ANALYSIS OF STUDENTS DESIGN ACTIVITIES
TOWARDS BIOMIMICRY CONCEPTUAL DESIGN

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ABSTRACT

The creation of a new idea is crucial in many aspects of thinking. An improvement in method of thinking process these days has been producing a lot of novelty in design circumstances. Design thinking is often and very much influenced by design work. Nowadays, there are many research fieldworks use design thinking process to explain certain arising problems. In this study, we use Biomimicry as an approach to develop students' design activities. Biomimicry study was highlighted when many solutions have been successfully implemented using this method in various fields of work nowadays. Biomimicry was originally formed by two different Greek root words which are "bios meant life and "mimesis" which means imitate. Now, many have started to recognize the importance of inspirations of nature since a lot of researches have been conducted to understand. Conceptual framework is the basis of understanding in any study or research. This study will be utilising properties specified in the frame work which has been produced in developing the research methods. By using two aspects of study methods which are questionnaire and drawing test as a medium for experimentation and analysis.

Keywords: biomimicry, design thinking, design activities

1. INTRODUCTION

Recent reference, scholars, practitioners and government sector claim that the design thinking has the power to stimulate and to encourage innovation to transform organizations and societies. In this research, the pivotal stage is to understand the design thinking process and Biomimicry concept. Once this information is understood, it will be a trigger to generate ideas. The way of understanding also will help for high expectation to produce creativity and emotional impact into a design solution. In the beginning of this research; the most crucial part is to understand the emphasis on the research scope. In this particular research, there are three general scopes, which put emphasis on people, process and product.

Figure 1: General scope in research

Definitely, the search for the needed theories will be easier by comprehending the research area. Therefore, to start a new formation of conceptual framework, we should determine the research area. The main concern of research is design knowledge which has three ramifications which are of people, process and product. These three factors will form the three main frameworks. For example, products and people will provide for design knowledge in the form of trendy lifestyle. The combination between product and process will contribute for technical study that essentially requires for Computer Aided Design (CAD) and also some technical research tools to determine the study result. The third factor is the blend between people and process which contributes for a design thinking management. This factor will determine how certain thinking models influence for a better management in thinking process. Thus, this study put an emphasis on this third factor which the theory used in this study will form a conceptual framework through KJ method.
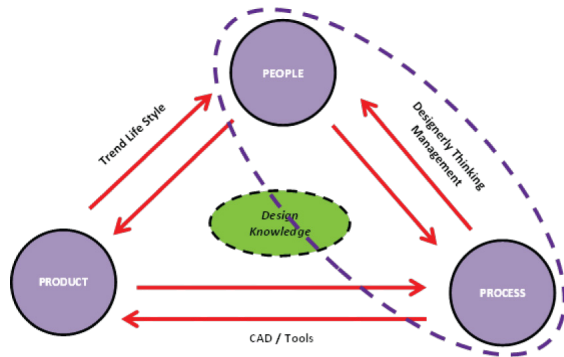

Figure 2: Specific scope in research. Sources by Rahman KAA (2013)
Sources by Rahman KAA (2013)

2. THE KJ METHOD

In this study, KJ method is particularly being used to build conceptual framework. KJ Method was developed by KawakitaJiro (thus KJ), was also called as "Affinity Diagram" (Ulrich 2003). The KJ method is known as the method for establishing an orderly system from chaos of information. This method was originally developed for anthropological fieldwork to extract the relation which leads to findings from the gathered and stored data. The KJ method as applied to technical innovations is the systematization of brainstorming and identifying its focus. The features of KJ method are cooperative works toward innovation (Yuizona et al., 1998).

