Orchestrating Data, Design, and Narrative: Information Visualization for Sense- and Decision-Making in Online Learning

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ABSTRACT

Information visualization involves the visual, and sometimes interactive, presentation and organization of complex data in a clear, compelling representation. Information visualization is an essential element in peoples’ daily lives, especially those in data-driven professions, namely online educators. Although information visualization research and methods are prevalent in the diverse fields of healthcare, statistics, economics, information technology, computer science, and politics, few examples of successful information visualization design or integration exist in online learning. The authors provide a background of information visualization in education, explore a set of potential roles for information visualization in the future design and integration of online learning environments, provide examples of contemporary interactive visualizations in education, and discuss opportunities to move forward with design and research in this emerging area.

Keywords: Data Design, Data-Based Decision-Making, E-Assessment, Graphic Representation, Information Design, Information Visualization, Online Learning

INTRODUCTION

The availability of large datasets combined with exponential growth in hardware and software capability creates the potential to improve communication through the use of enhanced visualization techniques (Cleveland, 1987; Sawant & Healey, 2007; Ware, 2004). Scientists relying heavily on programming-oriented and conceptual systems of analyzing data through algorithmic procedures are often overwhelmed by the amount of information that is gained through contemporary processes, especially when communication to public audiences is involved (West, 1997). Thus, in order for new information and knowledge to be created.

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from collected data, scientists and analysts must visually organize complex data sets into simplified perceptual models that present a fresh perspective for both novices and experts alike. This union of information analysis and communication design is the foundation of information visualization (InfoViz).

InfoViz, also known as information design, “uses pictures, symbols, colors, and words to communicate ideas, illustrate information, or express relationships visually” (Emerson, 2008, p. 4). With relation to the vital experience element of InfoViz and the proposed context of designing and developing online learning, Wilson (2005) illustrates an aesthetic perspective on instructional design as the careful orchestration of available design elements to provide a heightened and lasting experience for learners. This is a dynamic in which InfoViz can play a powerful role, but rarely does in our field. To this extent and for purposes of this paper, we amend the above definition of InfoViz to also include the orchestration of data, design, and narrative.

InfoViz in today’s society involves uses for analysis, advocacy, consumer education, and strategy (Emerson, 2008), and is prevalent in the fields of healthcare, statistics, economics, information technology, environmental science, computer science, and politics. InfoViz is rapidly becoming a fundamental element in the evolution of these fields (Lau & Moere, 2007), and as a result, more essential in our daily lives, especially those in data-driven professions. Teaching, in many ways, is a data-driven profession, yet the use of InfoViz in the design of online learning environments is only in its infancy when supporting students and teachers in knowledge acquisition, sense-making, and decision-making.

To remedy the scarcity of successful InfoViz examples in the design and integration of online learning, in this article we present (1) a background of InfoViz in education; (2) a framework of potential InfoViz opportunities for designers, researchers, teachers, and students; (3) illustrative examples of InfoViz in two current online learning environments; and (4) a prospective roadmap for future InfoViz design and research in online learning.

**What is InfoViz?**

The information design literature ranges from highly technical aspects of database visualization (Keim & Kriege, 1994) and frameworks for programmatically generating information visualizations (Sugibuchi, Spyratos, & Siminenko, 2009) to discussions on the interaction between information representation and art (Lau & Moere, 2007). Perhaps the most critical element of these discussions is the distinction between InfoViz and traditional data display.

InfoViz, as opposed to traditional static data representation and table-based data display, helps users experience the data and explore the rich narrative that can be crafted into the visualization, without needing to reference and process an overwhelming volume of numerical distractors. That is not to say that InfoViz is the hasty removal of numbers through replacement with imagery; on the contrary, InfoViz embraces numerical identifiers that add context to illuminate the powerful relationships and contrasts in data, ultimately expanding upon the narrative (Tufte, 2006). Moreover, good information design acknowledges the importance of clear, compelling, and convincing visuals (Emerson, 2008).

By nature, humans solve problems and recall information in a visual manner; however, the display of information through a clear, perceptive approach presents many technology professionals and researchers with the challenge of creating effective diagnostic imagery (West, 1997). Effective InfoViz design requires designers to create clear, compelling, and convincing visualizations; in other words, the design must (1) present complex information in an easy-to-understand fashion, (2) visually grab the user’s attention, and, most importantly, (3) persuade users to believe in what they see represented in the visualization, especially users who normally do not recognize the value of statistics and numerical data (Emerson, 2008). Ultimately, the primary goal of InfoViz is to communicate
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