CAPTURING CREATIVE BEHAVIOURS IN COMPUTER AIDED DESIGNING USING DESIGN DIARIES

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Designing often involves uncertain period of times before arriving at its attainment. In the context of research, an appropriate longitudinal data collection method is vital in facilitating data gathering activities such as a design diary. This article reports a study which aimed to identify and capture creative behaviours based on a Creative Behaviours Framework whilst designing using Computer Aided Design (CAD). A design diary was used to facilitate participants in recording creative behaviours occurrences when they were using CAD for designing. This method enabled the researcher to obtain information from participants’ CAD design activities throughout the design project phase. This study involved three participants who were postgraduate students of Industrial Design and Technology, Loughborough University. The participants were invited and recruited based on two factors: they had a CAD background and had the intention of using CAD in their final year undergraduate design project. Combination of a structured and open format diary were used as the data collection and in this study known as the design diary. The data were analysed by identifying the frequency of each creative behaviour was reported by the participant. From the analysis it was found that 125 creative behaviours descriptors were recorded. The findings also suggested that CAD potentially encouraged creative behaviours amongst its users.

**Keywords:** Computer Aided Design (CAD); Creative Behaviours; Design diaries; longitudinal data, Creative Behaviours Framework

**Introduction**

Computer-aided Design (CAD) has been going through a rapid technological changes in terms of its capabilities and use in designing since the beginning of it creation. Its widespread use by designers has led to a range of perceptions on the significant impact that it could bring for individual design ability, efficiency, and the quality of the design output itself. Researchers have made continuous efforts to explore the potential for CAD to make a greater contribution to the performance of designers (Bhavnani et al, 1993).

For some, CAD is a useful drafting tool which could help designers to effectively communicate and present their design intent accurately, but it is less likely to facilitate designing in particular in the initial stage (Cao and Protzen, 1999). This was supported by Charlesworth who suggested that ‘CAD should only be used after development, in order to refine and troubleshoot a final proposal. Its value as a development tool is extremely limited.’ (2007: 43).

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However, Hodgson and Fraser (2005) emphasized that there is a need to better understand the contribution that CAD could potentially provide in the designing. Nonetheless, they also noted that ‘the impact of Computer Aided ‘design’ and the role it can play in the activity of ‘designing’ is an area of potential not very well established or often recognised (Hodgson and Fraser, 2005).

**Design and Creativity**

Designing has been recognised as the translation of human creative thinking through planned action in achieving preferred needs or desires. Accordingly Dakers (2004: 1) stated that ‘one common feature inherent within the concept of creativity is that something manifest is brought into being’. While, Lawson described design as ‘one of the most creative of human pursuits’ (1997:148). He elaborated that the central designerly act is ‘to create something which other people will experience and which is in some way or other original and new’ (ibid: 148). Consequently, designing and creativity are closely related research agendas and many researchers have tried to explore links from various perspectives. Some researchers study the state of designers’ minds when engaged with creative thinking, and particularly through cognitive psychology approaches (e.g. Nagai and Taura, 2006; Goel and Pirolli, 1992). They have attempted to uncover possible links between designing and creativity through exploring designers’ cognitive thinking when engaged with such activities.

It is the interest of this study to capture creative behaviours whilst designer engaged in CAD designing. A framework known as the Creative Behaviours Framework (CBF) (e.g. Aede Hatib et.al, 2014; Danos et.al, 2013, Aede Hatib et.al, 2012; Aede Hatib et.al, 2009a) has been used to facilitate the attempt to capture such behaviours whilst CAD activities take place. The Creative Behaviours Framework is consists of 7 categories which each category being assigned with 3 descriptors (Aede Hatib et.al, 2009b).

**Figure 1:** Creative Behaviours Framework
Diary as Data Capturing Instrument

Designing often takes an uncertain period of time before a designer could arrive at its attainment. Hence, it appears to be appropriate for a longitudinal data collection method such as a design diary to be undertaken. Frequent diary entries were vital to avoid difficulties in recalling past experiences which could be important to the study. Smith-Sullivan notes that ‘diaries track participants’ daily activities and objective experiences’ (2008: 213). In this context, diaries would help the researcher to keep track, and gather as much information as possible from every CAD session participants anticipated throughout their design projects.

The design diaries also allowed the researcher to have hindsight about the designers’ experiences each time they used CAD in designing. This is supported by McKernan (1996: 86) who suggested that keeping a diary ‘forces one to reflect, describe and evaluate daily encounters’. Besides that, it can avoid or reduce the researcher from getting misleading information if solely relying on data from limited and ‘simple snap shots of behaviour’ (Wiseman et al, 2005: 395).

In terms of its format, diaries could be of open-format or structured. Corti (1993) notes that open-format diaries provide flexibility to the participants ‘to record activities and events in their own words’. However, for structured diaries participants’ responses are restricted only to pre-categorised items. In this context, Crosbie (2006) however raised concern regarding the level of details and accuracy with the responses given by participants. Based on her experience, she identified some problems when using self-administered diaries such as:

a) diaries were partially completed,

b) less attention to details,

According to Wiseman et al (2005: 395) these problems might be the result of ‘fatigue’ symptoms where participants become less motivated to give detail, and complete responses. In dealing with such problems, post-interviews were conducted to clarify ambiguous or incomplete entries. This was also suggested by Crosbie (2006: 9) who stated that ‘the most profitable way of employing self-administered activity diaries is some form of diary/interview method where the diary keeping period is followed by an interview asking detailed questions about the diary entries’.

