EduVis: 3rd IEEE VIS Workshop on Visualization Education, Literacy, and Activities

Christina Stoiber* Fateme Rajabiyazdi Mandy Keck Magdalena Boucher Jonathan Roberts
Lonni Besancon Mathis Brossier Benjamin Bach

ABSTRACT

This is the 3rd workshop on visualization education, literacy, and activities; after a succession of several successful workshops in 2023 and 2024 (30-50 people and 15-20 submissions annually). This workshop aims to become the primary forum to share and discuss advances, challenges, and methods at the intersection of visualization and education. It addresses an interdisciplinary audience from and beyond visualization, education, learning analytics, science communication, arts and design, psychology, or people from adjacent fields such as data science and HCI. In its 3rd edition, we introduce annual **spotlight** topics, with this year's topic being **Modalities** of learning and engaging. This also includes topics of education for visualization (**ed4vis**) as well as visualization for education (**vis4ed**). We will pursue the **'educators reports'** track, which will be published in the Nightingale Magazine, and offer a paper track to be published in the IEEE Xplore library.

1 MOTIVATION

Visualizations are increasingly being used in news reports, textbooks, scientific articles, and dashboards or tools geared toward public discussions of social issues [3, 6]. This highlights both the need to promote visualization education (ed4vis) [3] and the importance of communicating and studying the impact of visualization to educate the public about societal and scientific issues (vis4ed) [30]. Researchers are increasingly studying both topics in multiple research domains, from educational researchers to visualization researchers, and include scientists focused on reducing climate change [22], segregation [8], or public health [4]. From this growing interest, we see the need and opportunity to foster more collaboration and space to learn from other disciplines and the key role that visualization researchers may play in future developments of a research agenda that would foster both education about visualization and visualization for education. This is perhaps best exemplified by the multiple viewpoints and research domains represented in the 2024 edition of the workshop. Despite the research efforts already conducted, many challenges remain to be tackled. For instance, it remains important to consider different learning needs when teaching about or with visualizations [3]. Similarly, it is more than ever crucial to consider the role of AI in creating, assessing, or understanding visualizations and their underlying topics – a challenge that was the focus of the working group discussions during the last EduVis workshop. Many other challenges still remain and new ones arise as we start to see more collaboration between different research disciplines: understanding the intersection of educational research and visualization education [27], better understanding the role of different learning environments [11], developing appropriate interaction methods for education through visualization [5], fostering and creating self-learning materials and assessing their importance [21].

*e-mail: ieee-eduvis@googlegroups.com

To address these challenges, we wish to hold a new workshop edition of our EduVis workshop, which will once again provide a space for educators, visualization researchers, and domain-specific visual communicators to meet and discuss these growing issues and their potential solutions.

1.1 Workshop history & related scientific initiatives

Over the past decade, visualization education and pedagogy have undergone significant transformations, and along with past workshops, have shaped the foundation for the EduVis workshop series. Starting with a panel at IEEE VIS 2015 on "Teaching across the researcher-practitioner grap" [12]. This was followed by two workshops (2016, 2017) on the Pedagogy of Data Visualization [16, 15]. Building on these, the IEEE VIS workshops in 2020 and 2021 expanded the focus to data visualization activities as a means to facilitate learning, reflection, and discussion [13, 14]. A special issue on Visualization Education in IEEE Computer Graphics and Applications (2021) underscored the growing recognition of this research area [2]. Additionally, an interdisciplinary Dagstuhl seminar in 2022, titled *"Visualization Empowerment: How to Teach and Learn Data Visualization"*, brought together researchers to discuss frameworks and methodologies for visualization education [1]. In parallel, academic discourse on visualization literacy gained momentum, exemplified by an ACM CHI 2024 [9]. We also have seen the introduction of an Education full paper track at the IEEE/CGF EuroVis conference[1]. Besides, we also observed activities in related venues, such as the 1st VisGames Workshop on Visualization Play, Games, and Activities[2].

