The Correlation of Imagination and Computer Graphics Ability of Visual Communication Design Majors

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Abstract

This study aims to examine the correlation of imagination and computer graphics ability of visual communication design majors. To obtain a better understanding of visual communication design majors' imagination exhibited before and after the students take related classes, a questionnaire survey with pretest-posttest design was conducted in this study. The consensual assessment technique (CAT) was then employed to assess the students' works as designated by the classes. The consensual assessment and questionnaire analysis results were compared and analyzed to confirm the correlation of visual communication design majors' imagination and computer graphics ability.

Keywords: visual communication design majors, imagination, computer graphics, consensual assessment technique (CAT)

1. Introduction

The educational philosopher Greene (1995) criticized current teaching for often stifling the imagination and restricting the possibility of different points of view. Thus, Greene reminded teachers that they should go beyond the limited framework of their habits and attempt to get closer to students' consciousness, helping them to gain enough understanding and awareness to make decisions during the process of growth. Only education through imagination, enrichment of thinking resources and improved thinking skills can improve technological and cultural literacy, foster the scientific and technological talent of the future and enhance the research capabilities of the Taiwanese people (Executive Yuan, 2008).

In recent years, the Taiwanese government has been a strong proponent of cultural and creative industries. In response, domestic universities have also established numerous courses to enhance their students' creativity. In particular, departments of visual communication design have become the mainstream for design departments in recent years. In view of this, in this study, we have investigated the relationship between imagination and implementation capabilities in computer graphics in visual communication design students. Through the changes in the students' imagination, we explored the development of imagination in the process of learning computer graphics and the relationship between imagination and computer graphics capabilities. Our specific goals are detailed as follows:

1. To investigate the imagination performance of visual communication design students before and after taking computer graphics courses.
2. To perform expert assessments on students' computer graphics works and compare and analyze the assessment results and the questionnaire analysis results.
3. To explore the relationship between visual communication design students' imagination and their implementation capabilities in computer graphics courses.

2. Literature Review

2.1. Definition and Classification of Imagination

The U.S. educational philosopher Dewey (1980) held that imagination is a kind of ability to see possibilities. He stated that when things are integrated as a whole, imagination is a method of seeing and sensing the workings of the world clearly to transform familiar old things into new experiences. When the human mind intersects with the universe, some degree of risk is always present. This risk is imagination. Imagination allows single concepts to generate rich significance.

Image is the reproduction of sensory experiences from the past in the memory. Imagery is the psychological process by which image forms. Finally, imagination is the psychological process of integrating and combining memories and imagery in the memory to produce new imagery Chang (2003). Literally speaking, imagination is a kind of image seen in the mind's eye. For example, the image of a butterfly appears in the mind when seeing a butterfly. If the butterfly is not in front of my eyes, I can recall its appearance. This is memory, also referred to as the "reproduced imagination." However, art must also include "creative imagination." This is because art must not merely reproduce old experiences but must also add new components to previous experiences.

According to this definition of imagination formulated by numerous scholars, imagination is an abstract thinking activity of humans. It is the ability to reconstruct thoughts and images by analyzing and synthesizing existing knowledge and life experiences. This kind of thinking activity is not limited by any rules, nor is it entrapped by established modes of thinking. Imagination activities can be used to enrich existing things, improve knowledge, and enhance the sensory experience.

Scholars have held numerous views regarding imagination. Chang (1991) indicated that anticipatory imagination is a kind of imagination for the future. Possible future events or how to achieve expected goals are imagined. Examples include rehearsals and practical plans for work interviews or other social interactions soon to come.
Imagination is a human instinct that can be divided into three levels according to grade (McMillan, 1995):

1. The Natural Reaction of Imagination
This is the most fundamental imagination reaction. For example, when people think of pickled plums, their mouths involuntarily begin to water. They hear old songs on the radio and cannot help but start singing. These actions are the beginning of the formation of imagination. This is also the lowest level of imagination.