The most important process that needs to be conducted is searching for the keywords. It is important in identifying the keywords to understand the focus area in the research. Initially, KJ method starts with brainstorming, reading, discussion and few more ways. The first stage in this study is experience from designing process and as an educator. For this experience, brainstorming will be conducted to generate ideas from problems faced during the time as a designer and an educator. While the second stage is the process of searching where related materials like books, articles and journals were used. From the reading, Theories will start to be understood and important keywords are being identified and important keywords will be taken into consideration. In this phase, keywords have been clustered into five items namely design thinking, biomimicry, furniture, sustainable and method. Since there are three steps in this process, after the keywords have been identified, the next step will be organizing the workshop. The workshop implementation has been conducted to several groups of design students. Workshop conducted by explains the related topic from our research. In the workshop, keywords will be further identified and then issued based on their thinking process.
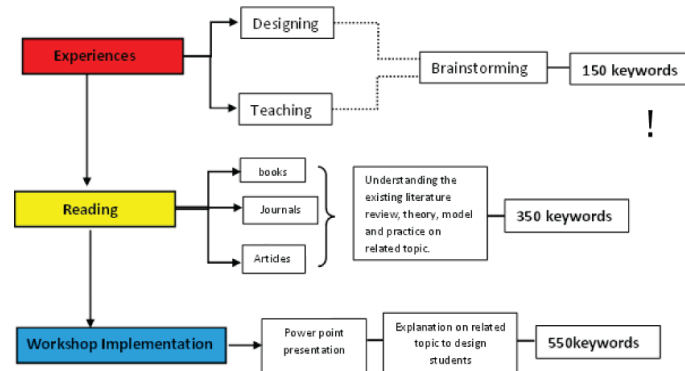

Figure 3: Method of searching keywords

2.1 Keywords Management

The next step in organizing keywords is by gathering ten experienced designers at the same time for the purpose of deciding on suitable keywords in formation conceptual framework. This analysis is conducted based on selected fifty groups of keywords. From these groups, decision will be made by lowering the groups of keywords to small groups. Briefly there are four steps to cluster the keywords which are:
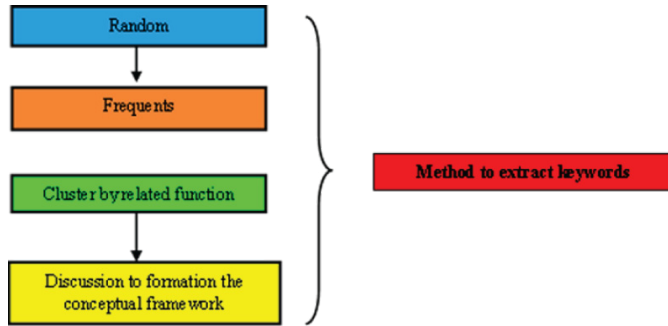
Figure 4: the step of keywords cluster

The uniqueness in KJ method is a decision is not a decision by one's preference but rather a decision based on group consensus. An important part of this study is how to decide for the right keywords for input of the conceptual framework. The decision for selecting the right keywords will be done with a group of experienced designers, as they will recommend and suggest for the best keywords from their own personal individual experience. Apart from that, we also identify the keywords by clustering them into specific groups. With design experiences that they have, specific decisions were suggested to facilitate the design process. All views were taken into consideration and further discussion will be undertaken during consultation with the supervisor.

3. THE FORMATION OF FRAMEWORK

The editor is a great tool at recording the thinking process as it depends on the amount of recorded information. For thinking aloud method, the information is usually huge and some data may need to be cut down. Apart from that, some thoughts may not be able to be recorded as the subject may not share some minor thoughts. By using KJ editor, it is certainly more gainful as the analysis process can be preceded faster since the record can be read and processed by latest gadget.

From the thirty five groups, the list will be further shortlisted to determine pivotal keywords for conceptual framework construction. After we finished shortlisting the keywords, names will be given to identify the groups of the shortlisted keywords. These groups will be analyzed based on their significance in the study and the effectiveness when it is used in conceptual framework. Based on observation of theories in the literature review, only selected keywords will be chosen to be included as functional keywords for this study.

Once the result is finalized, the conceptual framework will be classified to two main components; those are biomimicry inspiration and biomimicry development.The main aspect in the framework of this concept is Biomimicry inspiration for which it acts as a searching solution for the experiment that will be conducted. The selected keywords are understanding, bodystorming, emulate, empathy and development. These keywords were derived based on their suitable functions in design thinking process.