These milestones collectively demonstrate the increasing importance of visualization education within the research community, leading to the conception of the EduVis Workshop series, which aims to advance these discussions by fostering an interdisciplinary space for educators, researchers, and practitioners. In 2023, we organized a highly successful and well-attended 1st EduVis workshop at IEEE VIS [18] and published a paper on the challenges and opportunities in visualization education [3] as one output from a Dagstuhl seminar on the same topic [1]. Last year, THREE workshop proposals were submitted to IEEE VIS on education, which shows the high demand for discussion around education in the visualization community and outside. The workshop chairs approached us to combine all three workshops under the umbrella of the EduVis. As a result of this merger, we had 16 organizers (5 are among this year's organizers) who conducted the 2nd EduVIS workshop at IEEE VIS 2024 [23] in an online format due to a severe hurricane happening at the conference location. Under those circumstances, the workshop was well attended (20-25 attendees) via Zoom. We had a full-day workshop that started with a keynote from Kate Farrell (The University of Edinburgh): "Playful data visualizations: data literacy across the school curriculum". We received 23 paper submissions and accepted eight papers and five educator reports for presentation and publication. The paper and report presentations were focused on teaching visualization design, experience and engagement, and visualization processes. The eight papers were pub-

[1] https://event.sdu.dk/eurovis/education-papers
[2] https://visgames2025.netlify.app/

lished in the Conference Proceedings[3]. Five educator reports were published in the Nightingale magazine. In the afternoon sessions, we split attendees into breakout rooms to discuss three topics (Vis for education, vis and education, AI and vis). We had a lively discussion about cross-talk between vis research and learning science, sharing experiences in integrating AI in data visualization education and talking about visualization literacy levels, from novices to intermediate. These activities show a growing awareness of the importance of education in visualization and the responsibility that comes with the goal of advancing a highly dynamic field with strong ties between academia and practice. We saw a high demand for discussions around education; therefore, we have combined forces to align our workshop and questions. In this workshop proposal, we present our joint efforts in establishing a single workshop to be continued in the coming years.

We want to provide a platform for education and engagement practices in visualization, and we hope to eventually be able **to establish a permanent EduVis forum at IEEE VIS**, akin to other communities such as EduCHI (ACM SIGCHI) [10], the education track at Eurographics [26], or the public resources and activities created by the Data-Viz Society. This forum would benefit students, junior faculty members new to teaching, senior researchers in planning outreach and education, as well as researchers and practitioners outside the (academic) visualization community.

1.2 Workshop innovations

We introduce an annual **spotlight** topic for EduVis, highlighting emerging trends and challenges in visualization education and pedagogy. Each year, the theme will adapt to current developments, driving focused discussions and advancing the field.

This year's spotlight topic will be **Modalities.** We seek to understand how different modalities (e.g., videos, comics, serious games, etc.) can be effectively integrated into visualization curricula to cater to various learning styles and enhance comprehension of complex visual concepts. This area may examine innovative approaches to address the growing concern of declining reading skills and motivation among students (e.g., TikTok videos).

We will pursue the successful **'educator reports'**, a short template-agnostic report aimed at communicating 'advances, evidence, and best practices' to visualization educators. Educator reports will be published on the online blog Nightingale[4], run by the Data Visualization Society. We also keep the paper format, which will be published at IEEE Xplore (see Section 4).

Building on previous editions, the 2025 EduVis workshop introduces new elements to further advance discussions on visualization education. Building on last year's introduction of **working groups**, we are strengthening their role in EduVis 2025 by formalizing two distinct formats. We want to establish "Vis Activity groups" to focus on hands-on engagement with visualization games and playful learning activities, building on the success of the hands-on formats of CHI PLAY[5]and CHI[6]. While "Discussion groups" will provide a structured space for in-depth conversations on different topics. By explicitly defining these two types of working groups, we aim to ensure more structured discussions, active participation, and meaningful knowledge exchange among attendees.

Our EduVis Workshop aims to expand and reach individuals beyond the traditional visualization community. Given the presence of organizers in Austria, there is an opportunity to involve local networks, educational institutions, and professional communities that may not typically engage with IEEE VIS. By fostering connections with these groups, the workshop can introduce new perspectives and encourage broader participation in the visualization field.

