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Information Visualization and Design

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ABSTRACT

Recently, there has been an increase of data visualizations and in the diversity of forms. In parallel, design research has developed over the last decades. However, there have been few academic publications in the area of design specifically focusing on visualization research. In this poster, we present an overview of design research within the field of visualization in order to investigate key research areas and possible directions for future work.

KEYWORDS

visualization, design, visual thinking, user-centered design

1 INTRODUCTION

Today, visualizations are available to many people to view, analyze and to make decision upon, often used to give a comprehensible overview of large and complex amounts of data [9, 19]. Recently, the necessity and number of applications of data visualizations have grown dramatically and consequently, so has the diversity of forms [11, 18]. However, not all visualizations provide effective ways of communicating in terms of usability and usefulness [8, 9, 13]. Moreover, problems associated with the validity and reliability have been reported [7]. Visual literacy, the ability to use, interpret and critically examine visual material, is essential in all visually oriented disciplines [16]. The most essential steps in the visualization process is the encoding of data into visual elements by the designer and the decoding of visual elements back into the data in the mind of the reader [4]. In accordance, researchers argue that visualization developers are engaged in the design process [13].

2 METHODOLOGY

This study is based on a scoping of literature published in journals of design and visualization between 2000 and 2017. This scoping study comprises a further type of literature review with the intent to identify research gaps by reviewing existing literature [1]. The

scoping study is based on two steps: 1) searching for literature on visualization and design using search topic design, and 2) searching for literature on following keywords central to the research field of design; usability, evaluation and user experience using search topic visualization. Search tool used is Primo and search sources are electronic databases. Articles excluded are studies that tend to tackle design within the field of visualization without connecting to visual theoretical assumptions or design theories. However, instances where different design practices or skills were used in information visualization research were identified as this might point towards future areas for design research.

Table 1: Search strategy scoping review in two steps

| Scoping review	Step 1	Step 2
Keywords	Visualization + Design	Usability, Evaluation, User Experience
Search topic	Design	Visualization
Search period	2000–2017	2000–2017

3 RESULTS AND DISCUSSION

3.1 Design within the field of visualization

This section is a presentation of themes of design in visualization research found in the scoping review. The first theme is the *visual view*, mainly focusing on aesthetics. For example, the attractiveness of graph designs in visualizations are investigated and the findings shows that attractiveness judgements are affected by perceived ease of use of the graphs [15]. Here, design is important in the development of visualizations [6]. Researchers are critical to visualizations that present little guidance to the reader [6]. The scoping review also indicate a *cognitive view* related to storytelling. Visualization is a cognitive support for users and the way they perceive visualizations can influence their understanding of data [17]. Visualization must be seen as a process that combine art and science [2]. In addition, the presentation of visualizations using elements from storytelling should be the next logical step in research [10]. The transforming of data into visually stories should consist of 1) exploration of data, 2) making a story, and 3) telling a story [12]. Also, the results indicate a *usability* view. Here, researchers have reported on the problems of measuring insights of visualizations [3, 5, 14].

4 CONCLUSIONS

There is a gap of visual knowledge in the research field of visualization. This visual knowledge-gap arises from a lack of design

competence in the visualization process and an absence of evaluation methods. The scoping review conducted indicates the necessity of design research in three key areas: user-centered design, visual thinking and visual storytelling.

Visual Thinking   Visual Storytelling

V

User Centered Design
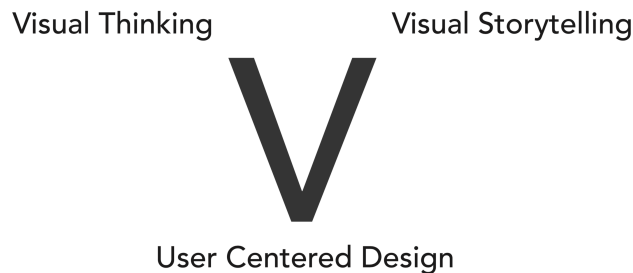
Figure 1: Key areas where design is required in visualization research.

This study shows that *user-centered* design could be an essential part in the visualization development. Design thinking through a design methodology have the potential to result in a clearly articulated process. Reading and understanding data is about human perception and cognition, and therefore, we firstly argue that this method could be beneficial in the developing process of visualizations. Secondly, we argue that we need new evaluation methods that attempt to measure insights of visualizations more directly. Hence, this points towards a potentially interesting research field in developing fast and reliable evaluation methods for visualization inspired by design methodology. Also, we find *visual thinking* being a relevant approach of design research in the field of visualization as visual thinking is an active problem- solving process that begins with perception and relies on the visual language of images, patterns, shapes, symbols and colors [20]. Visual thinking can help us to understand what we "read" in visualizations and how others "read" them. Therefore, the framework of design principles should be involved in the research field of visualization. Finally, *visual storytelling* is identified as a key area where design is required in visualization research. Not only the exploring and making in visualization is of importance, but also the telling. An essential part in making a visual story is design knowledge. This study indicates that the visual representations of design decisions are fundamental in any visualization process. Here, researchers can focus on design skills and manipulation of perception and cognition by advocating principles of design. This will prove even more crucial as visualization is increasingly used for decision-making. In conclusion, the *Visualization V* intends to bring an interdisciplinary approach to the research field. Here, design is more than information aesthetics, it is an essential dimension for visual communication supporting cognitive insights.

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