AN EMPIRICAL INVESTIGATION INTO THE INFLUENCE OF MEDIA TYPES ON DESIGN METHODOLOGIES

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Abstract. This paper reports on the findings of an empirical investigation into the impact of different media on design methodology. The statistical sample included 49 fourth year architecture students, divided into three groups: the drawing group, the physical model group and the computer group. They were given a problem of designing a façade in an urban context in Glasgow over a two week period. The design process of each group was monitored over that period through observations, recordings and attitude measurement via a questionnaire survey. The results were analysed using the Statistical Programme for Social Sciences (SPSS). The dendrograms from cluster analysis revealed that there were well established perceptual dimensions, or clusters, for the façade's design variables within the three groups because of using different media. The impact of media on design creativity, both as a process and a product, was investigated. All three media types yielded a positive correlation between 'media made design decisions more creative' and 'media made design scheme more creative'- with a correlation coefficient of 0.708 which was significant at the 0.01 level, $p<0.05$.

1. Technology as a Philosophical Problem

"Societies have always been shaped more by the nature of the media by which men communicate than by the content of communication. The alphabet and print technology fostered and encouraged a fragmenting process, a process of specialism and detachment. Electric technology fosters and encourages unification and involvement. It is impossible to understand social and cultural changes without knowledge of the workings of media". (McLuhan & Fiore, 1996) These were the words of Marshall McLuhan, who coined phrases such as 'the medium is the message', 'the global village' and 'sensory impact' which have become 'watchwords' in our electronic age. Further, He linked the 'periods of great technological and cultural transitions' to profound feelings of despair and confusion that emerge in societies that ensued such transitions, remarking "our age of anxiety is, in great part, the result of trying to do today's job with yesterday's tools- with yesterday's concepts". (McLuhan 2001)

McLuhan's argument seems to agree with a recent realisation to suggest that the type of design media one works with will influence the manner in which design problems are explored and consequently determines the nature of architectural product. Within the context of architectural media, Wienands highlighted the value of 'languages: words, drawings and models' architects work with as a vehicle for architectural thought (Janke 1978) suggesting that 'more differentiated environmental forms are the result of more differentiated thought processes and these require differentiated architectural languages. The more languages or methods used and the more often they are

interchanged, the greater the insight gained. The interchange of languages is a methodical help'. Equally, Heath equates the ability of a designer to conceive ideas and produce solutions with the nature and power of conceptual 'tools' in his disposal. The limitations of method constrain thinking and will be revealed as limitations of the design. 'The student who cannot draw freely will design within the limits of his power of representation. He is the victim of analogue take-over'. (Heath 1984) However, traditional working methods using models and drawings were pre-eminent during the seventies where little knowledge existed on the use of computers within the design process. They were expensive to acquire and CAAD programmes were limited in terms of modelling capabilities and difficult to use. Today, both hardware and software have improved markedly in performance and in 3D capabilities. Our knowledge about their integration in the design process has matured. In fact some of the complexity of the design process can only be dealt with effectively with the use of CAAD in the modelling as well as the manufacturing process of buildings, a point echoed further by Novak who argued that 'the most advanced and challenging architecture being designed around the world' could not have been conceived without the use of the computer. (AD 1998)

This paper argues that to view computers as a design medium will only provide us with sufficient understanding of their cognitive impact. One should address computers as part of a larger picture regarding the issue of 'technology', whose problems and those of 'philosophy' according to the philosopher John Dewey, are inseparable. (Hickman 1991) Two orders for technology, one narrow and another broad were identified. (Mitcham 1972) The former adopted by engineers and designers views technology as the realm of tools, machines and electrical devices and concerns such questions as: how to combine energy and materials to create new inventions? The latter, of philosophers of technology, is not only concerned with the making of material artefacts but more importantly with their 'intellectual and social contexts'. (Mitcham 1972) Furthermor, Mitcham and Mackey (1993) identified three philosophical approaches to analyse technology. The first approach examines technology as a problem of epistemology as revealed in the writings of Plato and Aristotle. The second adopts an anthropological position in regard to the nature of human life. The third scenario considers technology as 'the defining characteristics of thought and action in modern society'. Yet what remains more important to debate is whether or not technology is 'neutral'. Are technologies 'passive' things that can do nothing by themselves, or do they affect the 'very ways we act, perceive and understand'? (Mitcham & Mackey 1993) There appears to be two views on this. The first view which is called 'social determinism', argues that human social and political factors are dominant over the technological ones- the latter are viewed as background factors. The second view, 'technological determinism', maintains that development of a technology itself has always opened up many possibilities that have greatly influenced the future directions for the society at large. On examining issues of architecture and technology, Abel (2004) draws upon a number of disciplines to conclude that 'underlying technological changes in the process of architectural production are of a fundamental importance to the way we think about machines and the world we live in'. Speaking off computers as 'organic machines', Abel suggests that humankind has used 'biological analogies' to

