

*Derivations of the Factors Influencing Imagination
Capabilities of Students Major in Computer Graphics*

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Abstract

Computer graphics is an efficient mean for exchanging information through graphical communication. Imagination capabilities are essential for computer graphics majored students in creative graphics design. However, very few researches tried to uncover the factors influencing the imagination capabilities of students major in computer graphics. To derive the factors, the focus group method was introduced. Based on the focus group research results, sixteen factors influencing the imagination capabilities of students major in computer graphics were derived and can be divided into three categories: idea, behavior and personality. The factors can serve as a basis for evaluations of computer graphics majored students' imagination capabilities as well as designs of imagination capability development curriculum.

Keyword: imagination, creative concept, computer graphics, professional capability

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Introduction

Education should help nurture constructive imagination in students so as to help unleash their creativity (McMillan, 1995). There had been much research done on creativity both in Taiwan and abroad and it is accepted that imagination is one of the major factors in boosting creativity. Csikszentmihalyi (1996) based on nearly 30 years of research has presented ten main characteristics of the creative people and one of them is to have a rich imagination which shows the important influence of imagination on creativity.

In tandem with the government's aggressive promotion of the cultural industries, many domestic universities and colleges have subsequently introduced many courses aimed to increase creativity amongst students. As a result, this research would discuss the correlation between imagination of science students and their ability to draw computer graphics. The study would track the correlation between the two variables by following the changes in the imagination process of the students. The study would include the following areas:

1. Analyze the development of the creative imagination process of design students
2. Analyze the factors influencing the imagination of the design-related students.
3. Analyze the correlation between the imagination of the design related students and their computer graphic drawing ability.

Literature Review

Imagination: Its definition and classification

American educationist Dewey (1980) has said that imagination is the ability to see what is possible. He said: When the reality is integrated into one thing, imagination is ability to feel the way the world and the ability to turn the familiar into new experiences. When the human mind intersects with the universe, there is always a certain degree of risk; this adventure is the imagination, because imagination lets a single concept to produce a rich meaning.

Image is reflection in the memory to feel an experience while imagery is a trace left of that process in the mind, and finally the imagination is a mental process when a new imagery is formed as a result of mixture of memory and imagery (Chang, 2003). Literally speaking, imagination is an image which is seen by the mind's eye, for example, when we seen an object we would have an imagery in the mind. However, if it is not present in the front of our eyes, we could still be able to recall its shape, which is related to memory. It is also called "reproductive imagination." However, in design and art, we still need "creative imagination" because it is not just about recalling old experience but also involves creating new things.

Based on the definition of imagination put forward by many aforesaid scholars, imagination is a form of abstract thought process of humans. In total it includes knowledge, lived experience, and the ability to reconstruct thinking and image. This type of mental activity is not limited by any regulations and also not obstructed by the

existing thinking. Imagination would enrich existing conditions, raise knowledge and increase sensory experience.

Imagination is natural ability of the human being, and we can separate it into three categories (McMillan, 1995):

1. Natural reaction of imagination

It is the basic imaginary reaction. For instance, when humans think of pickled plum, we would involuntarily salivate; when we hear of old songs in the radio, we would naturally sing. Such activities could be seen as a primary form of imagination and the lowest form of imagination.

2. Free Imagery

For example, when we are eating pickled plum, we could think of a ripe plum, and can also think of a farmer who pickles the plum. As a result, this form of imagination is a reproductive imagination based on old experience and is not productive imagination. It is a slightly higher form of imagination.

3. Personal Mental Imagery

This is a higher form of imagination. For instance the dream in our sleep in which the world appears as if real, but the same with our daydream in which the mental imagery such as castles in the sky and monstrous floods. The highest form of imagination is when the thinker arranges his or her mental imageries and creates or designs new connections. This is a productive imagination. Be it industrial invention, artistic creativity or scientific discoveries, they all belong this form of imagination.

With regards to the “objective” of the imagination, it includes “involuntary imagination” and “voluntary imagination”. Involuntary imagination is an unintended imagination and it changes the main theme and the objective of the imagination. Much of the imagination before childhood belongs to involuntary imagination. Voluntary imagination is a kind of stable imagination and it has a stable topic and objective (Lee, 1996). Chen (1995) has classified the nature of imagination into creative imagination and re-creative imagination and fantasy.