The second component is the biomimicry development in which it works to expand the concept of the idea which it aims to help equip the inspiration and will complete the design process. among the keywords that have been chosen are define, principal, interaction, imagination, intuitive, creative, environment, experiences, conceptual and testing. The combination between biomimicry inspiration and biomimicry development is biomimicry design thinking attributes.

Biomimicry design thinking attributes assist designers in producing products through the biomimicry idea. These design development is further focused on furniture design.
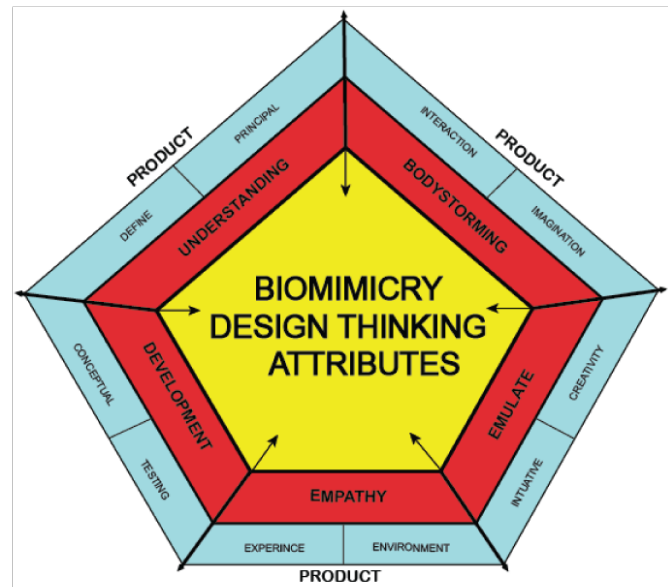

Figure 5: The framework of research

3.1 Pilot Study

The first step after the formation of framework is conducting the pilot study. The test was conducted with some groups of design students. The main objective of the study given to design students is to enhance the understanding related to biomimicry design development. We use a workshop implementation type for this experimentation.

After identifying certain failed protocols in the workshop implementation, a more suitable instrument has been discovered and utilized for the real study. In short, there are six steps for this research method that we feel to be really suitable to be implemented in this study, which are understanding the questionnaire without understanding the topic, drawing test, telling about the related topic through a PowerPoint presentation, brainstorming to planning bodystorming, and answering a questionnaire after gained some understanding about the topic.

4. PARAMETER IN QUESTIONNAIRE

We have developed the questionnaire by dividing it into six sections. The first section is for general information and the other five more sections are from the framework which was developed in the beginning of this study. The questionnaire is divided into one to five and parameters are in the form of likert scale as follows; hardly important, less important, neither important nor important, important, and very important.

There are 21 questions which were decided from the framework according to its functions. The results of this questionnaire can be divided to pre-test and post-test results.

4.1 Analyzing the Answer

Our method in this research for analysing the answer is to distinguish between before and after design activities. By using the characteristics in the framework, the result has been counted into percentages.

4.2 Data Result

For this study, the data bridge construction based on conceptual framework. In this study, we took eight months to recover, which involved 100 people from some local university students who study industrial design.

GROUP	A			B		
	Mean			Mean		
Attributes	**Before**	**After**	**Percentage**	**Before**	**After**	**Percentage**
UNDERSTANDING	29.1	32.9	6.1%	26.6	31.1	7.7%
Define	34.1	41.3	9.5%	34.9	39	5.5%
Principle	29.9	36	9.2%	29.3	33.9	7.2%
BODYSTORMING	23	27	8.0%	21.9	25.2	8.2%
Interaction	25.1	27.6	4.7%	24.1	25.3	0.5%
Imagination	26.7	28.8	3.7%	25.1	25.9	1.5%
EMULATE	10.8	12.6	7.7%	10.5	12	6.6%
Intuition	16.2	18.1	5.5%	15.7	17.3	4.5%
Creativity	30.7	35.8	7.6%	30.9	32.3	2.2%
EMPATHY	32.9	33	0.1%	31.2	34	4.3%
Environment	25	25.2	0.4%	23.4	26	5.2%
Experience	24.4	23.8	1.2%	22.4	25.5	6.4%
DEVELOPMENT	22.4	22.8	0.8%	20.5	21.8	3.0%
Conceptual	12.2	13.3	4.3%	11.9	12.7	3.2%
Testing	18	18.8	2.1%	17.4	18.3	2.5%