model machines, i.e. computers, on nature. This evolutionary step and change of thinking, he argues, will have far reaching consequences for the 'future of architecture as well as other aspects of life'. (Abel 2004)
The essence of technology was investigated by Martin Heidegger, Unfortunately, Heidegger's text on technology has been misread and misrepresented by many scholars as they conclude that Heidegger was against the use of technology. (Leach 2002) In this text, Heidegger establishes a firm 'relationship' between human existence and the 'essence' of technology. He defines the 'essence' of technology in terms of three things: means to an end, a human activity and an 'instrument'. On the latter, He suggests 'wherever ends are pursued and means are employed, wherever *instrumentality* reigns, there reigns *causality*'. (Krell 1993) He also identifies causality as being of four types: material, shape/form, subjective will of maker, and functional. Four causes, according to Heidegger, are responsible for bringing 'something into appearance' or what he calls 'the idea of bringing forth- 'poiesis' which brings out of concealment to un-concealment', a state of 'revealing'. (krell 1993) He then suggests that 'bringing forth [revealing] gathers within itself the four mode of causality- and *rules them throughout*'. Heidegger concludes that 'technology is therefore no mere means… technology is a way of revealing' and that 'the possibility of all productive manufacturing lies in revealing'. Within the context of using technology, i.e. computers, in architectural design, Heidegger's message should have implications. If we take Heidegger's message on board, then computers cannot be mere means to produce design drawings; they are a way of bringing forth designs.

3. The Research Design Methodology

A design research experiment was conducted with 4th Year students over a period of two weeks. They were given a design problem of designing a façade for a building in Glasgow. Their attitude towards the design process was recorded and measured over the same period, followed by an informal 'thinking aloud' design research seminar, where students were free to express their views about their design process. We selected Ziesel's structure of 'imaging', 'presenting' and 'testing' as a viable design methodology. (Ziesel 1984) The research method used during this informal design session is called the 'free association test', which required the student to temporarily suspend intellectual censorship and freely speak about design thoughts. The aim of this research technique is to bring to the surface of (students') conscious mind 'psychic complexes' of design thinking which are unconscious. It was hoped that this research methodology would reach the 'unconscious' root of design thought by means of 'free' association of design notions and conceptual scenarios. The method is an adaptation of Freud's free association psychiatric techniques (Freud Part I & II 2001), which he used with his patients, to the context of design research in architecture. The intellectual assumption, which led to the application of this method, is that a great deal of design activity happens in the realm of the unconscious mind, and if one is to demystify design then unconscious design thoughts need to surface through verbal reasoning/association as well as images and sketches. The second assumption made is that 'language' is an easier tool to describe design thoughts than drawings as well as being more precise. Hence, this explains why we did not analyse sketches and drawings

to demystify design thoughts. This informal design research session helped both researchers understand students' cognitive processes involved at the sub-conscious level of design and identify variables, judged relevant to the design process, to be incorporated into the questionnaire. The session also enabled the making of sound, objective and well informed interpretations of the statistical findings. (Freud Part III 2001)

Also, a questionnaire was designed and administered to all 4th Year students to measure their attitude to variables associated with the design process of the façade. The variables were developed from 'concepts' that architectural theorists deemed influential for the intellectual development of the phenomenon of 'facadism' and 'surface architecture'. These 'concepts' were culled out of a thorough literature search on facadism, such as (Leatherbarrow and Mostafavi 2002) and going back to Albert Kahn, the 'father' of façade thinking and the creator of the concept of the 'pure functional façade'. (Kahn 2000) Design concepts were converted to variables to provide operational definitions, as concepts are immeasurable whereas variables are measurable. The variables in the questionnaire were under different headings. Section 1 included 2 variables, one about grouping and the other about the extent to which the 'type of media' 'helped/hindered the design process'. Section 2 attempted to unearth the influence of media on a series of variables, namely: façade aesthetics; light (day, night, urban, sky, sun); transparency (lateral ad phenomenal); conflict between image and construction; material exploration and representation; context; urban massing; dynamics of architectural composition. Section 3 had one variable: media's influence on communicating the architectural message. Section 4 encompassed one variable: the impact of media on the creativity of process. Section 5 dealt with the impact of media on the 'creativity of product'. Section 6 explored design opportunities or limitations provided by the media in terms of: communicating the architectural message; as a device for representation; flexibility as a working method; potential as a design tool; as a device for 3D cognition; conceive and deal with complexity. The final Section, an open ended, gave students the freedom to write down variables un-covered in the questionnaire. The response was analysed using the Statistical Package for Social Sciences. (SPSS 1993)