1. Creative imagination:

If one can imagine without depending on things that can be seen with one’s eyes, then it can be categorized as “creative imagination”. Chang (1991) suggests that creative imagination is a process of reorganizing one’s past experience in our consciousness and thus creating something new by overcoming our experience. It is a new idea to an old problem, and it is also known as “constructive imagination.” Creative imagination needs three other conditions: original impulse, active thinking and inspiration. Therefore creative imagination can be born without the help of things before our eyes. Therefore, it also needs a medium which triggers the imagination, which would lead the creator remember certain images or events. However, the catalyst and image of constructive imagination are different because it can exceed that which is visible to the eye, and enter into certain explore and discover (Arnheim, 1997).

2. Reproductive Imagination:

“Reproductive Imagination” is an imagination, which is normally based on words and graphics and is many variations of imagination, which is triggered through the process of reading. Therefore, normally it requires one to have certain degree of knowledge with regards to literary products as well as rich memory (Li, 1996).

As for the latter two parts, Spencer (2003) has also pointed out that human imagination has creative and reproductive functions.

Development of Imagination

The process of creation is varied and normally comes in two types, which is its ability to imagine internally and also observe externally and translate the external observation into internal imagery and finally expressing their views through creative products. It is a way of transforming form into thought and then further translating it into products (Chen, 2000). Social psychologist Wallas (1926) has established a four stages of creative process: (1) Preparation Stage: Collecting information about the problem concerned and combining experience with new knowledge; (2) Fermentation Stage: Jettisoning the problems which could not be understood and subconsciously think of the problems that can be solved; (3) High-spirited Stage: Epiphany about the key issues to be addressed to solve the problem; (4) Experimentation Stage: It is a time to implement and see if the ideas are feasible or not.

Patrick (1937) observed the work of poets, artists and scientists and realized that their creative process also follow the four-stage model. Chen (1995) also learned that that the creative process of the artists, which goes from the rise of the image to its process of expression go from creation of internal idea to completion of an external creative product. This process includes observation, experience, imagination, selection, organization and expression (Figure 1).

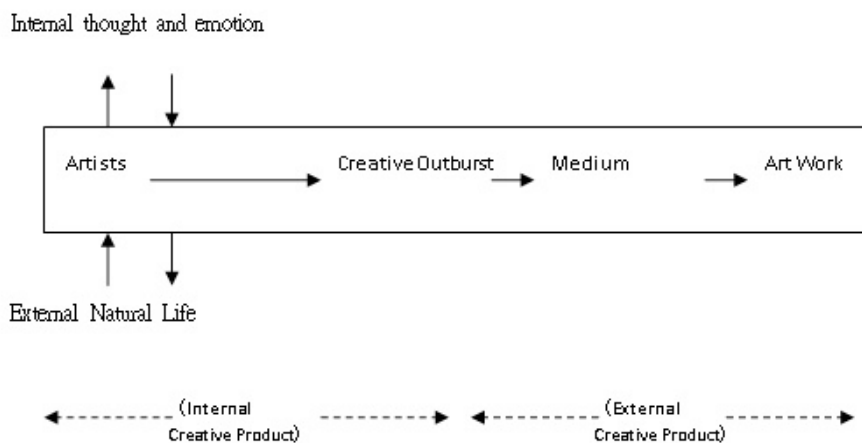


Figure 1: Creative Process, Chen (1995).

Moreover, there are few places, which do not require imagination. In the process of imagination, it can be known that it is a process in which experience in our memory and our ideas are rearranged (Chang, 1991). Chen (1995) believes that imagination is “a process in which new image is formed as a result of processing, restructuring and

reorganizing memory which is already existent in human brain.” Wang, Ye, and Chiang (2012) argue the most important role in the process of imagination which consolidates individual experience and transformed into imagination is played by that of “association of ideas” and “divergent thinking.”

As expressed by scholars above, creation follows these processes to produce imagination and to create. The development of imagination has an implicit structure, while the internalization of experiences resembles the development process of creation. In other words, internationalization of individual experience results in association of ideas and divergent thinking which ultimately leads to imagination.

The Evaluation of Imagination

In the 1990s, the Test of Creative Imagination created by Kujawski is the most commonly used measurement of creative imagination to researchers. The test consists of four straight lines, four semicircles, four dots and four curved lines. The test taker is asked to use the 16 elements as many as possible to draw the objects that they imagine but not yet been seen. The objects drawn may be a new invention or tool. Finally, evaluation of the test taker’s reaction in fluency, originality and flexibility are given in order to assess the creative imagination of the individual (Karwowski & Soszynski, 2008).

