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Does evidence based design for healthcare built environments limit creativity?

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ABSTRACT

Research into therapeutic built environments and Evidence Based Design (EBD) has increased during the past three decades and the concept more readily adopted in practice. However, some practitioners believe that, as with any approach that builds on previous experiences to develop standards and guidelines, EBD could limit creativity. Given that creativity is often regarded as a major source of competitive advantage for a design, if EBD is seen as a barrier to creativity this may hinder its acceptance and application.

The extent to which EBD could limit creativity during the design process is explored through a literature review. The findings suggest that only a smaller segment of evidence-based information, which relates to concept development, would affect creativity. Such information could foster information-driven design strategy and result in a lower level of creativity. However, properly implemented EBD strategies should not limit creativity since expert designers in EBD would use their knowledge (of therapeutic evidence) and expertise in the design process and need not follow and information driven strategy.

KEYWORDS

Evidence Based Design, Creativity, Design strategies

1 INTRODUCTION

Research into therapeutic built environments and Evidence Based Design (EBD) has increased especially during the past three decades. EBD is the process of basing design decisions on credible research to achieve the best possible outcomes (Ulrich et al., 2008). Thus, it provides a gateway between research findings and actual design practice. Fashioned by the concept of Evidence Based Medicine, EBD initially emerged to support healthcare environment designs and were later adapted in other areas of design. Even though the concept emerged nearly three decades ago, over the last five the topic has attracted increased attention in environmental design conferences, papers and books (Moore and Geboy, 2010).

A substantial amount of research evidence regarding how properly designed built infrastructure can improve health outcomes is available. These range across areas such as how to achieve enhanced patient safety, better patient outcomes, increased staff performance and staff and patient satisfaction through an improved built environment (Ulrich et al., 2008; Codinhoto et al., 2009). Broader benefits of EBD ensuing for the design practice and industry at large help to address issues of an aging population and workforce, labour shortage (Webster and Steinke, 2009); resource conservation; whole life cost savings; decreases in staff turnover (Berry et al., 2004); acting as a competitive advantage for design organisations (Stankos and Schwarz, 2007; McCullough, 2009) and bringing innovation into the design practice (Lawson, 2005; Suttell, 2007) have also been recognised.

Despite the benefits and substantial amount of research, the application of EBD is still in question. Belief and acceptance by users and potential users acts as a major influence for the acceptance or rejection of any new concept (Rogers, 2003). There are number of negatively influencing persuasions regarding EBD. Those includes, lack of credibility and completeness of evidence (Moore and Geboy, 2010; Stankos and Schwarz, 2007); inappropriate forms and formats of evidence (Hamilton, 2003; Martin and Guerin, 2006); some characteristics related to designers and design organisations which limit EBD practice (Grol and Grimshaw, 2003;

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Martin and Guerin, 2007; Nelson et al., 2005); designer's reluctance to change practice (Cama, 2009; Grol and Grimshaw, 2003); lack of knowledge about EBD (Chong et al., 2010; Hamilton, 2003); unique nature of buildings as the product (Stankos and Schwarz, 2007); clients and other stakeholders lack of awareness of the benefits of EBD (Cama, 2009); obsolete or ineffective laws and regulations regarding hospital design; high capital costs of evidence-based design and renovation projects (Nelson et al., 2005) and designer's belief that EBD would limit creativity in a form of increased standardisation (Chong et al., 2010; Cama, 2009; Hamilton, 2003). Most of the above are barriers related to evidence and resource allocation for EBD within design organisations and lack of stakeholder knowledge related issues which can be removed through simple measures. But the issue of creativity is something that is enmeshed within designers' minds and needs strong clarification of such issues to improve the belief in EBD. Thus, this paper discusses the issue of creativity in relation to evidence-based design which appears to be a significant barrier for designers in accepting and adhering to EBD.

The paper is based on the literature of previous research into EBD and design creativity. First, the paper outlines the background to identifying the existence of such an issue and explanations by contemporary researchers into the issue. The paper then describes creativity in the design process and what does and does not constitute creativity. Creativity has been investigated within architectural design literature. However, theoretical explanations combining creativity and EBD are not available. Thus, the current practice of EBD is described in order to place EBD within the design process literature to establish the relationship between creativity and EBD. Finally the paper presents the author's conclusions by connecting together the above two or three major areas of literature.