[3] https://ieeexplore.ieee.org/xpl/conhome/10747654/proceeding
[4] https://nightingaledvs.com
[5] https://chiplay.acm.org/2024/interactivity/
[6] https://chi2025.acm.org/for-authors/interactivity/

2 Workshop Goals

A workshop on Visualization Education, Literacy, and Activities can bring new people to IEEE VIS who are outside the traditional visualization network. This includes people from education, learning analytics, science communication, psychology, art, and design, or people from adjacent fields such as data science, AI, and HCI. Another goal of this workshop is to bring together newly appointed and experienced faculty to share experiences and discuss novel datavis activities, teaching methods, and challenges. Furthermore, this format is intended to serve as a platform to foster interdisciplinary exchange and share research results and best practices. With this workshop, we want to achieve the following goals:

- build a permanent forum and interdisciplinary community around teaching data visualization, open to researchers, students, and practitioners outside the VIS community.
- publish the results of our discussions on visualization literacy, education and teaching, activities, and practices.
- discuss best practices to teach data visualization to diverse audiences (e.g., children/adult learning, data journalists/data scientists/computer scientists/designers) and in different scenarios (onsite, online, hybrid).
- share visualization educational tools, materials, and processes.
- collect, and systematize learning activities.
- discuss higher-level issues concerning human-centered approaches to visualization, visualization design, and education.
- promote the critical discussions around the implications of AI for visualization education.

3 Scope of Topics

The workshop topics include, but are not limited to:

- Modalities (e.g., videos, comics, serious games)
- Visualization Activities & Games
- Engagement with visualizations
- Generative AI and visualization (in learning and assessment)
- Visualization literacy and pedagogy in visualization
- Learning goals and learning methods
- Evaluation methods and learning analytics
- Educational tools
- Hybrid and online teaching
- Reflective and research practices
- Understanding audiences
- Guidelines, strategies, and guidance for education
- Debate and discussions on visualization guidelines and well-established knowledge
- Challenges and personal experiences
- Experiential learning (hands-on learning and physicalization)
- Visualizations for public education (e.g., health education, science communication)
- Teaching to encourage creativity and design critique
- Accessibility of visualization learning resources

4 Submission Formats

The workshop will accept two types of submissions, peer-reviewed by at least two PC members and one workshop organizer.

- **Paper submissions:** full papers (4-8 pages excluding references); submissions will be published at the IEEE Xplore
- **Educator reports:** short template-agnostic reports (1-2 pages) to discuss opinions or reflections on teaching experiences, or description of the results of a datavis activity conducted and how it could be reused by others and in other contexts; they will be published in the Nightingale magazine (pre-arranged with the Data Visualization Society). This is

not intended to be assessed as scientific writing; we recommend framing these reports similarly to blog posts. The goal is to disseminate knowledge to non-academic audiences.

5 Workshop Activities

We plan a half-day hybrid workshop that will include paper and report presentations, working group sessions, and a general discussion on community building and sustainability of this workshop.

Submission presentation: Each accepted submission will be given 5-10 min to present, followed by a Q&A session. The timing will depend on the submission type. After all accepted submissions have been presented, we will leave space for an open discussion on challenges and directions related to the workshop topic.

Working groups: We will conduct working groups where participants explore visualization education through two distinct formats:

- **VisActivity groups:** These dedicated spaces will showcase live demonstrations of visualization games and playful activities. Participants can interact hands-on with innovative educational tools, fostering experiential learning and idea exchange.
- **Discussion groups:** These working groups will facilitate in-depth conversations. The aim is to engage small groups in topics around visualization education.

Workshop organizers will moderate these groups at the different working groups. We will encourage the participants in the working groups to continue their discussions during the lunch break. We plan to disseminate their outcomes using a shared repository, such as Google Drive and our website.

Networking: After the workshop session, a voluntary workshop lunch will be planned to encourage community building and networking among working groups.

Back-up policy: We anticipate that the workshop will receive between 10-20 submissions, similar to last year. However, if we receive few submissions, we plan to invite a keynote speaker to provide inspiration for the working groups planned for the second part of the workshop.

6 Tentative Schedule

We are applying for a half-day workshop to be held hybrid. The workshop will require a standard conference session room that can fit 50-100 people, with sound/visual equipment, internet access and preferably large tables and chairs that can be moved around.