Some researchers think that odor, taste, sound and words can all stimulates creativity, but the main method is still using visual stimuli (Baars, 1993). To make imagination easier to evaluate, Trotman (2006) listed the following ways that imagination can be expressed clearly: (1) Observe the student’s emotions, behaviors and reaction; (2) Record the conversation.; (3) Observe the interaction between students.; (4) Collect the essays and journal of the students.; (5) Photography records.; (6) Using pictures and images.; (7) Using animation, clips and stories.; (8) Dance.; (9) Music composition.; (10) Impromptu creation or speech.

Regarding to above, based on the difference level in individuality, novelty and creativity in the progress of imagination development, they can be categorized into four categories as follow: (1) Creation of imagination. (2) Recreation of imagination. (3) Expected imagination. (4) Perspective imagination. Also, imagination can be evaluated through teaching activities, imagination test and learning record.

The purpose of this study is to investigate the relation between the imagination and the abilities of computer illustration of students in design related departments. Thus, the imagination mentioned in this research is an ability of analyzing and combing past experiences to reconstruct thoughts and images. Even in the absence of actual objects, past memories or similar experiences may be used.

Research Design

The research intended to understand the development of imagination and to further discuss about the relation between the imagination and computer illustrating abilities of students in design related departments. Focus group interview was conducted to understand the progress of the imagination development of the students, and

questionnaire to analyze the relation between the imagination and the abilities of computer illustration.

Research Framework

The research conceptual framework is as Figure 2:

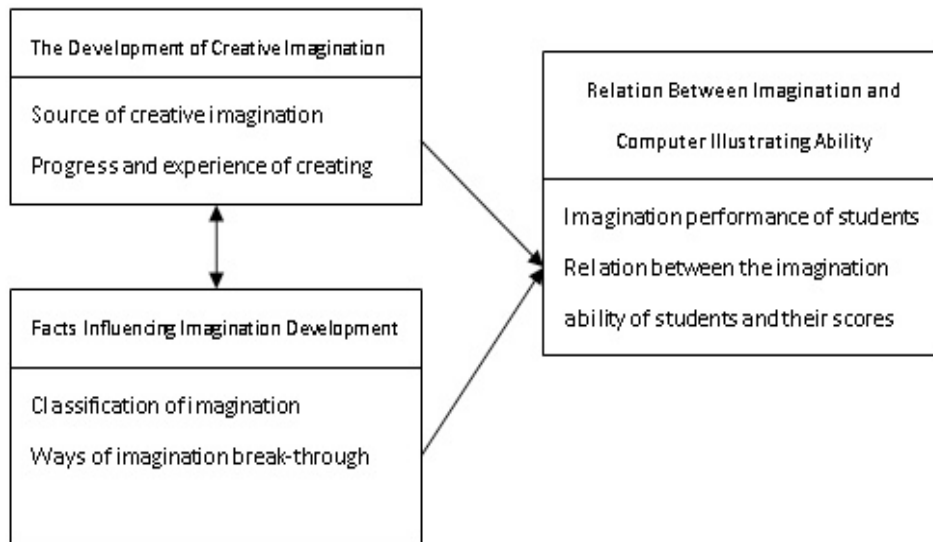


Figure 2: Conceptual Framework.

Data Collection and Instruments

A total of 94 valid samples were collected from two universities. Participants had to satisfy two requirements: majoring in design department and having assignments of graphic design. In order to ensure richness of data and deeper insight, this study used two data-gathering instruments including questionnaire and interview questions.

The Two-Factor Imagination Scale (TFIS) designed by Jason Thompson (2009) were adopted and translated. The items were examined for comprehensiveness and clarity by research associates and three experts in psychology and design fields. This scale was pre-tested by 46 college students in the target pool and then verified by preliminary analyses. Removal of one item with low correlation led to an improvement in Cronbach's alpha. The 21-item scale was found to be reliable with Cronbach's alpha values of .65.

Based upon the literature review above, questions were developed to represent the issues identified in this study. The focus group interview questions were designed into three sections: (1) Analysis of creative imagination sources; (2) Thinking and creation process and experiences; (3) Ways of imagination break-through.