Table 1: The result of first group

In this measurement, the test aims to find the result before and after workshop implementation. Discussion regarding editing and manipulating were conducted between the two groups who have executed the design activities. In order to find out the difference, we followed the functions from the framework. In creating discussion idea boxes, there is a significant in the mean between understanding in group A (6.1%) and group B (7.7%). In this situation we could see the increment of understanding level after the test execution. There have massive difference in the group A define (9.5%) and for the group B (5.5%), while the principles has been shown in the group A (9.5%) and group B (7.2%). In this study, we are introducing bodystorming as a part in designing process; it slightly felt between group A (8.0%) and group B (8.2%), while interaction group A (4.7%) and group B (0.5%), in additional imagination shown the result for in the group A (3.7%) and group A (1.5%).Emulate is one of the important elements to transform the thought form for Biomimicry design phase, as a result, in the group A (7.7%) while group B it was (6.6%). Accompanied by an intuition increase in group A (5.5%) compared with group B (4.5%). There is a significant distance on the creativity of the group A (7.6%) and group B (2.2%).Our study highlights the way of thinking of sharing between designers, whose concept Empathy have shown results in group A (0.1%) and group A (4.3%).Empathy concept is backed by two components, namely environment and experience which also demonstrated significant results in each group. The first component in the scope empathy the environment have shown a different consents of the concept in the design stage, the results of group A was (0.1%) and group B (4.3%). Similarly, the element experience in group A (1.2%), while group B (6.4%). In the designing phase, several steps must be followed to achieve the final design. In this study,

we had allowed the designers to use their own creativity in developing their ideas. With the effects indicated by the group A is (0.8%) and group B (3.0%). Two factors that have been proven for the conceptual and testing each element of the show is not indicating an obvious alteration in their role in the invention procedure. In group A conceptual is (4.3%) and a slight decrease in group B of (3.2%). While testing at the group A was (2.1%) and group B was (2.5%). The effectiveness of the implementation of the workshop, what has been achieved is an understanding of biomimicry design phase, whether in the form of a questionnaire or drawing the Activity. What can be shown is the mean change on every level after tests.

5. APPLICATION TO DESIGN ACTIVITIES

In this study we are using questionnaire as a medium to get the result in understanding of biomimicry. In the process of comprehending the matter, students will be given design activities to test thinking process in which for this activity, students will be given a subject matter to sketch and further develop the idea. There were five subject matters given from flora and fauna for this design activity. These designs include hibiscus, tarantula, beehive, hand skeleton and shapes of water splashing. Next, respondents will be introduced with bodystorming For next step, respondents were given briefing regarding biomimicry and design thinking using slides. For the last design activity, students who are design students will be asked to answer a questionnaire to identify the significance of each section in the questionnaire.

5.2 The Execution of Design Activities

Our research is using design students specifically industrial design as respondents. The method of implementation of the design activities is to divide two people to each group from 10 people. Each person gets a different subject matter. Then they are given the freedom to use any method to get ideas based on experience in the process of teaching and learning. Even though they are given different subject matters, they are allowed to discuss the outlook for the implementation of this task by sharing ideas. This discussion is shared by using the method of brainstorming as for recording purposes. Towards the end of the sketching process, they need to decide upon one final design even if they were given different subject matters.

In the drawing test there were two sessions which every session they have been given 30 minutes to do the sketches. In the middle of drawing session they need to do some actions for bodystorming to help with their design process. In this study, bodystorming is used as a medium for stimulate the thinking process by using interaction and imagination.

Figure 6: Drawing test during the workshop implementation

Figure 7: Bodystorming action during workshop.

