Chapter 12
Data Visualization in Online Educational Research

Xue Wen
https://orcid.org/0000-0002-7529-9436
Louisiana State University, USA

Xuan Wang
https://orcid.org/0000-0001-9183-3080
The University of Texas Rio Grande Valley, USA

ABSTRACT

This chapter presents a general and practical guideline that is intended to introduce the traditional visualization methods (word clouds), and the advanced visualization methods including interactive visualization (heatmap matrix) and dynamic visualization (dashboard), which can be applied in quantitative, qualitative, and mixed-methods research. This chapter also presents the potentials of each visualization method for assisting researchers in choosing the most appropriate one in the web-based research study. Graduate students, educational researchers, and practitioners can contribute to take strengths from each visual analytical method to enhance the reach of significant research findings into the public sphere. By leveraging the novel visualization techniques used in the web-based research study, while staying true to the analytical methods of research design, graduate students, educational researchers, and practitioners will gain a broader understanding of big data and analytics for data use and representation in the field of education.

INTRODUCTION

Advances in technology have created numerous opportunities for research in online education. With the vast needs of resources for a diversity of learners, various online learning platforms have developed free online courses for online learners to acquire new skills, advance their careers, and deliver quality educational experiences at scale (Chen, Chen, Liu, Shi, Wu, & Qu, 2016). Massive open online courses (MOOCs), a popular online learning platform in recent years, have emerged and attracted a remarkable
amount of public attention (Hollands & Kazi, 2019). The term MOOCs—massive open online courses, was first used in the educational community in 2008 by Stephen Downes and George Siemens (MAUT-McGill University, 2018). Educators intended to explore the possibility for interactions between a wide variety of participants made possible by online tools that provide a more productive learning environment than traditional tools would allow (Chen et al., 2016). Learners from all over the world can enroll in more than 1,000 courses, and the number of registrants has reached 10 million (Rollins, 2018). Because of its volume and complexity, MOOCs often generate large, heterogeneous datasets comprising clickstream data, contributions to discussion forums, and various performance metrics (Vieira, Parsons, & Byrd, 2018). Thus, to study MOOCs or related online learning platforms, educational researchers would be required to master visual learning analytics, educational data mining, and visual analytics to capture rich data about students and their online learning behaviors.

From this perspective, Vieira et al. (2018) define a new term called visual learning analytics, which can be defined as an integration of learning analytics, educational data mining, and visual analytics, to illustrate how designers and researchers can employ data visualization approaches for analyzing educational data. To help readers systematically review the field of data visualization in online educational research, the authors present a brief agenda for the field of visual learning analytics in an educational context in this chapter. Also, based on the unique characteristics of MOOCs’ environment, this chapter focuses on illustrating three data visualization techniques that help readers understand which types of educational data can be customized and how to visualize the educational data in MOOC scenarios. Visual learning analytics is a discipline that shows significant promise in helping users gain insight into data visualizations (Vieira et al., 2018). This term integrates data analysis, visual representations, and user interactions to leverage the strengths of technology and humans. In the context of the web-based environment, visual learning analytics use computational tools and methods for understanding educational phenomena, such as students’ learning paths, the effectiveness of learning materials, and different approaches that students use for a given task through visualization discourse.

While there is a large body of work providing innovative visualization skills in data representation, educational researchers, instructors, and school administrators typically have a difficult time processing and interpreting big data about online education. This is because they have a limited understanding of necessary data mining and processing techniques. Challenges for educators mainly arise when analyzing MOOC data. First, MOOC data is often large, complex, and heterogeneous. Second, the users of the analytics system in MOOC are often course instructors, educational researchers, and students, who usually have little to no knowledge of data analytical techniques (Qu & Chen, 2015). Given this information, the purpose of this chapter is to illustrate three scenarios in online learning platforms along with the possible solution of data visualization techniques. This chapter aims to enhance the understandings of researchers, instructors, stakeholders, and students of necessary data processing and interpretation in online educational research. Therefore, this chapter focuses on the discussions of data visualization approaches by incorporating the basic concepts of visual learning analytics. This chapter looks at what types of data in online educational research can be approached using visualization techniques and how they can be approached. On one hand, the “what” focuses on characterizing the data source, data analytical approach, tools, and purposes. On the other hand, the “how” focuses on the possible solutions in visualization that can specifically help readers to understand big data and data analytics in online educational research. Therefore, the objectives of the chapter are: (1) to identify the primary uses of visualizations in online educational research, (2) to customize data visualization techniques for online