Data Analysis

Analysis of sources of creative imagination

Throughout the interview, we asked the interviewees' sources of their imagination for creation. Starting from the interests of daily life, aiming to find the relation between creative imagination and interests. From the words of the interviewees, we found that most of the interviewees' interests are listening to music and watching movies. For example:

I like to play guitar, listen to music and take photos. (S1)

My interests are listening to music, watching movies and reading novels. (S2)

My interests are listening to music, watching movies and reading novels. (S5)

I also like to read and paint, well, I also enjoying wandering on the street. (S6)

I like to watch movies a lot, I watch almost every types of movies, especially those you need to think to find out the killer, well, movies with suspension and mystery. I also enjoy watching cartoons, I can watch it for all day. (S9)

Some of the interests of the interviewees are sports, for example:

I like to watch television, listen to music and play volley ball. (S4)

I like to play ball games, most of the sports with balls like volley ball or basketball. I also like to paint and draw everywhere. (S7)

We found that most of the interviewees' interests cline to literature and arts, only some of the interviewees' interests are related to sports.

Interviewee S9 mentioned that, "I found that not to reject things is really helpful for the generation of imagination. When we confine ourselves to not watching or accepting specific things will lose a lot of imaginary power. Anything that happens in daily life is helpful for creative mind. Thus, if we limit the things that we approach will lose the power of imagination." The experiences and perceptions of daily life are relatively important and influential to the creators.

Most of the interviewees enjoy interests of literature and arts like movies and music. Regarding to these interests, movies are with stories and properties of imagination and vitality; music concentrates on one's spirit and may come out with creative thoughts with musical notes, which is very expendable to imagination.

The progress and experience of thinking and creation

Via the progress of creation, we investigate if there is a direct relation between the progress of production and imagination. By the way, we discovered that many imaginations come from the experiences and perceptions in the interview mentioned above. From the experiences of the interviewees, some of them start their creation in a relatively relaxed state, for example:

Things just come to my mind when I was listening to my friends chatting. (S2)

We need to create a poster for club performance, it's more free to make club posters because I have less pressure that making those of school work. The idea of this poster comes to my mind when I was walking home. (S1)

Both of the interviewees sketched the rough images of their imagination in a relaxed state of life. S1 brought up that making a poster in the club is relatively free than making one as a homework due to the pressure. Regarding to the difference between club and homework, the inspiration of imagination is easier to generate in a relaxed condition for S1.

Some of the interviewees associate the topic of their mission with the expansion of their thoughts, in order to inspire their imagination to come up with ideas. Starting from the key words of the topic, associating related things to expand the thoughts and ideas is an organized way to construct a zone of expanded and diverse ideas. For example:

We are organizing a game project in a course, and one of the classmates brought up that we can make an “edible” character, but when I was watching the television, it came up to me that we can set that the special items obtained in the game is edible, and followed with more associations. (S8)

One assignment was to make a commercial clip, and our topic is Satay sauce. Our inspiration came from the “pop” sound when we open the lid. (S7)

It’s worth noting that via setting the topic and the accumulation of the experiences and observations of daily life, they could become a way of triggering inspiration. For example:

I think that I’m pretty good at observing, I don’t usually just see the appearance of things, I always observes longer and think deeper. Maybe things won’t be useful now, but I’m saving it for the power of future. Sometimes when you associate things with other incidences, many new ideas will come to mind. (S6)

More even, some of the interviewees develop their ideas and creation via discussing. For example: A brainstorm with a group of people is way better than doing alone, but I think that everyone should do some research in advance, and that will be more helpful. (S7)

In the progress of discussing and collecting data, exchanging ideas to create new ideas or associating collected information with life experiences and changing direction of gathering data will be other inspirations. For example:

I often read or notice things about graphic design, but not intentionally. I will keep some of the special or nice ones in my mind, but not record them with pen and paper. However, when I’m about to use them, they just came up together to my mind. (S1)

The teacher told us to decide our one topic of the homework this time, and we’re encouraged to draw whatever we like as long as it’s a whole series. I found a children’s book in the shelf of my home, and because I’ve read a lot of them when I was little, i decided to find one of the stories and draw them. Alice in wonderland is the one that I choose because of the variety and abundance of its characters. (S3)

The teacher told us to use “The Art Nouveau” as a topic, and most of my classmates chose the style of Mucha for creation, but I searched with the key word art nouveau and found out that Klimt’s artworks are great, so I decided to use them as references. (S5)

The inspiration phase of creation can be divided into three dimensions regarding to the interviewees experiences. I. Relaxed state of life and experiences. II. Motif observation and association. III. Discussion and data association. To the interviewees' experiences, three of them are strongly connected, for example, the imagination of S3 comes from the combination of data collecting and life experiences; and S8 came up with ideas with discussion and association proceeding simultaneously.