2 BACKGROUND OF THE ISSUE

Designers play an important role in developing creative product designs, which is the key for a company to survive in the highly competitive market with ever-increasing demands from customers (Yao, 2008). EBD, even though marks a significant transformation in the design of healthcare facilities, there is a belief and a fear that through standardisation EBD will limit creativity (Hamilton, 2003; Chong et al., 2010; Keenan and Fedorowicz, 2003).

Hamilton (2003) states this as an overlook of the challenge of continuously inventing responses to emerging results and new facts, requiring imaginative and ever-changing interpretations of the design implications. Author further state about the designers' labelling of EBD as "cookbook architecture", who think evidence-based design could lead to rules and limits and "Cookbook" architecture suggests dull, repetitious buildings stamped from a mould.

Chong et al. (2010) for an example, describes the perception of designers in relation to several issues of EBD. Six major concerns are identified which are referred to as myths about EBD. Surprisingly, half of them are related to the issue of creativity, and are stated below in the author's own words;

- EBD is too scientific. Creativity is not all about facts. The process of creating is subjective and inductive. It starts with a spark of inspiration. Science is deductive and all rational.
- EBD is reminiscent of a legal process. There are rules about how to consider evidence and decisions must follow the rules. It's about right and wrong. Personal judgment is diminished.
- EBD is prescriptive. It limits options and stifles innovation.

Subsequently the authors suggested that the important question that needed to be researched is: 'to what extent are these concerns based in truth?' The issue of creativity in relation to EBD was also raised at the third Steering Group Meeting of the research project: Nurturing an Evidence-Based Learning Environment (EBLE) which supports the innovative design of healthcare facilities where it was stated it was the mind-set of designers and clients to using EBD that may limit creativity. Researchers of EBD have rejected the issue of this view but have limited empirical evidence that clarifies this. For example, Hamilton (2003) states that "research-informed design is like the continuous search for truth in the world of science. Not static, it doesn't easily conform to fixed regulations that will be made obsolete by new findings". Chong et al. (2010) while emphasising the benefits of EBD, put forward the question of "Will the performance outcomes be enhanced by the design or is it merely a beautiful expense?" Thus, despite such simple clarifications, existence of such fear would act as barrier to implementing

standardized solutions within healthcare buildings. Thus the aim of this paper is to provide an answer through a descriptive analysis of the issue.

3 CREATIVITY IN THE DESIGN PROCESS

3.1 What is creativity?

Creativity is the human ability that surpasses the daily and routine processes of thinking and doing, and is able to produce outstanding and innovative outcomes (Coyne, 1997). The commonly recognized "aha!" response is universally considered as a reference to the moment when a creative flash arrives (Akin and Akin, 1996). Creativity is a result of a cognitive process taking place in designers' minds at the early design stages (Dorst and Cross, 2001). It is a suddenly conceived idea (Akin, 1990) within designer. However, knowledge of this cognitive process contains black boxes. These are not described in detail in this paper. Instead, factors affecting creativity and what facilitates creativity will be explored to primarily identify whether EBD impacts on creativity of the design solution.

3.2 Factors influencing creativity

Akin (1990) in his descriptive work, identified that there should be a "preparedness to fruit" the suddenly conceived 'creativity'. While talking to two of his interviewees who were questioned on the creativity, the author mentions that,

"Tchalkovsky speaks of the 'soil' being ready or the 'disposition of the work' being there."

"Mozart speaks of retaining the memories of the pleasures that come and of mentally nurturing them into a 'good dish'."

Reviewing the above interviewee's discussions the author emphasises the need for preparedness for creativity to emerge. The author at this stage argues that such preparedness is 'a matter of expertness'. Notwithstanding the expertness, several later researchers have identified that creativity is not caused by one source but is related to number of components.

Creativity skills: Designers' skills of creative thinking have been identified as a factor influencing creativity (Lawson, 2004; Cross, 2004). It is identified that some people have inborn creativity skills while some do not. Creative people are said to be higher in intelligence than non-creative people and they tend to be more individualistic, flexible, independent in judgements and willing to take risks (Candy and Edmonds 1996). These characteristics are personally inherent and reflected in designers' practice. For example some designers take more time on identifying and understanding the design problem and later come up with a creative solution while some rely on the information available and try to come up with a solution to suit the information and by sub dividing the problem (Dorst and Cross, 2001; Kruger and Cross, 2006).