2. Free Images
For example, when we eat plums, we may imagine gardens full of plums and think of peasant women pickling plums. However, this kind of imagination is the reappearance of past experiences, not productive imagination. This is a higher level of imagination.
3. Images of Individual Inner Activity
This kind of imagination development is on a higher level. For example, when dreaming, the inner world appears as if it were real. However, daydreams also belong

to this category. Images, such as castles in the sky and monstrous floods, sweep by. The highest level of imagination is the thinker's creation or design of new associations after integrating images. This is constructive imagination. Industrial inventions, artistic creations, and scientific discoveries all belong in this category.

Regarding the "purpose" of imagination, Li (1996) divided imagination into two types:
"involuntary imagination" and "voluntary imagination." Involuntary imagination is a type of imagination that does not occur freely and where the themes and purposes of the imagined content change. The imagination activities of toddlers are primarily classified as involuntary imagination. Voluntary imagination is a more stable type of imagination with stable themes and purposes. Depending on its nature, voluntary imagination can be divided further into creative imagination, reproductive imagination, and vision (Chen, 1995).

1. Creative Imagination

Imagination that does not rely on "ready-made descriptions" of stimuli in front of the eyes is "creative imagination." Chang (1991) held that creative imagination is the recombination of past experiences in the consciousness. This imagination attempts to surpass past experiences to produce new ideas. Because it produces new ideas for old problems, this type of imagination is also referred to as "constructive imagination." Creative imagination also requires other conditions for its development. Three of these conditions are inspiration from prototypes, active thinking, and inspiration. These conditions allow creative imagination to produce things that depart from the things in front of the eyes. However, a medium to trigger this imagination is also critical to allow the creator to recall a certain picture or event. The images produced by creative imagination are not the same as the stimuli. This is because creative imagination transcends the things in front of the eyes and conduct exploration and discovery in a temporal and spatial field (Arnheim, 1997).

2. Reproductive Imagination

"Reproductive imagination" is imagination based on "ready-made descriptions," such as descriptions in texts or diagrams. Various manifestations occur in the process of reading literary works. Thus, considerable ability to comprehend literary works and rich memory images are crucial (Li, 1996).

2.2. The Development Process of Imagination

Creation is a kind of psychological and intelligence operation. The creative process is also the process of psychological and intelligence operations Wu, Chang, & Rau (2008). Rothenberg (1972) indicated that during the creative process, creative people are unable to note or record their actual thinking and behavior. Ultimately, they often adopt a mythical perspective to treat the inspiration achieved by their creative thinking. However, the source of creation is not merely waiting for inspiration to arrive. Preparatory work before inspiration and evaluation and examination work after inspiration arrives are indispensable processes (Lin, 2012).

The process of artistic creation does not have a fixed model. Creation can occur anywhere and at any time. Chen (2000) indicated that the processes through which artists create art are diverse. Forms imagined internally or observed in the outside word are converted into internal images before ultimately being converted into works to express these ideas. This is a creation process that converts form into thinking before turning the internal into the external.

The social psychologist Wallas (1926) established a four-stage model for the creative process: 1. Preparation: Information related to a problem is gathered and combined with previous experiences and new knowledge. 2. Incubation: Temporarily shelving problems not thoroughly understood while continuing to consider solutions on a subconscious level. 3. Illumination: Sudden inspiration and understanding of the key to solving the problem. 4. Verification: Implementing the concepts from the illumination to verify whether they are feasible.

The scholar Patrick observed the work processes of poets, artists, and scientists and found that their creative processes also fit the four-stage model (Patrick, 1937). In addition, a study by Lin and Huang (2002) indicated that artistic creation must undergo two processes: incubation and cultivation. J.C.H. Chen (1995) also agreed that artists engage in an artistic creation process beginning with the cultivation of imagery and then adding expression, meaning the process starts from the creation of internal thinking to the completion of external objects. This process comprises observation, experience, imagination, selection, assembly, and performance.

Human imagination has both creative and reproduction functions (Spencer, 2003). Imagination can be used on many things. The imagination process reveals that imagination is the psychological process of producing new imagery after the reintegration of experiences and ideas in the memory (Chang, 1991). G.M. Chen

(1995) held that imagination is "the process of processing and reforming existing memory images in the brain to be recombined into new images."

