗比傳統教室好。 □是 □否 □不確定

Q6. 我可以自在的參與線上討論。 □是 □否 □不確定

Q7. 上網工作時，我傾向接收立即性的回應。. □是 □否 □不確定

Q8. 從網路活動中我愉快地學習。 □是 □不是 □不確定

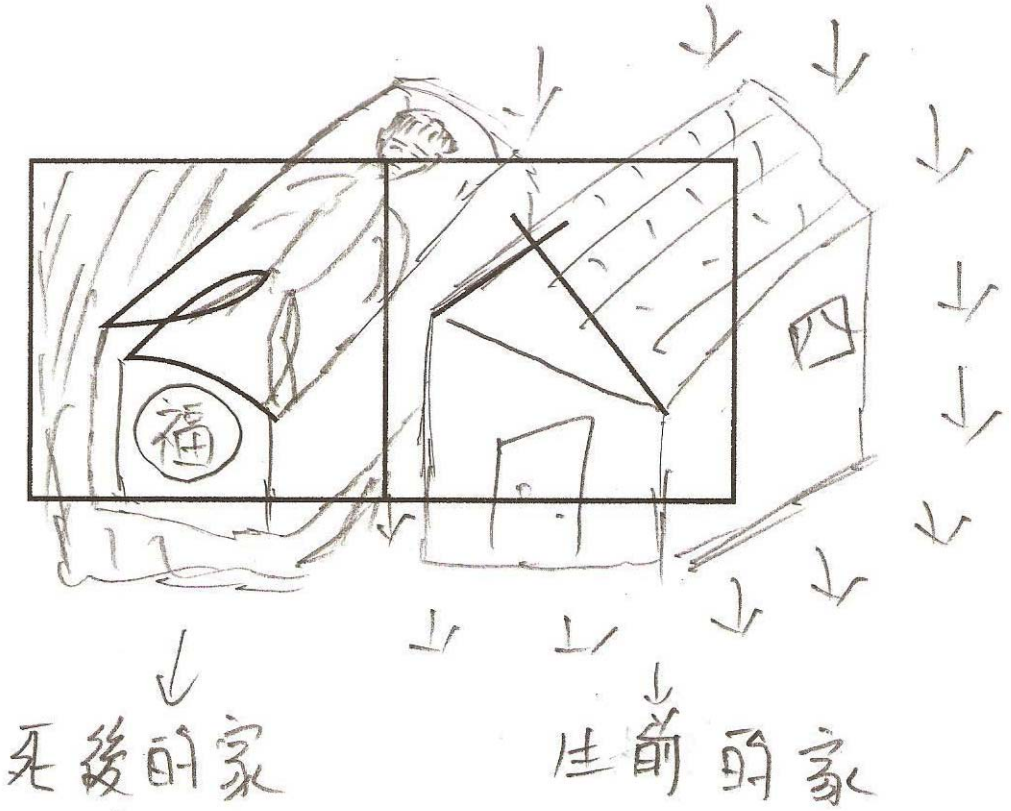
T5. 大體而言, 對小組線上會議的活動有任何建議或評論嗎?

請勿留下空格，非常感謝你的合作！

Appendix L: Examples of the Responses on the ATTA

Task 2: Figural activity

Use the incomplete figures to make some pictures that are unusual and interesting and give each picture a title.



Task 3: Figural activity

Make as many pictures as possible using these triangles and every picture should have a meaning and a title.