Expertise: Designers' expertise in a particular field impact on the level of creativity of their design solutions (Demirkan and Hasirci, 2009; Cross, 2004). Researchers have identified that the creativity of expert designers is higher than that of novice designers since novice designers at the start of their professional life always look for information to drive solutions.

Design process and nature of output: Design process and nature of output has been identified as affecting creativity (Candy and Edmonds, 1996; Dorst and Cross, 2001). Some designs are standardised in nature which limits designers' ability to come up with creative solutions. Especially in risk adverse sectors such as healthcare, designs tend to be more standardised and based on reliable solutions rather than allowing higher levels of creativity.

External environment: the external environment where designers work also impacts on the level of creativity of employees. Researchers have identified that (Amabile et al., 1996; Amabile, 1998) organisational motivation to be innovative, resources allocation, management practices, support and creativity of other subordinates and other environmental aspects influence creativity. Specifically, built environmental designers work as a team to develop their designs and therefore their working environment affects the creativity of the design solution. Researchers have also

discussed how to manage creativity within team and collectively combine and preserve individual's creative solutions to integrate into a whole design.

3.3 Speciality about creativity in healthcare

Literature identifies that innovation in healthcare is different from other sectors because, ultimately, it affects patients. Innovations in patient care, treatment practices and hospital procedures may include significant health risks (Lansisalmi et al., 2006). Therefore, knowledge dissemination and innovation in healthcare is slow (Berwick, 2003; Suttell, 2007), complicated and often regulated by law (Lansisalmi et al., 2006). On the other hand, failing to use available scientific advances can be costly and harmful; it leads to overuse of unhelpful care, underuse of effective care, and errors in execution (Berwick, 2003) and failure to fill performance gaps may lead to death, disability, or permanent discomfort (Lansisalmi et al., 2006). However, these are stated on medical practice literature and even though it seems applicable, not tested for in built environment innovation and creativity.

As such, a number of factors affect creativity of a design. These will not be discussed in detail in this paper. After describing what EBD and evidence is, how EBD impacts on creativity will be discussed next in this paper.

4 EVIDENCE BASED DESIGN

As stated earlier in this paper, EBD is the process of basing decisions about the built environment on credible research to achieve the best possible outcomes (Ulrich et al., 2008). There are debates as to what constitutes credible research. In its early stages, the term 'evidence' has not been clearly identified within the definition of EBD. Thus, evidence has often been represented (Hamilton, 2003; Geboy, 2007) by evaluations of projects, well established best practices, reliable observations, etc. Recent definitions of EBD are more specific and have constrained evidence into credible research. Hamilton (2009) presents a more specific (than his earlier definition) definition for EBD, and he refers to evidence as "best evidence from research and practice". However, his definition is not comprehensive enough. Doing a sound philosophical review of all related aspects Moore and Geboy (2010) have defined evidence based design as, "environmental design that is informed by the totality of available evidence gleaned through the most up-to-date, credible research conducted according to the highest standards of rigour appropriate for that given research approach, which is then applied in a critical and appropriate manner in order to achieve collective intentions". This definition is more comprehensive than earlier definitions and it has specified the process of applying evidence as well, therefore this definition will be adopted as the definition for the EBD for this research. The current collection of therapeutic building evidence exceeds 1200 pieces of published research works (Sadler et al., 2011). Simply, EBD prefers to rely on this collection of evidence in designing to ensure a healing built environment. Therefore, evidence base plays a major role in EBD. The next section of this paper, therefore, looks in detail at the evidence and its formats.

4.1 Written and Published Evidence

A substantial amount of evidence is published in peer-reviewed journals, magazines and other reports as discrete pieces of evidences. These are published by individual researchers based on their research into healing-oriented building features. Similar to most of the publications they use research jargon and entail descriptive writings about findings and conclusions. Journals or magazines dedicated to therapeutic building research are rare and therapeutic building evidence is scattered among other types of building evidence. Researchers have established how a particular building feature affects psychological, physiological and physical outcomes of facility users (Codinhoto et al., 2009) and thereby identified therapeutic building design strategies (Ulrich et al., 2008). Ulrich et al. (2008) have identified a common set of design features of therapeutic buildings while synthesising therapeutic building evidence scattered in different places. Those general design considerations include, providing single and acuity adaptable bedrooms, providing appropriate lighting levels, noise reducing finishes, view and access to nature, space for family members, efficient nursing unit layouts and decentralised supplies. However, these evidences are not always generalisable and in many cases are applicable to a building and/or disease typology. For example, researchers have explored how paediatric units and cardiology units can be designed

as healing environments. Therefore, designers sometimes need to search for particular evidence applicable to the different units they are designing.