If one wants to have a different ideas with others, reverse operation is needed. S5 decided not to use the information that most of the people know, and integrated life experiences to come out with different ideas.

We can speculate that the production of ideas owns a state that they just pop up to one's mind via the results of the interviewees. The phenomenon may be contributed to the personal experiences or the internalization of read data. Imaginary may be influenced in an extent by the imagination of the information or the experiences and observation of daily life.

Ways of break-through of creation

The interviewees stated that they often encounter circumstances of no inspiration or thoughts in the progress of creation. We could found in the interview that many of the interviewees think that if the teacher can display some of the previous works or artist masterpieces, it will be very helpful for inspiring their creativity. Most of the interviewees are influenced by such acts.

The teacher inspired us with the display and analysis of many artworks from different epochs, along with masterpieces of modern art. (S4)

The teacher showed us many examples before the class starts, which inspires our imaginations. Nevertheless, a lot of classmates will follow what the teacher said, so if I made some differences, the teacher will find them creative. (S2)

Some of the interviewees inspires their imagination by walking outdoors and be in contact with daily life. For example: I'm quite restless and enjoy outdoor activities. I'll be fine as long as I'm not staying at home. (S6)

A relatively less interviewees hold negative attitude, for example:

When I was thinking a story, I've been working on it for months but still without results and I'm not satisfied with the things that I've come out with. What I did was completely leave it alone, for three entire months. However, I found out a lot of ideas when I picked it up after three months. (S9)

It's alright even though I have no inspiration, because the homework will be done before the deadline anyway. (S8)

Combing the perspectives of interviewees, most of the them resolve the problem of less inspiration by accepting information and artworks that the teacher gave, whilst some of them deal with them by ignoring them or using time pressure to force oneself to come up with ideas. However, stepping outdoors is one of the positive ways to inspire imagination when it comes to the dilemma of lacking ideas.

The imaginary performance of university students

To understand the self-rated score of student imagination that this research aimed at, we defined that who has a higher score than 73.5 as high imagination ability; score within 73~53 as medium imagination ability; and those with lower than 52.5 as low imagination ability. The analysis standards are as above.

There are 12 individuals scoring higher than 73.5, with a percentage of 14%; 67 individuals with scores within 73~53, contributing 82% of the population; and 4 with scores lower than 52.5, consisting 4% of the group. The result shows that the students sampled by our institute have an above average imagination performance, but most of them still belongs to the category of medium imagination ability, while the number of low imagination ability is the lowest.

The relation between imagination capability and artwork score

The research cross examined the self-rated score with their curriculum score of last semester, using Chi square analysis to process the contingency table of two variants ($X^2 = 542.246$, $p = 0.128 > 0.05$). Level of significance was not reached, meaning the two variants are independent and conspicuous relation is not detected.

Through Figure 3, the curve of artwork score and the imagination capability are not quite the same, so we can infer that the relation between the artwork score and imagination capability is relatively low in the sample students of this present study.

