

comparative studies between expert and novice designers were also undertaken by comparing junior students with final-year undergraduate [4, 7] or undergraduate and graduate students [35].

Some studies also included non-designers, i.e. people without specific design training, as their research subjects. Most of these studies were user studies, but Crismond [10] also investigated how ordinary people engaged in designing tasks. Archer [3] and Cross [11, 14] argued that design capability not only resided in professional designers, but it is a specific form of general problem-solving capabilities (i.e. every ordinary person can design though their levels are varied). However, it still lacks empirical evidences to support these arguments. It requests further investigation on how ordinary people design and compare it with designers' design processes.

4. Discussions

Delft protocol workshop argued that "... of all the empirical, observational research methods for the analysis of design activity, protocol analysis is the one that has received the most use and attention in recent years. It has become regarded as the most likely method (perhaps the only method) to bring out into the open the somewhat mysterious cognitive abilities of designers" [16]. This review confirmed this statement. Various types of protocols, study settings and analysis approaches were identified.

However, many design protocol studies took this method for granted. Only one third of publications (N=45) explicitly reflected the pros and cons of the method they employed. Most of these criticisms just repeated the constraints of generic verbal protocol analysis; few studies considered the distinction between design protocols with original verbal protocol analysis, like the dual mode issue discussed in the introduction section. It demands more methodological reflections to make protocol analysis more fit to the requirements of design research.

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