As stated earlier evidence collection exceeds 1200 discrete pieces of evidence. The table below illustrate three exemplar evidences to emphasise nature, form and format of evidence.

Table 1: Exemplar evidences that can be used in EBD

bibliographic information	Title	Environmental variable	Findings
Butler and Biner 1989	Effects of setting on window preferences and factors associated with those preferences on environment and behaviour	<i>view window</i>	The study was designed to investigate window preferences across a large variety of common spaces and to examine reasons or factors that may underlie these preferences with the ultimate goal of predicting them. The study confirmed that window preferences vary across settings.
Barker et al 1993	The effect of environmental sound and communication on CCU patients' heart rate and blood pressure	<i>sound</i>	The effects of high ambient stressors (equipment sounds) and social stressors (conversation) on heart rate (HR) and blood pressure (BP) were examined in coronary care patients. Research revealed maximum HR to be significantly higher during conversation than during low ambient sounds (quiet). BP did not significantly change during any of the sound conditions.
Shuttleworth, 1997	Use of action research to explore the experience of being a parent living in a regional paediatric oncology unit	<i>patient experience in paediatric unit</i>	20 very premature babies born at 24-29 weeks gestation have been studied while they were maintained in intensive care with continuous intravenous feeding and constant ambient lighting and temperature. The development of rhythms within the ultradian circadian and infradian domains was sought as a whole did not show an increasing rhythmicity with chronological age.

The table shows that discrete pieces of evidence provide some form of information in its original version. Therapeutic building evidence covers knowledge on a variety of design aspects including lighting, noise, aesthetics, ergonomics, design layout, and building services. Many other aspects occur across different phases of the design, but the majority are useful at design development and technical design stages.

The format in which information and knowledge is represented is important in acceptance and application of such knowledge. As stated earlier, evidence is often published in journals and magazines as discrete pieces of information. Journals or magazines dedicated to therapeutic building evidence are rare. With thousands of journals and magazines relating to the built environment, keeping in touch with information published in each of them is impossible. In a recent survey it was found that evidence published in journals and magazines is not a first choice of designers when gathering design information (The Center for Health Design, 2010). As a result, researchers have compiled discrete evidence into evidence databases. International databases exist such as the US, 'InformeDesign' web based evidence database; 'Ripple' evidence database and in the UK 'Sheffield University's Environmental Evidence Database' provide reasonable efforts to overcome barriers related to evidence. These evidence databases collect discrete evidence scattered in different publications and compile them into a data base so that prospective users can retrieve them through a keyword search. In addition to compiling the databases, both of these database development teams have analysed individual evidences for their credibility and for other criterion. Therefore, they can be easily understood by users with limited knowledge of research jargon. 'IDEAS' image database is a collection of images of good building features built in accordance with therapeutic building evidences. The next section describes how therapeutic building evidence is presented to the designer by means other than their original publication within journals and magazines.

4.2 Web enabled databases

Web enabled databases have been identified as a potential strategy to transfer evidence. InformeDesign in the US and forthcoming Sheffield University's Evidence Base are major databases developed to aid EBD. A detailed explanation of the databases and their feature are given below.

4.2.1 InformeDesign

InformeDesign is a searchable database of research summaries (RS) that are generated from refereed journal articles. These user-friendly RSs transform the article's research findings into evidence-based design criteria. The tool is developed and facilitated by University of Minnesota and funded by the American Society of Interior Designers. The database is not healthcare specific (it includes 109 research summaries in relation to healthcare designs and is added to weekly), and contains research evidence in relation to other building types such as residential and sports and fitness. Users can search evidence easily and cost free for a particular design criteria that subsequently can be adopted in their design process. Additional details of evidence such as, research methods, research limitations and commentary by the database developer helps users to evaluate evidence in terms of its credibility and applicability.