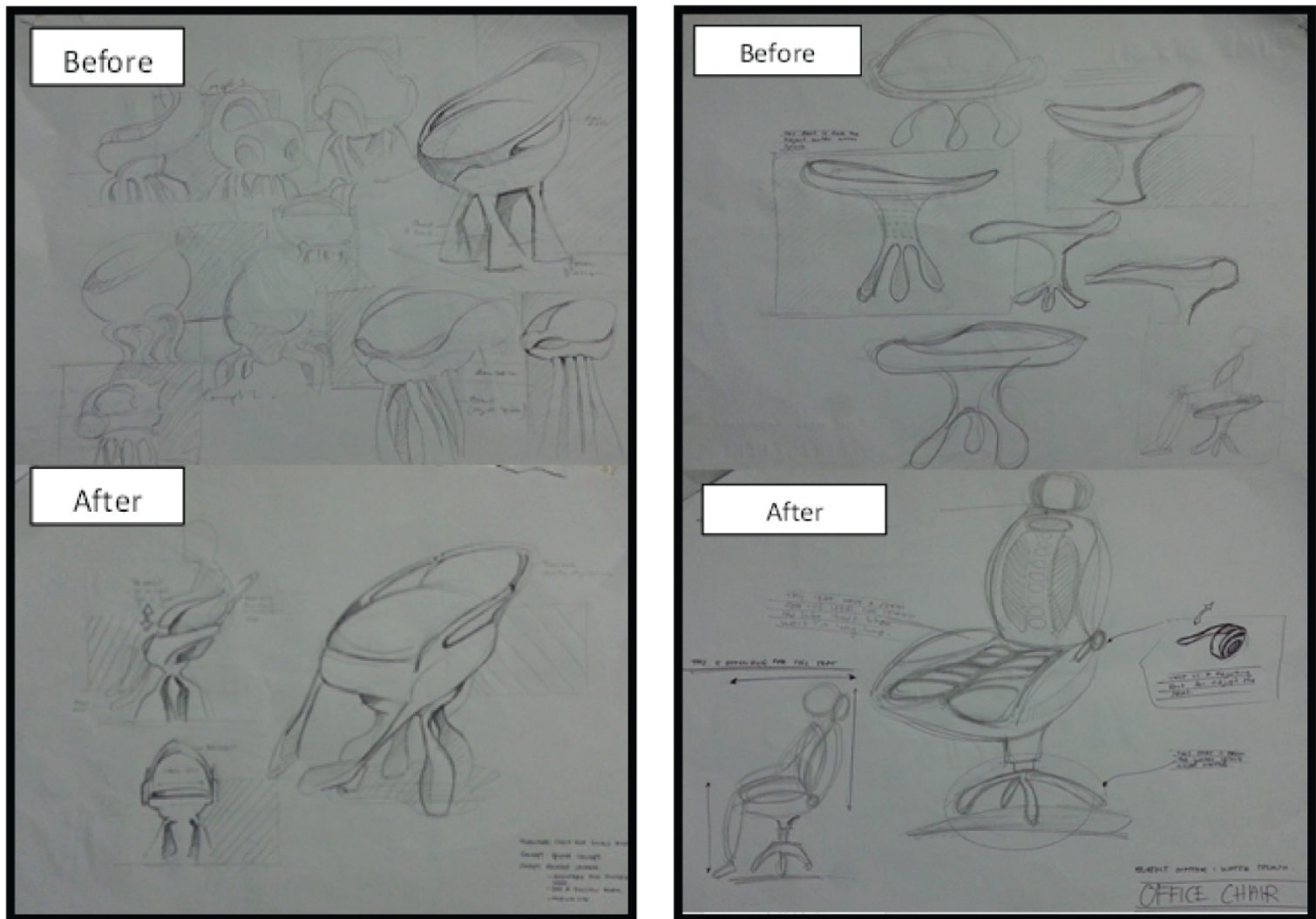## 5.3 Experimental Result

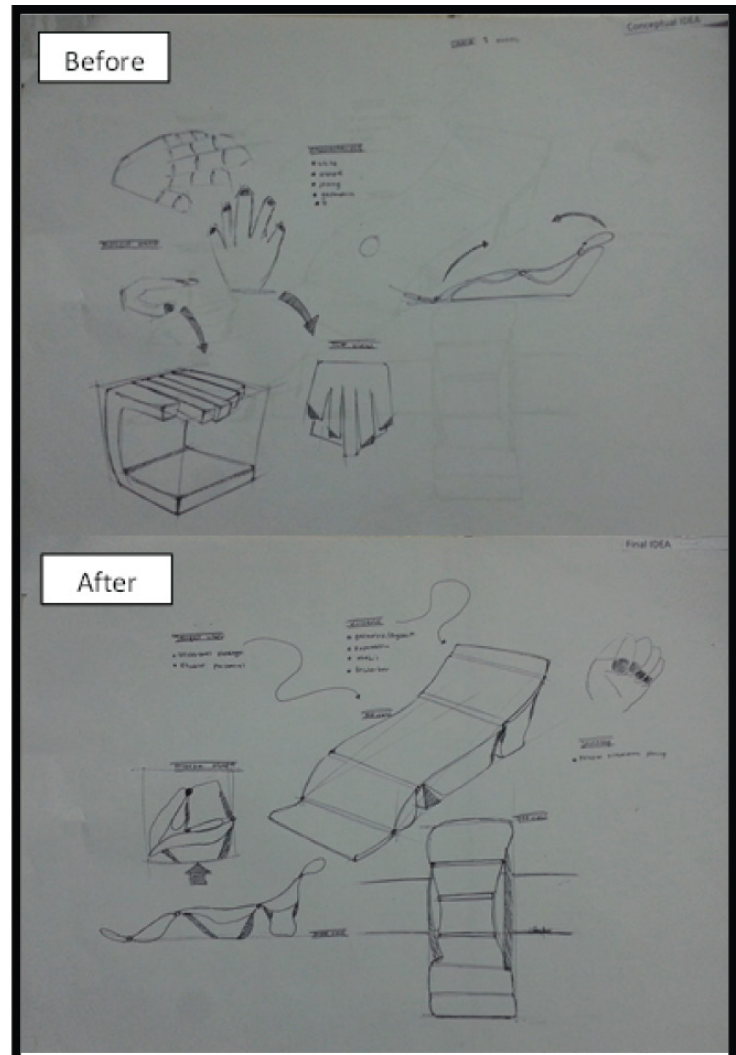