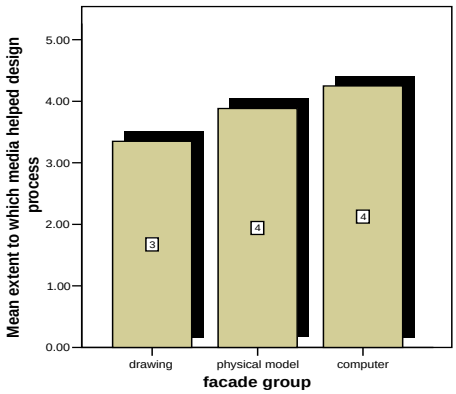

Figure 1 Media's influence on the design process by façade group

4. The Findings

4.1. INFLUENCE OF MEDIA ON THE DESIGN PROCESS

The mean vote for both the computer and the physical model groups, Fig. 1, was slightly higher than that of the drawing group. It could be that students who used the computer and physical models felt that the media they used helped them to describe their ideas more than the drawing group. Fig. 2 examines the tendency (mode) of registered attitudes toward media and creativity, both of process and product. The results confirm that the computer group showed a tendency,

clustered around 4 & 5, helpful and V. with only one outlier (student 42). In the physical model group there was no tendency shown a round any variable, just outliers, and a score between 3 and 4 on the other variable. The drawing group showed some variation as the tendency of score on one variable was around 4 and 3 on the other. It appears there was more consistency between subjects' votes in the computer group than in the other two groups. In analyzing the computer group's response to open ended questions and their comments during the informal design research session, two issues appeared to be significant: that the computer provided an objective platform for visualization, i.e. what you see on screen is similar to the final product (solution) and the computer provided an accurate perception of scale in relation to the body. Fig. 3 shows that the computer group felt that the medium of CAD helped resolve the perceived conflict between the façade as an image and a façade as an art of engineered skin and as environmental system. The response from the other two groups was more towards the 'little influence' end of the scale.

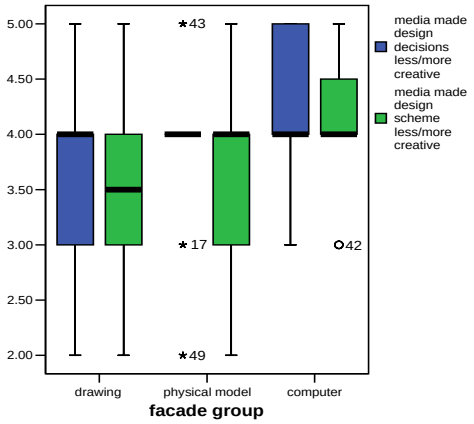

Figure 2 Mode statistics on creativity

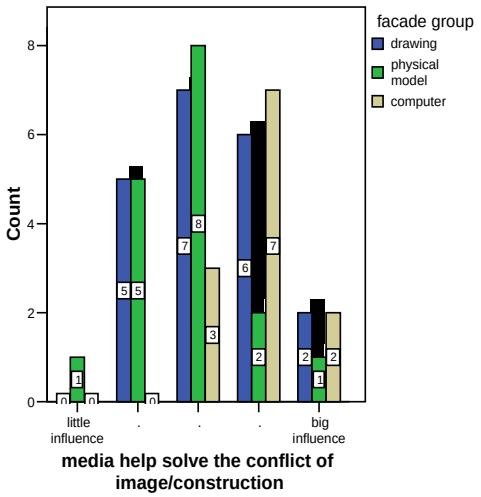

Figure 3 Media's impact: image + construction

Again noting the comments on the questionnaire and analyzing design utterances (during the informal design research session), we conclude that this difference can be attributed to CAD visualization, i.e. students being able to generate 3D live sections where construction and façade imagery can both be visualised in 3 dimensions. Fig. 4 shows that the three media types were viewed both as an appropriate working method and have potential of becoming a design tool. Further design issues related to types of media were also examined. For instance, all three groups scored a mean of 4 (out of 5) when asked about the media being an effective