4.2.2 Sheffield university's evidence database

Sheffield University in the UK is currently developing an evidence base by synthesising all the relevant literature in relation to how physical environments can have a positive effect on the therapeutic experience. At the moment the database consist of about 700 summarised and analysed research works. In addition to synthesising, the analysis also includes ranking of evidence in terms of its relevance and identifying credibility of research and significance of findings. The final format of the evidence base has not yet been finalised but will be published on the Internet. This new evidence database will provides a very positive approach to EBD and thereby improves the quality of patient experiences and outcomes while saving time and costs.

4.2.3 Ripple database

The Ripple database has, initially, been developed as an open source searchable web-based database by the Center for Health Design to support the initiative of Kaiser Permanente (one of America's leading health care organizations). The initial objectives of the database were to share Kaiser Permanente's best practice design strategies and to link research to support such strategies. Later it was enhanced by adding more information from the CHD's pebble partners and other healthcare organisations. The current database consists of information on design, operational, cultural and technology strategies and industrial standards to achieve patient safety, worker safety, environmental safety, cost effectiveness, staff effectiveness and quality of care. Users can search for strategies and related research evidence around the above-mentioned topics. However, this database is developed to share Kaiser Permanente's best practices and it does not attempt to collect all therapeutic building evidences and evaluate them so that subsequent users can easily apply them, whereas the two databases discussed above attempt to collect all up-to-date evidence and evaluate them on behalf of subsequent users.

4.2.4 IDEAs (Inspiring Design Excellence & Achievements)

IDEAs is an image database hosted by the Department of Health in the UK to support healthcare design. Working with the latest evidence, IDEAs provides design ideas (pictograms, photographs and accompanying text) for the design of healthcare buildings. They are categorised into exemplar activities that people undertake in healthcare situations such as arriving and entering, receiving, waiting, circulating, consulting/examining, beds, and so on. Alongside the pictorial images the database provides textual explanations citing therapeutic building evidence (see <http://ideas.dh.gov.uk>).

4.2.5 Standards, guidance and tools

Development and dissemination of clinical guidelines to improve quality of care is a frequent international activity (Grol and Grimshaw, 2003). The Department of Health together with academia and other advisory bodies has published a vast array of standards, guidance and tools to support healthcare building design in the UK. Those are in the form of standards, guidance, assessment tools, strategy tools, bench marking tools, frameworks, databases, etc. To a certain extent they contain therapeutic evidence, however they do not represent the full array of therapeutic research evidence. Further there is some criticism by scholars in relation to the content and effectiveness of guidance.

4.2.6 Activity Data Base (ADB)

ADB is a data and software package aimed at helping users to create a brief and design for healthcare buildings in the UK. The data can be used to produce exemplar room layouts based on the activities taking place in each room or space. It has been developed based on the contents of health building notes for guidance and is not backed by a comprehensive set of credible research evidence and needs improvements to support the full array of therapeutic research evidence. Use of ABD and other standards, guidance and tools are not fully equivalent to EBD, since they are not supported by the totality of evidences.

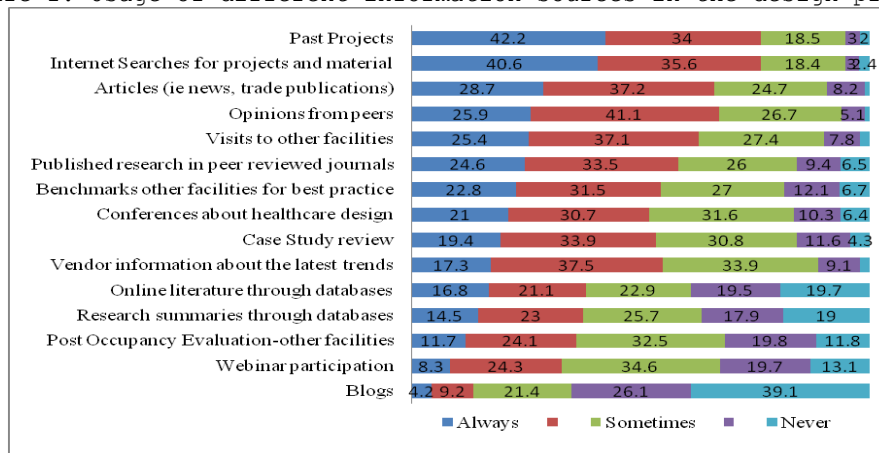
In conclusion, therapeutic building evidence contains information which is useful throughout the design phase (concept, design development and technical design) with evidences ranging across a wide range of disease typology and building design. Evidence is not always generic and can be peculiar to a building or patient typology. However, at ground level it can be observed that therapeutic building strategies such as single patient rooms, which are strategic level decisions, are gaining popularity in the UK. The majority of therapeutic building evidence is useful at the detail design stage and some evidence (such as the effect of nursing station location on patient outcomes) is useful at the concept development stage where designers make decisions as to what information to use. Having explained EBD and the evidence available, the next section of this paper looks at how EBD differs from contemporary design practice.