Methodology

The research design for this study is qualitative through a case study. In this case study, three final year undergraduate students from the Industrial Design and Technology Degree Programme, Loughborough University gave their consent to be the research participants. They were assigned alphanumeric pseudonyms (e.g. P01 for Participant 01). However, only two participants remained involved until the completion of their design projects. These two undergraduate participants were
undertaking projects related to a self-administered vaccination pack for people in remote areas and a new concept for a musical instrument.

Participants in this study were provided with a combination of structured and open-format diaries as shown in Figure 2. It is a self-administered diary where the participants were required to fill in the diary entry by the end of every CAD session. Participants were given a briefing on how to administer the diary, and supplied with a sheet of guidelines on how to complete the diary entry. The design diary sheets were given to the participants before they commenced the design project. The completed design diaries were then analysed, and any vague responses were followed up by a post-interview session.

Figure 2: Design diary format
Results and Discussion

Each participant was given a set of design diary sheets to be completed until the end of their projects. The completed design diaries were submitted to the researcher for analysis. Post-interviews were undertaken to confirm and validate data established from design diaries analysis. The data were based on 12 CAD sessions by MP01, and 23 sessions by MP03. From the analysis, Figure 3, indicated that ‘basic form’ was the most frequent reason for CAD were used by participants with 37% throughout the design projects. It can also be seen that participants used CAD in developing their product’s design with 29% involved design ‘detailing’, and even in the ideas generating phase with 16% in ‘ideation’.

![Figure 3: Percentage of design related CAD activity engaged in by participants when data clustered](image)

The creative behaviour occurrences recorded by participants, P01 and P03 were also analysed and the findings were tabulated as shown in Table 1. In 12 CAD sessions P01 has identified 50 creative behaviour occurrences. Novelty behaviour was recorded in one of the sessions. While P03 has undertaken 23 CAD sessions, nearly double compared to P01. From all those sessions, 75 emergences of creative behaviours were reported with 10 of them under novelty category.

The design diaries of P01 indicated that ‘appropriateness’ was the most significant from all seven creative behaviours categories. Findings shows that the most frequent creative behaviours identified were ‘appropriateness’ (13), followed by ‘sensitivity’ (10). The lowest of all was novelty with only one occurrence. However, this provides further evidence of a link between the novelty category of behaviour and CAD usage in designing. In describing this novelty occurrence, P01’s related diary entry stated:
TABLE 1: THE FREQUENCY OF CREATIVE BEHAVIOURS OCCURRENCES
BY P01 AND P02

<table>
<thead>
<tr>
<th>Creative Behaviours</th>
<th>Frequency (P01)</th>
<th>Frequency (P03)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novelty</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Appropriateness</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Motivation</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Fluency</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Flexibility</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Insightfulness</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>75</strong></td>
</tr>
</tbody>
</table>

‘New ideas were generated for mechanism for mechanics and reduction of parts-dual use parts’ (P01- Diary entry)

This was later emphasized by the participant in the post-interview which affirmed

‘it change...what...my original idea was because CAD highlighted that you could do it easier...it was an improvement of the design...that was unexpected [novelty descriptor] because I thought I had...mechanism design and then found it...that an easy way to do it.’

(P01, post-interview)

Table 1 also indicated that CAD promotes participant P03’s motivation in undertaking his design work. It displays the highest emergence of creative behaviours. The data also suggested the possible link between CAD usage and participants’ consideration of ‘appropriateness’. Interestingly, P03 reported a high percentage of novelty occurrences with 10 occurrences which was far higher than identified by P01. This is something interesting to be further investigated on what aspects contributed to this higher occurrences.

Subsequently, data from both participants were clustered and presented in Figure 4. It shows that the highest percentage category was ‘appropriateness’ with

![Figure 4: The percentage of creative behaviours occurrences by P01 and P03](image-url)
20% and the lowest was ‘novelty’ with 9% of overall occurrences. This findings implied that CAD encourage its user to not only generate good ideas, but keep on ensuring that the ideas produced would be useful, fit with the purpose, potentially functional. An expert designer might be only by looking to a design would be able to judge whether a design is good, practical or bad and impractical. However, for a novice designer they need appropriate knowledge and experiences to have such ability. But, with the features CAD has (e.g. simulation, finite elements) a novice designer might have the ability similar to what an expert designer have.

**Conclusion**

This paper outlines an attempt to provide evidence that CAD would potentially have links with creativity specifically through creative behaviours by using design diary. It has been indicated that the design diary is evidently appropriate in facilitating longitudinal data collection activity. Findings show that 125 creative behaviours had been identified and captured which link to CAD designing activities. Such findings should motivate other researchers to further explore what CAD potentially could do in encouraging and facilitating creativity in designing. This study also suggested that the Creative Behaviours Framework have further been proven to be capable of facilitating the effort to capture the emergences of creative behaviours.

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