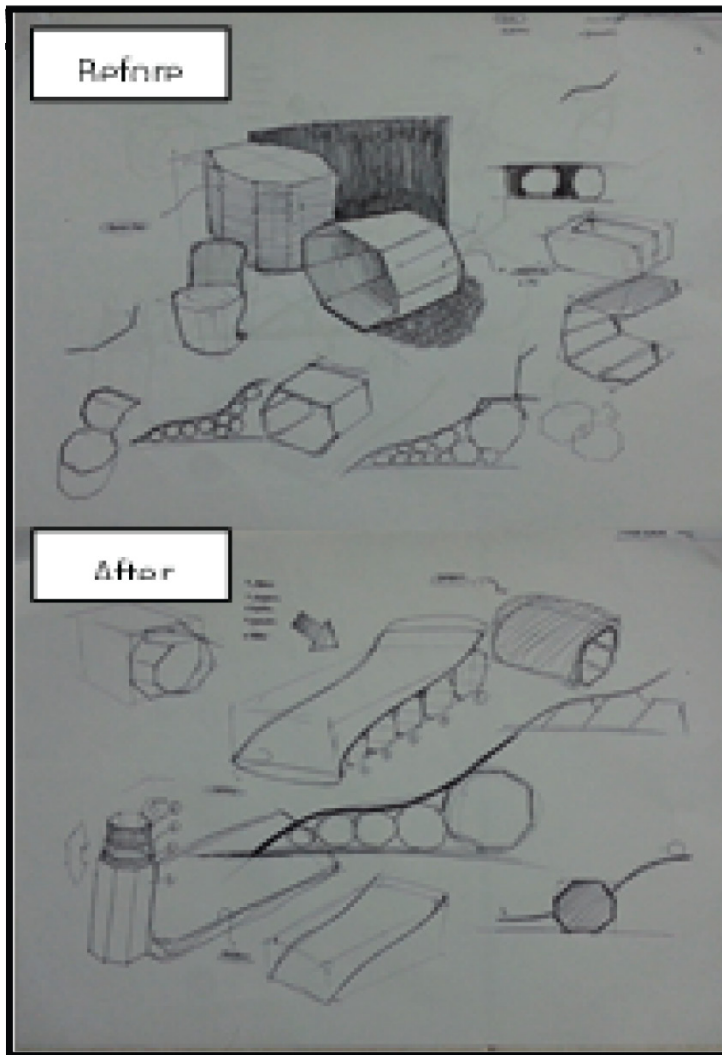*Figure 8: Result from group A*

