Special Issue on Visualization Teaching and Literacy

Benjamin Bach, *University of Edinburgh, EH8 9AB, Edinburgh, U.K.*

Samuel Huron, *Télécom Paris, F-91120, Paris, France*

Uta Hinrichs, *University of Edinburgh, EH8 9AB, Edinburgh, U.K.*

Jonathan C. Roberts, *Bangor University, LL57 2DG, Bangor, U.K.*

Sheelagh Carpendale, *Simon Fraser University, Burnaby, V5A 1S6, Canada*

Visualization literacy is the ability to read, write, and create graphical representations of data using digital or physical artifacts. With the rapid adoption of visualizations as a way to analyze and communicate data in every domain of the society, it is becoming essential for every citizen to understand and use visualizations, especially to prevent misuse and misinterpretation. At the same time, developing visualization literacy skills must be high on the education agenda to develop a society of critical and informed citizens, effective and responsible analysts and decision-makers, as well as honest advocates for the use of data that support human values.

However, teaching visualization skills and helping people build their knowledge in visualization is challenging because of the open and broad nature of visualization and its wide application to different domains and audiences that engage in a range of activities following different conventions. While structured guidelines and extensive empirical knowledge exist on how to visually represent data, there is little foundational and empirical knowledge about how to teach and train visualization literacy skills for general audiences and for specific sectors (e.g., politicians, journalists, professionals in industry, children, citizens etc.). Beyond dedicated and highly successful textbooks (e.g., by Munzner, Kirk, Cairo, Meirelles, and others), the topic of teaching visualization has been discussed predominantly at scientific workshops including the most recent IEEE VIS workshop series "Data Vis Activities to Facilitate Learning, Reflecting, Discussing, and Designing."[a]

---

[a]https://visactivities.github.io

What we are missing are both well-founded scientific theories and empirical knowledge, as well as actionable exercises and activities that help guide education practices in visualization. This scientific and practical knowledge has to account for tacit insights from practice, engage with a range of audiences (children, pupils, students, working professionals, domain-experts), and should take into account the contexts in which visualization and education happens, whether this is online or offline, at school or at home, in the office or lab, or elsewhere in the wild. Building this knowledge requires broad contributions from across disciplines: education, cognitive science, graphic design, computer sciences, and potentially many others.

The seven articles in this Special Issue (some of which extend on results from the first workshop in the "Data Vis Activities" series, which was held in 2020) address issues and questions around visualization education from multiple perspectives, including considerations of online and in-person, large- and small-scale teaching, promoting creativity and design thinking, different forms of visual representations, gamification, and the analysis of learning objectives and achievements. The articles by Aerts *et al.*, Vetria *et al.*, and Beyer *et al.* broadly focus on teaching methods and tools to support different sizes of workshops and teaching activities that can serve as a source of inspiration for visualization educators. Perin and Beasley *et al.* discuss methods of evaluating and analyzing the effect of specific activities (i.e., personal data physicalization and peer feedback) on student engagement and learning outcomes, while providing practical activity and workshop instructions. Finally, Amabili *et al.* and Keck *et al.* adopt a more theoretical perspective, providing models and frameworks that could support either designing or analyzing activities in information visualization courses.

FUTURE DIRECTIONS

This Special Issue points to a range of future research directions, informing actionable research programs

and, hopefully, novel collaborations in a growing community around visualization education research.

On methods and tools, Keck *et al.* and Amabili *et al.* ask how to adapt courses and methods to diversity in prior knowledge. While this is a common issue in education, the problem in visualization often is to identify what and how much people know about visualizations. We are effectively lacking visualization literacy tests tailored to specific audiences but also to make people aware of what they know about visualization and ideally communicate the knowledge they are lacking.

In running design sprints, Beyer *et al.* found a tradeoff between speed versus creativity and build courses around time constraints. Likewise, the article calls out issues of scalability in a domain that requires frequent and individual feedback and where feedback is hardly automatable, as, e.g., in programming. Eventually, during his physicalization workshop, *Perin* reports on challenges found with students collecting and managing personal data and asks about the therapeutic use of personal data visualizations.

Baesley *et al.* highlight the value of peer feedback but ask how teachers can guide students toward better quality feedback and how teachers can assure this quality, while not directly being involved in peer feedback. This is related to the much broader topic of evaluation; Aerts *et al.*, Byrd *et al.*, and Keck *et al.* ask about ways of evaluating the success of teaching methods complementing observation. We are missing a clear framework and criteria for evaluation also in order to compare the impact of teaching methods. While observations can provide a lot of evidence, how can methods be efficiently compared to scientific standards? In particular, both articles report on how they adapted to remote settings and wonder questions on how this adaptation impacts their methods.

There are also challenges and opportunities which this (first) Special Issue on visualization literacy and education could not touch on. These include specific education settings, such as museums; similarly, there is potentially a great difference between different audiences such as students, professionals, as well as casual users. Another specific challenge in studying teaching activity is to provide clear results and findings. Workshops are often happening in various contexts, in which it is difficult to have clear comparable measures, and to separate confounding factors. We believe that it could be valuable first to have specific article tracks focused on visualization teaching, and a discussion in our community on what types of methodology we should use to access these works. This will help consolidate methods for teaching and learning through a variety of activities and workshops. Plotting this territory and linking it to existing pedagogical theory seems important for the community.

All articles in this Special Issue focus on formal teaching through courses and workshops, mostly likely situated in an academic setting. Informal learning captures situations beyond the classroom, including online and hybrid teaching, teaching working professionals, and teaching without teaching but acquiring and learning alone through books, tutorials, cheatsheets, or simply by doing. As visualization of data is becoming a common cultural object, tool, and process, we need to proactively create the foundations of an education for visualization.

BENJAMIN BACH is currently a Lecturer in design informatics and visualization at the School of Informatics, University of Edinburgh, Edinburgh, U.K. He is the corresponding author of this article. Contact him at bbach@ed.ac.uk.

SAMUEL HURON is currently an Associate Professor in design of digital technology with the Institut Polytechnique de Paris, Télécom Paris, Paris, France, and part of the Lab CNRS i3. Contact him at samuel.huron@telecom-paris.fr.

UTA HINRICHS is currently a Reader in data visualization at the School of Informatics, Design Informatics, and the Edinburgh Futures Institute, University of Edinburgh, Edinburgh, U.K. Contact her at uhinrich@ed.ac.uk.

JONATHAN C. ROBERTS is currently a Professor in visualization with the School of Computer Science and Electronic Engineering, Bangor University, Bangor, U.K. Contact him at j.c.roberts@bangor.ac.uk.

SHEELAGH CARPENDALE is currently a Professor and Canada Research Chair in Information Visualization with the School of Computing Science, Simon Fraser University, Burnaby, Canada. Contact her at sheelagh@sfu.ca.