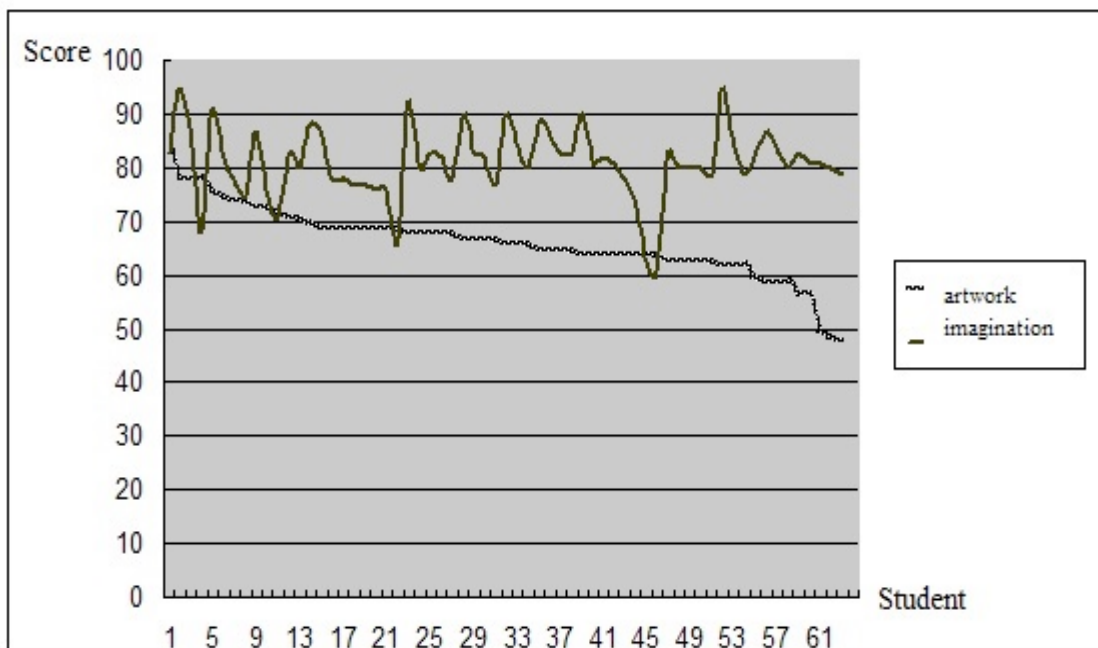


Figure 3: Relation between Artwork Score and Imagination Capability.

Research Results

The creation progress often starts from the task given by the school teacher. With different environment, past experiences and personality of each creator, different

emotion withdrawal progress develops. Imagination is an important phase of the students' creation, happens in the middle phase of the creation progress. Associating the ideas obtained from imagination with the task given, create after having a specific clue and produce the artwork at last (Figure 4)

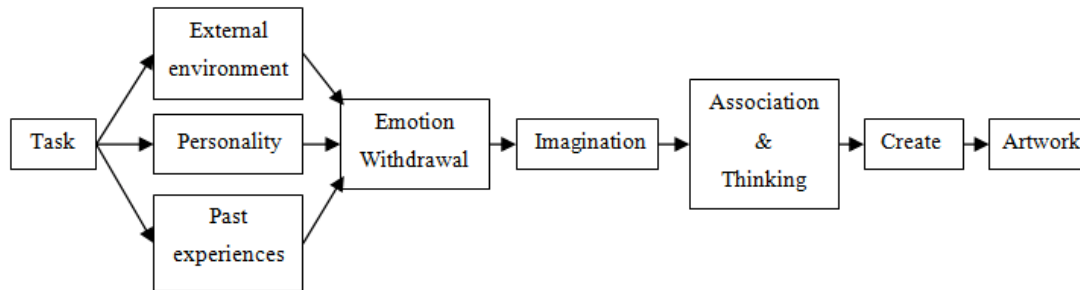


Figure 4: The progress of students' creation and imagination.

Previous research indicated that the creative imagination progress of a sixth grade elementary school student can be separated into "The start of imagination," "The correct of imagination," and "The cease of imagination" (Wang et al, 2012). Their conclusions are identical with the results of this study, and we discovered via interviewing university students, as one's age grows, the influence of "external environment," "past experiences," and "personality" becomes more predominant.

Imagination is one of the most important factors in designing problem resolving progress (Liang & Hsu, 2010). However, the factors influencing the development of imagination can be elaborated as Table 1.

Table 1: The interviewees' Characteristics.

Factors	Characteristics
Belief	innovative, original, divergent thinking, alternative, integrative
Behavior	passionate, humorous, impatience, vigorous, confident, novel
Personality	observant, adventurous, agile, diverse, unpredictable

Also, we found in the interview that the student will have different imagination development regarding to the different creating tasks given by the teacher. Thus, when the teacher is conducting computer illustrating courses, there will be positive help towards the imagination development of students if the instructor can understand the students' interests and give different sensational stimuli.

In addition, the sampled students' imagination performances are above average, while most of them fall into the category of medium imagination ability, with the lowest ratio of low imagination ability. After cross examination of the self-rated imagination score and their score of computer graphic course, the result did not reach significance level, showing that the imagination ability is not conspicuously related to the computer illustrating ability. This might be affected by the students'

“ability to perform techniques”, which means that the students had abundant design imagination but their creation was limited by the ability to perform computer graphics techniques and therefore failed to convey their whole ideas.

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