Evaluating The Impact Of Novice Students' Sketches On Their Mental Imagery

F. Helmi, K. A. M. Khaidzir

Abstract: 'Reinterpretation' is one of the activities that occur in visualization, the role of reinterpretation is restructuring half form idea, and it can be performed with applying sketch as a useful tool, and creation, development, evaluation, communication and sharing of ideas can be facilitated by sketching. 'Reinterpretation' basically is the outcome of the lateral thinking process. Investigating of the reinterpretation of some designers indicate that externalizing a design may not be the solitary approach of designing visually and for expert architects sketching is not a crucial action in the early stages of conceptual designing. Moreover, experts could progress in design by thinking only. However, novice students have problem in reinterpreting patterns in their mental image whether tools such as sketch could help in the better performance of the reinterpretation process. This paper raises a fundamental question that if the sketch of novice students can support their mental imagery, in order to answer this question, this paper uses documentary method to investigate the previous studies in this field. Finally in accordance to the weakness of novice's sketches, this study concluded that their sketches could not support their mental imagery.

Index Terms: visualization, design transformation, mental imagery, sketch, and reinterpretation.

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1 INTRODUCTION
The visual mental images used by the designer during the design process named visualization that facilitates the generation, interpretation, and manipulation of information through spatial representation. Roozenburg (1995) stated that visualization assist designers in different aspect such as recognizing the design problem, arising design solutions for the problem and lastly evaluating the developed solution [1]. One of the activities that occur during the design visualization is reinterpretation that is, in fact, restructuring half-formed idea. The reinterpretation is seemed to be a worthwhile process that related to the quality of the ambiguity. Ambiguity can be defined as 'interpretable in two or more distinct ways' or as 'vague or imprecise' [2]. The sketch's perception assist in producing a mental image that in turn may generate further sketches that have the possibility of producing other mental images, this process is named reinterpretation. Reinterpretation is, in fact, a precious resource of new and unanticipated ideas that could be considered as the consequence of lateral thinking process [3]. Having variety of ideas in the initial stage of design assists designers with plentiful solutions to select from. Reinterpretation can be performed with applying sketch as a useful tool, and creation, development, evaluation, communication and sharing of ideas can be facilitated by sketching [4].This study divides visualization to internalization as mental imagery and externalization as sketch.

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2 LITERATURE REVIEW

2.1 Pattern reinterpretation in mental imagery of novice students
The Mast, F. W., & Kosslyn, S. M. (2002) investigate the reinterpretation of vague shapes in imagery. In their study, they had a measurement on personal key mental imagery abilities and for this purpose, 44 participants were examined. Out of those 44 participants, eight people discovered the alternative version while they remembered the figure; 16 participants after mentally rotating an image were able to report it; whereas 20 were not able to "see" the alternate version. According to their observation, they came to this conclusion that objects in the mental image may be ambiguous, and few people can reinterpret earlier unrecognized object [5]. Moreover, Chambers & Reisberg (1985, 1992) argue that people have problem in reinterpreting the shapes in mental images thus mental images are more like description than delineation ([6] and [7]). In this respect Bilda, Gero, & Purcell (2006) for their investigation assist from 3 experts whom were worked in 2 separate design processes of 'sketching and not to sketching'. The results and comparison of design activities were derived from protocol analysis and didn't show any considerable diversity between sketching and not sketching. Thus, they conclude externalizing a design may not be the solitary approach of designing visually and for expert architects sketching is not a crucial action in the primary stages of conceptual designing and experts could progress in design by thinking only [8]. According to above evidence since novice cannot reinterpret object in mental imagery, is sketch as a tool essential for them in the initial step of the design process?

2.2 Sketch features
Among the traditional tools in design process sketch plays an important role in the early stages of the design process because of their features and it is a basic representational activity used by the students throughout the design process. Garner (1990) stated that sketching largely influence on the creation, progression, evaluation and sharing of the ideas [4]. Sketches bring into being from concept design ideas throughout highly detailed representation of product artifacts or sub-assemblies [9], moreover Goel (1995) mentioned that freehand sketch smooth the progress of lateral transformation

and avoid early fixation [10]. Sketches have the capacity to support perception. Fish & Scrivener (1990) stated that visual design starts with some vague, half-formed ideas [11]. For simplifying the existing ideas and developing new ones, sketching can be helpful. Paper sketching determines ways that can help the artists to perceive or imagine lots of options. Sketch plays an important role in supporting the mind for translating descriptive propositional information into delineation. This part will focus on how sketching support student in designing and what features of the sketching help in progress in the early stages of design process, for instance, 'Speed' is the first feature of 'sketch' which initiates more alternative in early stages of design process. Tang, Lee and Gero (2011), state that the factors which cause designers to create and represent ideas simply and rapidly are the 'convenience' and 'speed' of applying sketches [12]. Besides, McKim (1972) proposed that according to quick performance, sketching has a 'freshness' that is not always obvious enough in refined form of design [13]. In addition, 'Ambiguity' is the second feature of the 'sketches'. Some researchers such as Fish and Scriver (1990), Goel (1995) and Goldschmidt (1991) came to this conclusion that the ambiguity is more evident in draft designs that are rendered in pencil or pen. The designers could work more quickly by 'Rough and untidy sketching' and suspend the judgment on accomplished and refined versions. 'Rough sketches,' on the other hand, could help in generating new ideas and also may represent visual reminder of the areas which need to be resolved ([11] and [10] and [14]). Finally, in conceptual design, sketch plays an important role. Purcell and Gero (1998) state that the free-hand sketches' role in the conceptual design process as well as their association to designers' cognition has been focused more on design perception research [15]. (Goel, 1995) stated that in the preliminary design since it is 'dense and ambiguous,' sketch could facilitate the lateral transformation [10]. This part of the study raises questions that if novice students are successful in the case of sketching; and if their sketches are powerful enough to support their mental imagery.