In addition, scholars have indicated that imagination is an "implicit" process structure. For example, after a designer balances an idea with the needs and restrictions of the problem, the problem is redefined to allow the coevolution of the problem and the solution, promoting the generation of imagination in a process rich in information (Liu, 2011). Wang, Ye, and Chiang (2012) stated that among the operations of imagination, "association" and "divergent thinking" occupy the most critical positions in the integration and conversion of individual experiences.

In summary, the research described above indicates that creation occurs when imagination is produced through these processes. The development process of imagination is an implicit structure. The internalization of experiences is similar to the model of artistic creation. Personal experiences are internalized to produce associations and divergent thinking, ultimately resulting in imagination.

2.3. Methods of Assessing Imagination

In her work *Releasing the Imagination*, the U.S. contemporary philosopher of education Greene (1995) indicated that imagination breaks habits and repetition, departing from the inertia of certainty and consistency. Therefore, imagination requires space for liberation. It must not be limited by established concepts. Uncertainty and ambiguity must be allowed to exist in the classroom.

Applying this concept to teaching, Greene (1971) indicated that imagination can allow us to see different modes of existence. She proposed teaching based on aesthetic experiences to stimulate learners' curiosity and to place learners in unknown, unfamiliar states to intersect with others' stories. The surprise or shock generated by such intersections arouses curiosity and imagination.

Developed in the early 1990s by Kujawski, the test of creative imagination (TCI) is currently the most common measurement instrument for creative imagination used by researchers. The content of this test comprises 16 components: 4 straight lines, 4 semicircles, 4 dots, and 4 curved lines. Subjects are asked to use as many of these 16 components as possible to draw an imagined object that they have never seen before. The end product drawn can be a new invention or tool. Finally, the fluency, originality, and flexibility of the subjects' responses are scored to assess the creative imagination of the subjects (Karwowski & Soszynski, 2008).

Scholars have held that smell, taste, sound, and text can be used to stimulate the imagination. However, the primary method of stimulating the imagination is still the use of visual stimulation (Baars, 1993). Trotman (2006) proposed the following methods to allow imagination to be expressed clearly, facilitating its assessment: (1) observe students' emotions, behaviors, and reactions; (2) record conversations; (3) observe interactions between students; (4) collect students' writings and journals; (5) make photographic records; (6) use photographs and images; (7) use animation, videos, and stories; (8) dance; (9) compose music; and (10) improvisation and impromptu speeches.

In summary, imagination can be divided into the following four types based on the degree of independence, novelty, and creativity generated during the process: (1) creative imagination, (2) reproductive imagination, (3) anticipatory imagination, and (4) perceptive imagination. In addition, imagination can be evaluated through teaching activities, imagination testing, and learning records.

In this study, we investigated the relationship between imagination and implementation capabilities in computer graphic design in visual communication design students. Thus, the imagination discussed in this paper is the capability to analyze and synthesize past vested experiences to reconstruct thoughts and images. Past memories or similar experiences can be used to reconstruct things that are not present.

3. Study Design

In this study, we explored the development of imagination to investigate the imagination performance of visual communication design students before and after taking computer graphics courses. Expert assessments of the students' computer graphics works were also performed. The assessment results and the questionnaire analysis results were compared and analyzed. We used these findings to explore the relationship between imagination and implementation capabilities in computer graphic design courses in visual communication design students.

3.1. Subjects

We administered the questionnaire to 72 first-year students in the Department of Visual Communication Design at Shu-Te University. The questionnaire was conducted to the same batch of subjects before and after the course was taught. In other words, we administered the questionnaire once at the beginning of the semester

and a second time at the end of the semester. A total of 144 questionnaires were recovered, 22 of which were excluded because the students did not participate in the assessment of the computer graphics works. Thus, the number of valid questionnaires was 122 (61 questionnaires each on the pretest and posttest). These questionnaires served as the foundation for the statistics.

3.2. Research Instruments

The research instruments and methods used in this study comprise an imagination questionnaire and expert assessments. The research instruments used in each stage are described as follows:

(1) Source of the Imagination Questionnaire

To understand the degree of the students' imaginations, we used the imagination scale developed by Liang, Hsu, and Lin (2014) to measure the imagination of the visual communication design students. The questionnaires were distributed physically for testing and data analysis was performed on the recovered results.