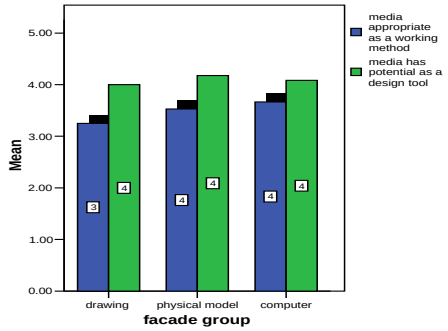

Figure 4 Media type & working *method*

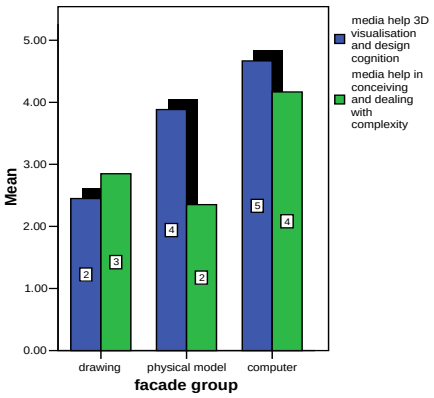

Figure 5 Media: cognition,complexity

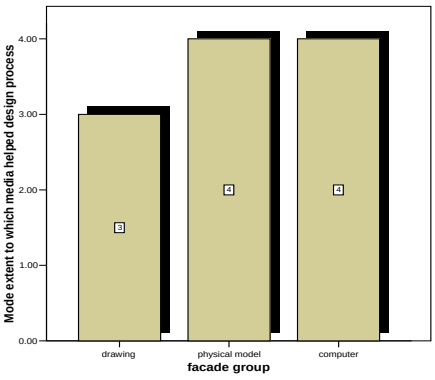

Figure 6 Media and the design

representation tool as well as being able to convey the architectural message. Attitudes towards media being an effective tool in exploring cognitive design strategies as well as dealing with complexity were also measures. Fig. 5 shows that the computer scored higher than the other two media in terms of both variables. Analyzing the computer group's comments on open ended questions as well as talking to them during design crits around the screen, the research concludes that the computer was seen as a powerful medium, perhaps more than the other two, in: handling multi layered design information, dealing with complex geometry as well as being able to generate three dimensional drawings for that complexity. A student commented 'in fact you can do complex things with the computer and draw 3Ds in a way that you cannot do with pencil drawing and physical models'. On media's impact on the design process, the computer and the physical model group scored slightly higher than the drawing group. On further analysis of the standard deviation statistics (SD), results showed an SD of 0.8 for the drawing group, 0.6 for the physical model and 0.4 for the computer group. This implies the vote within the computer group was more consistent, more clustered and less deviated from the mean. In the drawing group, if a student is unable to draw effectively then his design process will, to a large extent, be inhibited.

4.2. INFERENTIAL STATISTICS ON MEDIA TYPES

Table 1Test of significance & media

	facade group	media made design decisions less/more creative
Chi-Square(a,b)	2.000	18.837
df	2	3
Asymp. Sig.	.368	.000

The research used four types of inferential statistics: the Chi square test of association; Correlations; Kruskal Wallis test of group differences; Cluster analysis on cognitive dimensions of design.

The variable 'media made design decisions less/more creative', which was examined in Fig. 2, has been put through the Chi square test for the analysis of '*significance*' in difference between groups. Table 1, confirms that the difference in attitude toward this variable was significantly different between

groups, *Sig. <0.01*. This implies that differences in media will in the future yield differences in attitudes toward the design process. Furthermore, such differences will be matched by differences in design outcomes with regards to form, function, aesthetics, etc. The level of significance cannot be attributed to chance or demographic differences between groups. Rather it could be that differences in the way a particular medium was used would ultimately lead to differences in levels of creativity. Fig. 7, cluster analysis, revealed that design variables in regard to the façade, as perceived by students, fell within three clusters. The first which was the strongest in terms of proximities included two variables, context and urban mass, with a Euclidian distance of 0.25. The second cluster encompassed 3 variables: façade aesthetics, composition and construction materials. The Euclidian distance of 1.0 was computed between the 3 variables. The third cluster was registered between: urban lighting, façade transparency and reconcile image to construction and the proximity distance of 1.5.