- 09:00 —09:15 **Opening and outline**
- 09:15 —10:15 **Submission presentations and Q/A**
- *10:15 —10:45* ***Coffee Break***
- 10:45 —12:00 **Special topic working group discussions**
- *12:00 —14:00* ***Voluntary Workshop Lunch in the break***

7 Workshop Organization Timeline

The timeline for the workshop organization is as follows:

- April 25, 2025: **Call for Participation**
- July 1, 2025: **Paper and Educator Report Submission**
- July 15, 2025: **Reviews Collected**
- July 18, 2025: **Author Notification**
- August 1, 2025: **Camera-ready Submission**

We plan to advertise on the respective mailing lists for ACM CHI, IEEE VIS, DRS, ACM DIS, and social media (X, LinkedIn, BlueSky, etc.).

8 Intended Outcomes

This workshop will allow participants to discuss the challenges they face in data visualization education and exchange ideas and approaches with other visualization researchers and educators. Participants in the working groups will be encouraged to work towards publishing the outcomes of their discussions in the forms of full paper, position paper, and workshop paper. Upon collecting the outcomes of the working group discussions, we will sketch a research agenda and highlight the opportunities for visualization education, literacy, and activities for the community. This will contribute to the broader visualization community, literacy, and education agenda.

9 Program Committee

We had a diverse list of program committee members for last year's EduVis workshop, which we will re-invite this year[7]. In addition, we will reach out to new potential members, for example, inviting members from the CHI'24 workshop "Toward a More Comprehensive Understanding of Visualization Literacy" [9] organizers.

10 Organizing Committee

Our organizing committee has structured itself as a collaborative unit, ensuring a well-coordinated and efficient workshop experience. We defined a website chair who manages the workshop website and handles communication with the Nightingale Magazine. The Paper chairs oversee the peer-review process. The publication chair is responsible for handling publication logistics. To ensure broad visibility, we defined the role of the Publicity chair, leading promotional efforts. Session Chairs will facilitate the working groups and ensure smooth session organization.

Christina Stoiber, a researcher at St. Pölten University of Applied Sciences in Austria, specializes in Information Visualization, HCI, and Visualization Literacy and Education. She completed her dissertation on visualization literacy and onboarding in December 2023 [28]. Her work aims to improve the use of visualization tools across various domains [29]. She co-organized the 1st EduVis [18] and 2nd [23] Workshop and co-authored [3].

Fateme Rajabiyazdi is an Assistant Professor in the Department of Systems and Computer Engineering at Carleton University. She received her Ph.D. in Computer Science in the area of information visualization from the University of Calgary. She actively studies and teaches data visualizations to engineers. She led the organization of the 2nd IEEE EduVis workshop [23], was a co-organizer for the 1st IEEE EduVis Workshop [18] and co-authored [3].

Mandy Keck is a professor in UX and Interaction Design at the University of Applied Sciences Upper Austria. She co-authored papers on visualization education [3, 20] and design workshops [19, 17], and was co-organizer of several workshops, including the 1st and 2nd IEEE EduVis Workshop [18, 23], and the IEEE VIS Datavis Activities workshops in 2020 and 2021 [13, 14].

Magdalena Boucher is a PhD candidate at St. Pölten University of Applied Sciences and TU Wien, Austria. She researches how to enhance visualization literacy with comics [7] and teaches game storytelling and several design courses. Magdalena was a member of the program committee of the 1st and 2nd EduVis Workshop [18, 23] and co-author of the paper on challenges and opportunities in visualization education [3].

Jonathan C. Roberts is a professor in Visualization at Bangor University. He is the creator of the Five Design-Sheet method [24] and lead author of the book Five Design-Sheets: Creative Design and Sketching for Computing and Visualization, Springer Nature, June 2017. His research spans pedagogy, heritage, archaeology, oceanography, lexicography, and law domains, and for many years has encouraged researchers to develop multiple coordinated view systems. He is a keen advocate of sketching and low-fidelity design [24, 25], and promotes more design thinking in teaching.

Lonni Besancon is an assistant professor at Linkoping University, Sweden. He was a co-chair of the IEEE VIS Open Practices. He has contributed several workshops and meet-ups at both IEEE VIS and ACM CHI (e.g., Fail Fest, alt.VIS 2021, alt.VIS 2022, alt.VIS

[7] https://ieee-eduvis.github.io/#program-committee

2023, the JoVI meetup,...). He has publications related to using visualization for educational purposes in science centers and is currently co-supervising a large research effort in this direction at the Norrkoping Visualisation Center C.