(2) Method of Administering the Self-Assessment Questionnaire for Imagination

To achieve our objective, we administered the questionnaires to the same group of subjects before and after the courses were taught to understand the mechanism of action of the imaginations of visual communication design students. The imagination performance of first-year visual communication design students taking computer graphics courses with regard to "creative imagination," "conceptual imagination," and "reproductive imagination" was compared. We used these results to investigate the correlation between implementation abilities in computer graphics and imagination.

(3) Method of Implementing the Expert Assessments

In this study, the students took 18 weeks of a computer graphics course. Before the course concluded, the students in the course created computer graphics works. We collected these works and invited three experts to perform expert assessments. The assessment scores were divided into a high-score group (at least 80 points), a middle-score group (79 to 60 points), and a low-score group (no more than 59 points) to serve as a foundation for subsequent data analysis.

4. Data Processing and Analysis

4.1. Analysis of the Correlation between Imagination Performance and Implementation Capabilities in Computer Graphics Courses

This section addresses pretest and posttest questionnaire results for three dimensions of imagination:

"creative imagination," "conceptual imagination," and "reproductive imagination." Comparison of the pretest results for the high-, middle-, and low-score groups indicates clearly that the average score of the low-score group was the highest, followed by the middle-score group. The average score of the high-score group was the lowest of the three. We also compared the averages on the posttest. The results clearly indicate that the students improved in creative imagination, conceptual imagination, and reproductive imagination after taking the course. Therefore, the students' implementation capabilities in the computer graphics course had a positive impact on the increases in their imagination.

Table (4-1)

Score Group	Pre/Posttest	Item	Creative Imagination	Conceptual Imagination	Reproductive Imagination	Average
High-Score Group	Pretest	Average	3.547	3.615	3.606	3.529
		N	13	13	13	13
		Standard Deviation	.6801	.9608	.7903	.7441
	Posttest	Average	3.685	3.681	3.708	3.689
		N	13	13	13	13
		Standard Deviation	.5883	.6679	.7614	.6663
Middle-Score Group	Pretest	Average	3.657	3.549	3.779	3.643
		N	34	34	34	34
		Standard Deviation	.8012	.8429	.8205	.8237
	Posttest	Average	3.680	3.654	3.875	3.720
		N	34	34	34	34
		Standard Deviation	.7825	.7731	.8049	.7843
Low-Score Group	Pretest	Average	3.897	3.720	3.929	3.831
		N	14	14	14	14
		Standard Deviation	.7719	.8012	.7271	.7726
	Posttest	Average	3.815	3.617	3.833	3.736
		N	14	14	14	14
		Standard Deviation	.7680	.7679	.7524	.7628

4.2. Analysis of the Expert Assessments and the Questionnaire Analysis Results

The results of the expert assessments of the students' computer graphics works placed 13 students in the high-score group (at least 80 points), 34 students in the middle-score group (79 to 60 points), and 14 students in the low-score group (no more than 59 points). These data are in line with a normal distribution. Based on the overall averages from the analysis results, the low-score group was higher than the middle-score group and the high-score group was lower than the middle-score group. Thus, what we saw was that the average scores were lower as the experts' assessment scores increased. Conversely, when the experts' assessment scores decreased, the

average scores increased. This result was consistent in both pretest and posttest performance. In summary, comparing the pretest and posttest analysis results reveals that the posttest averages all increased significantly (In addition to the low group decreased slightly). This confirms the presence of a significant correlation between students' imagination and their implementation capabilities in computer graphics courses.

5. Results and Discussion

Analysis of the imagination performance of visual communication design students before and after taking computer graphics courses reveals that their imagination was consistently higher than the average (evaluation indicators for analysis were based on 5-point Likert scale). In addition, comparison of the averages between the pretest and posttest indicates clear improvements (In addition to the low group decreased slightly).

Table (4-1) shows the experts' assessments of the students' computer graphics works. Analysis and comparison of the assessment results and questionnaire analysis results reveal a clear correlation between the visual communication design students' imagination and their implementation capabilities in computer graphic design courses. However, this result was a negative correlation. That is, those with higher scores on implementation capabilities in computer graphic design courses had relatively low average scores in comparison to those with lower scores on implementation capabilities in computer graphic design courses.

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