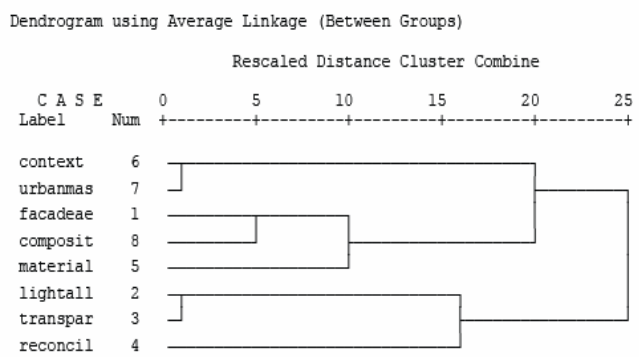

Figure 7 Cluster Analysis: perceptual dimensions of facade design

Table 2 Media's impact on both domains of creativity: process and product

			media made design decisions less/more creative	media made design scheme less/more creative
Spearman's rho	media made design decisions less/more creative	Correlation Coefficient	1.000	.708(**)
		Sig. (2-tailed)	.	.000
		N	49	49
	media made design scheme less/more creative	Correlation Coefficient	.708(**)	1.000
		Sig. (2-tailed)	.000	.
		N	49	49

** Correlation is significant at the 0.01 level (2-tailed).

Table 2 shows a strong correlation coefficient, rho=0.708 & sig. <0.01, between the impact of media on design creativity from two domains: that of the process and that of the product. This implies that for the whole sample, N=49, both process and product were deemed by students as equally important, hence the strong coefficient computed. This challenges the notion that what matters in architectural design is the final product, not the process. Most architectural reviews still focus on the outcome of design rather than how the design solution is reached. Further analysis of this correlation was conducted using regression and scatter plots. Fig. 8 shows a scatter plot of

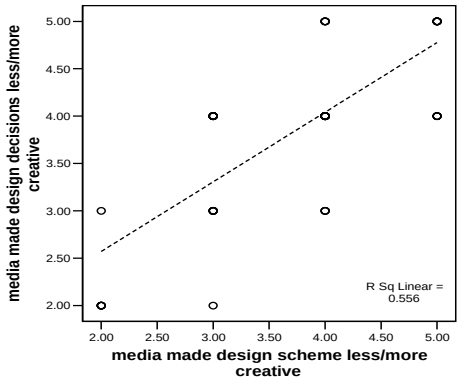

Figure 8 Scatter-plot: media and

the above correlation. The R sq Linear 0f 0.556 implies that 55% variance, i.e. change, in one variable is caused by a change in the other. In other words, as the type of media used exerts certain pressure on the process which will be matched by a change in the outcome, i.e. the final design scheme. The relationship appears to be perfectly linear with a Y-intercept of 2.5. Thus, one would expect that these two variables would appear together in the future, i.e. they are paired. The Kruskal Wallis test for mean ranks was also computed to ascertain how media helped the design process. The results show a mean rank of 33.50 for the computer group compared to 17.93 and 27.32 for the drawing group and the physical model respectively- Chi-square of 12.98 and Sig.=0.002. This suggests, the computer was more helpful for the design process than hand drawing. If one is bad at drawing then her ability to communicate design will, to a great extent, be hindered.

5. Conclusions

A single case study with a limited number of variables can at best refine a research hypothesis than establish a theory. However, the sophisticated research methodology and the rigorous statistical analysis enabled the formulation of some tentative but significant conclusions. The cluster analysis revealed the presence of significant perceptual and cognitive clusters for variables considered relevant to the design process of the façade. Also the high 'positive' correlation coefficient, of 0.708, between the influence of media on the process and its influence on the product should allow us to infer that the process was viewed as significant as the product. The mean rank for the extent to which media helped the design process was highest within the computer group, followed by the physical model group, then the drawing group. On the issue of media being able to 'conceive and deal with complexity', the CAD group produced the highest score, leading us to conclude that CAD could be the optimum design media that can help us visualize and deal with complex design object. Finally, it is worth mentioning that the research did not allow for demographic and sociological differences between the three groups. This is an area for further research.

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