5 EBD, DESIGN PROCESS AND CREATIVITY

5.1 Contemporary design process and EBD

Building design is a complex and difficult process. According to RIBA (Royal Institute of British Architects) the outline plan of the construction development process, the design phase includes every aspect from the concept, through design development and technical (detail) design of a building. The design process entails a number of aspects that have interested researchers. But, simply, EBD is about basing design decisions on credible research evidence. Thus, this paper only looks at design information on which designers base their decisions. The Center for Health Design (2010), in a recent survey has explored design information strategies of healthcare designers (see Figure 1 below).

Figure 1: Usage of different information sources in the design process



Looking at the results of their research, it is evident that designers seek information from a wide variety of sources. The most utilised source of information has been identified as past project details and internet searches. Therefore, capturing concepts and ideas has been the priority and not the specific design features. EBD is different from contemporary design practice only in the sense that it makes use of available credible therapeutic building evidence and incorporates these into the design. Therefore, EBD can be recognized as a specific design strategy among several other design strategies used within design practice. The next section of this paper elaborates on the theoretical place of EBD in relation to design strategies.

5.1.2 Position of EBD in design process literature

For a long time design strategies have been categorised as either problem based designs or solution-based designs. Exploring design activities further, Kruger and Cross (2006), in a recent survey, have identified further sub categories of solution and problem driven design through a protocol study measuring the activities of designers throughout a particular design process. By studying the different activities in which designers engage during designing, the authors have identified four different strategies as discussed below.

Problem driven design: the designer focuses closely on the problem at hand and only uses information and knowledge that is strictly needed to solve the problem. The emphasis lies on defining the problem and finding a solution as soon as possible.

Solution driven design: the designer focuses on generating solutions and only gathers information that is needed to further develop a solution. The emphasis lies on generating solutions and little time is spent on defining the problem, which may be reframed to suit an emerging solution. Instead of gathering information knowledge is retrieved from memory.

Information driven design: the designer focuses on gathering information from external sources and develops a solution on the basis of this information. The designer tries define the design problem as strictly as possible using the information gathered.

Knowledge driven design: the designer focuses on using prior, structured, personal knowledge and develops a solution on the basis of this prior knowledge. Only minimal necessary information from external sources is gathered.

Kruger and Cross (2006) state that all designers belong to one of above styles based on their personal skills and expertise in a particular field. Therefore, one’s style can be changed with one’s expertise (Lloyd and Scott, 1994), and one’s style can be identified by examining the activities whilst designing.

In EBD, designers who practice EBD need to search for and use therapeutic building evidence which is related to their unit of design during the design process. Evidence based designers cannot first develop the solution based on memory and knowledge then compare them with the applicable evidence, similarly to solution driven designers and knowledge driven designers. Therefore, having understood EBD, evidence and four different evidence-gathering practices by designers, it is apparent that designers who practice EBD need to be problem driven and/or information driven. This positioning makes it easier to explore the creativity of evidence based design practice that is discussed in next section.

5.2 Creativity and EBD

Researchers have identified creativity in relation to the above-mentioned four different design practices. Recent work by Kruger and Cross (2006) has specifically explored the issue through a protocol study. At the beginning of their research they considered the nature of the four different practices and have hypothesised how each can be creative. Table 3 below, summarises their theoretically hypothesis of creativity expectations in relation to the four different design strategies

Table 3: Hypothesised design outcomes of different design strategies (Kruger and Cross, 2006)

Outcomes	Problem driven design	Solution driven design	Information driven design	Knowledge driven design
Solution ideas	Few	Many	Few	Few
Requirements identified	Many	Few	Many	Few
Activities	Emphasis on problem defining	Emphasis on solution generating	Emphasis on data gathering	Emphasis on modelling
Solution score for creativity	Low	High	Low	High

Looking into the table it is evident that theoretically, solution driven and knowledge driven design should be high in creativity while other two are low.