Figure 9: Result from group B

We have used drawing as a medium test to evaluate comprehension of the designer in designing a piece of furniture. In this study, designers use their own creativity to inspire the design using subject matter. As we mentioned previously subject matter in this experiment was defined by us. Designers have been given time of 1 hour 15 minutes in the session sketch. The division of time in this form of activity; they have 30 minutes in the first session, and 15 minutes were allocated for bodystorming and brainstorming sessions. While for the second session, they have been given 30 minutes to complete the design.

Figure 8 in the group A shows the first designers that student (A) has been given a shape of water splash for the purpose to transform into a chair. In the first stage of the design process is still in an ambiguous form without considering the specific functions of a chair. Student (A) has used seven steps to get the initial idea, while students (B) was also given the assignment to produce a chair, student (B) using thumbnail sketches to develop the idea. Student (B) was given a subject matter of the category from animal, a type of spider. In the process of this experiment, students (A) and student (B) have been instructed to consult with each other to find the inspiration to produce a suitable design for a chair that is still in the stage of idea development. Apart from that, students (A) and student (B) were asked to produce a brainstorming idea based on their discussions. The next step was student (A) and student (B) were given a task to do bodystorming for the purpose of stimulating ideas and getting the final design. For the second session in their design activities, they were required to complete the designing process according to their plans, which is with features that have been for mulated through brainstorming and bodystoming. What we can ascertain in their plans, student (A) and student (B) have produced similar in their design to the use of a backrest and armrest.

Figure 9 is from Group B in this experiment. In the first session the students (A) have been given the assignment to the transformation of beehives to a chair. While a student (B) was given subject-matter, it was hand skeleton. In the process of brainstorming sessions and bodystorming students (A) and student (B) have agreed to design a seat that serves as a lounge chair, for which the criteria contained in them are upholstered design that can lay down on it without armrest. It can be concluded that the effective functioning of Empathy is right in teamwork, will able to expedite the design process compared with individual thinking.

6. DISCUSSION

Based on questionnaires and workshops implementation analysis, we can see that understanding plays an important role in the overall process for translating a subject-matter which was inspired by nature. Understanding also can help the process design concept of biomimicry in any form of development ideas more effectively. Apart from that, understanding is also among the ways to help the designer to define the design based on the principles contained in biomimicry, for example as a model of nature, nature as a measure and nature as a mentor. (Jenine 2002). However bodystorming is also one of instruments to accelerate the process design based on biomimicry approach. One of them is to translate imagination into motion using equipment around. Other than that, empathy also plays an important role in strengthening the experience in design activities, especially in the process of looking for ideas and doing sketches effectively. The emphasis on three aspects is the understanding compared than others. This important aspect is not only evident in the analysis of the questionnaire, but also intimately linked with the understanding of all the aspects in the framework.

7. CONCLUSION

Body storming is a role-playing to gain an emphatic sense of user by acting their part, bodystorming encourages active design ideation, concept generation and even testing of idea parallel. (Martin et. al 2012) However, each criterion in the research method for this research hopefully will be beneficial for next generation in developing ideas for any design task. As for the effectiveness of the method used, we are hoping that this will be a guideline to designers whom are interested in biomimicry concept in design tasks. Apart from that, appreciation, understanding and experience of using creative ideas play a really crucial role that will help generating more ideas.

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