2.3 Challenge of novice students' sketches
Fish and Scrivener (1990) propose that although paper-and-pencil sketching is flexible, it has a limited capacity for generating and amplifying the mental imagery due to the short duration and small spatial capacity of working memory[11]. Moreover, Kavakli, M., & Gero, J. S. (2001) expressed the novice's sketch are less successful in supporting 'mental simulation' than the expert's[16]. Furthermore, Andjomshoaa,(2011) indicate the most of the students had basic mistakes in 'sketching', furthermore, Verstijnen et al. (1998) compared the expert and novice designers' performance [17] and determined that in order to simplify restructuring, just the expert designers could employ their proficient sketching skills. In addition, novice students could produce a few alternative of vertical and lateral transformation. Kavakli, M., & Gero, J. S. (2001) from investigation in the imbalance in cognitive activity between expert and novice designers came to this conclusion that the experts are more creative in comparison with the novice and they produced three and a half times more pages than the novice, the expert designers produced 7 alternatives whereas the novice students had 2. They conclude that perception of the 'alternative interpretation' and organization of 'spatial relations' might take a longer time for the 'novice' than 'expert designers'[16], moreover, Atman, Cardella, Turns and Adams

(2005) stated that more alternative solutions, higher quality solutions and more transitions among design stages were considered and produced by seniors in comparison with the freshmen[18].

2.4 Novice students' behavior in model of sketch activity
A thinking prototype that employs the design rules and the process of 'reflection-in-action' is called 'Design reasoning' [19]. He propose that designers first "see," and then "move," design objects [20]. 'Seeing'- 'moving' are the sequences of the design and seeing with the unintended consequences of moves cause the designer to use different aspect of their knowledge in their thought and be more successful in dealing with the complexity of ill-defined problems[20]. Moreover, the 'seeing–moving–seeing' model has been supported and broadly accepted by the plenty of studies on design thinking externalization in sketching and drawing. On the other hand, Goldschmidt (1991, 1994) believed that 'moves' and 'arguments' are divisions of the 'design process.' Sketching activities are correlated to moves in terms of whether the designer concern about a sketch and 'reading off' a sketch and if the sketching within a move is active enough or not. However, there are two types of argument within the moves, 'seeing as' and 'seeing that.' 'Seeing as' arguments are generated during sketching and 'seeing that' statements are produced during the sketching as well as during examining a sketch. 'Seeing as' is straightly associated with sketching since the designers are involved in 'seeing' figural possessions in the sketch. In another word 'seeing as' referred to reinterpretation of the figural possessions of the sketch, while 'seeing that' are those 'arguments' that related to non-figural statements on the design ([14] and [21]).
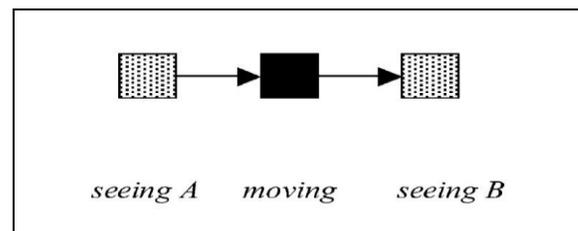

Figure 1. Schon's basic model of 'seeing-moving-seeing.'

Reviewing literature shows that most of the novice students cannot reinterpret object in mental imagery. Moreover, for supporting the mental simulation, the novice's sketches are not adequately powerful. In addition, they have problem in transform design between steps of the design process. Thus, the question arises is that problem of novice students related to which part of design transformation?
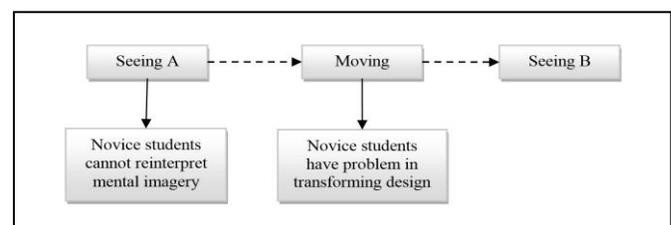

Fig. 2. Process of "seeing-moving" for novice students

2.5 Challenging in design transformation

The designer employs a set of quick sketches to transform images in a cyclical way: every sketch produces images in the brain, which drive the progress of the themes embodied in the design. Sequentially, this guides the designer to transform the previous image by 'additions', 'deletions', and 'modifications'. According to Goel (1995) lateral transformations and vertical transformations are two types of transformations identified in the drawing. In lateral transformation, there is a transform from one idea to an altered idea, whereas the vertical transformation relates to the development of one idea to a more detailed form. Lateral transformations mostly relate to unstructured sketches and take place in the preliminary design phase, whereas vertical transformations link with more detailed and defined drawings and arise during the refinement [10]. Therefore, the inefficiency of novice students' sketch in movement between design steps related to vertical transformation rather than lateral transformation. To sum up, a framework for realizing the core of design transformation should be established to discover the causes of problems that occurred in this process.

3 CONCLUSION

In summary, novice students have problem in reinterpreting object in mental imagery, furthermore, their sketches are not professional to support mental imagery; moreover, they cannot transform design between design steps easily. In order to cover this gap, it necessary to establish a framework for understanding nature of design transformation by observation of their sketching behavior. Consequently, establishing this framework and methods will be created base on it, are crucial issues for students to achieve a more effective design transformation and for the lecturer to conduct their students and it is beneficial to design education and training.

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