However, within empirical testing of above hypothesis, problem driven designers have not produced the results as expected, and this has resulted in many solution ideas and high creativity going against the expectations. However, the other three strategies have almost proven their expectations at the beginning. Solution driven designers have acted as has been assumed in all aspects but have raised many requirements and knowledge driven designers have been moderate in creativity. Table 4 below, demonstrates the relationship between design strategy and creativity derived through the results of the same research.

Table 4: Actual creativity outcomes of different strategies (Kruger and Cross, 2006)

Designer ID	Individual score for creativity	Strategy	Mean creativity score for the category
3	7.6	Solution driven	5.9
8	6.8		
7	3.2		
4	6.4	Problem driven	5.1
5	5.2		
1	3.8		
6	5.0	Knowledge driven	4.9
2	4.8		
9	3.4	Information driven	3.4

The results demonstrate a higher (well above average) creativity score for solution driven design strategy while a lower (well below average) creativity score was demonstrated for the information driven strategy and also a low score for the knowledge driven strategy. Surprisingly, 'designer 7' who demonstrated a solution driven strategy had the lowest individual creativity score (Kruger and Cross, 2006). Researchers have not given reasons for the situation of 'designer 7'. However, looking into the research conditions it is evident that the only criterion which was different from the others for 'designer 7' was his own creativity skills.

Since EBD entails problem driven and or information driven strategies, creativity of EBD should analogous to creativity that of problem driven and information driven designs. However, the above empirical results confirmed that problem driven strategy has no relationship to lack of creativity. The information driven designer has shown a lower level of creativity. However, there was only one person with an information driven style and the overall results can be biased according to his personal skills as well. Therefore, with above results it is difficult to confirm that information driven designs generally show a lack of creativity.

6 DISCUSSION AND CONCLUSIONS

Literatures in relation to EBD, creativity and design strategies were revealed and an attempt made at understanding the relationship between creativity and EBD. EBD literature is rich in methods, but limited in application researches and lacks a theoretical foundation. The creativity and design strategy literatures are rich in theories, application and methods. The relationship between design strategies and creativity appears well established. However, the literature does not establish a relationship between design strategies and EBD. This paper identifies EBD as a problem driven and/or information driven design strategy.

Some therapeutic building evidence is directly applicable information that is useful during detailed design. These do not necessarily need to be in a form of a designer's knowledge but can be referred to as evidence sources such as databases and guidance books. Seeking information from such sources in the detail design stage is not new and designers are familiar with the practice. Architects are used to catching up with information sources such as material performance specifications, codes that were developed based on testing and performance history, and equally comfortable drawing upon knowledge of their previous work (Chong et al, 2010). In the UK there is an ensemble of standards, guidance and tools published by the Department of Health to support design, with which designers are familiar (though they are not mandatory). Thus, use of such information to a certain extent is not new in design practice. Therefore, the use of therapeutic building evidence in the detail design stage should not be a major issue in relation to creativity.

On the other hand, some types of evidence are useful during concept development. However, an information-driven (as opposed to problem-driven) design strategy may

result in lower levels of creativity. If a designer adopts an information-driven design style it might negatively impact on design creativity. When designers are familiar with the ensemble of therapeutic building evidence they can adhere to other design strategies which accounts for higher levels of creativity. Because, 'more experienced' designers use more 'generative reasoning' which then results in creativity at solution driven strategy (Scott, 1994). Designers who start practicing EBD might struggle consciously but this would change into effortless performance as they become experts in EBD (Lawson and Dorst, 2009, cited in Yilmaz and Seifert, 2011). Hamilton and Watkins (2009) also confirm this argument saying that "An aspect of gaining access to information from research is that, like Pandora's Box - which once opened, could not be shut again - the information cannot be ignored ... it influences subsequent thinking ...". Other factors such as a designer's own creative thinking skills, other environmental factors such as motivation, and the creativity levels of subordinates in a team would simultaneously affect creativity of the final solution.

In conclusion, EBD might limit creativity at the early stages of design, but this would not matter once the expertise is developed. A further empirical study would be helpful to clarify the extent to which EBD affects creativity at early and later (if any) stages of design. That would also be helpful in creating a positive attitude within designers' minds about EBD and thereby increase its practice.

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