Mathis Brossier is a PhD student at Linkoping University, Sweden. His PhD work will focus on providing and studying visualization with visioverbal interaction components in public settings.

Benjamin Bach is a Research Scientist at Inria working on interactive visualization interfaces for communication, exploration, and education in visualization.

Acknowledgments

We would like to thank all participants of the IEEE EduVis 2023 and 2024 workshop for the inspiring discussions and ideas.

References

[1] B. Bach, S. Carpendale, U. Hinrichs, and S. Huron. Visualization Empowerment: How to Teach and Learn Data Visualization (Dagstuhl Seminar 22261). *Dagstuhl Reports*, 12(6):83–111, 2023. doi: 10.4230/DagRep.12.6.83 1

[2] B. Bach, S. Huron, U. Hinrichs, J. C. Roberts, and S. Carpendale. Special issue on visualization teaching and literacy. *IEEE Comput. Graph. Appl.*, 41(06):13–14, 2021. 1

[3] B. Bach, M. Keck, F. Rajabiyazdi, T. Losev, I. Meirelles, J. Dykes, R. S. Laramee, M. AlKadi, C. Stoiber, S. Huron, C. Perin, L. Morais, W. Aigner, D. Kosminsky, M. Boucher, S. Knudsen, A. Manataki, J. Aerts, U. Hinrichs, J. C. Roberts, and S. Carpendale. Challenges and opportunities in data visualization education: A call to action. *IEEE TVCG*, 30(1):649–660, 2024. doi: 10.1109/TVCG.2023.3327378 1, 3

[4] C. S. Bao, S. Li, S. G. Flores, M. Correll, and L. Battle. Recommendations for visualization recommendations: Exploring preferences and priorities in public health. In *Proc. CHI*, CHI '22. Association for Computing Machinery, New York, NY, USA, 2022. doi: 10.1145/3491102.3501891 1

[5] L. Besançon, A. Ynnerman, D. F. Keefe, L. Yu, and T. Isenberg. The State of the Art of Spatial Interfaces for 3D Visualization. *Computer Graphics Forum*, 40(1):293–326, 2021. doi: 10.1111/cgf.14189 1

[6] L. Besançon, K. Schönborn, E. Sundén, H. Yin, S. Rising, P. Westerdahl, P. Ljung, J. Wideström, C. Hansen, and A. Ynnerman. Exploring and explaining climate change: Exploranation as a visualization pedagogy for societal action. In *VIS4GOOD: A Workshop on Visualization for Social Good, part of IEEE VIS 2022*, 2022. 1

[7] M. Boucher, B. Bach, C. Stoiber, Z. Wang, and W. Aigner. Educational Data Comics: What can Comics do for Education in Visualization? In *2023 IEEE VIS Workshop on Visualization Education, Literacy, and Activities (EduVis)*, pp. 34–40. IEEE, 2023. doi: 10.1109/EduVis60792.2023.00012 3

[8] B. Elbers and R. J. Gruijters. Segplot: A new method for visualizing patterns of multi-group segregation. *Research in Social Stratification and Mobility*, 89:100860, 2024. doi: 10.1016/j.rssm.2023.100860 1

[9] L. W. Ge, M. Hedayati, Y. Cui, Y. Ding, K. Bonilla, A. Joshi, A. Ottley, B. Bach, B. C. Kwon, D. N. Rapp, E. Peck, L. M. Padilla, M. Correll, M. A. Borkin, L. Harrison, and M. Kay. Toward a More Comprehensive Understanding of Visualization Literacy. https://visualization-literacy.github.io/CHI2024/, 2024. 1, 3

[10] C. M. Gray and C. M. MacDonald. EduCHI 2023: The 5th annual symposium on hci education. https://educhi2023.hcilivingcurriculum.org/, 2023. 2

[11] K. W. Hall, A. J. Bradley, U. Hinrichs, S. Huron, J. Wood, C. Collins, and S. Carpendale. Design by immersion: A transdisciplinary approach to problem-driven visualizations. *IEEE Transactions on Visualization and Computer Graphics*, 26(1):109–118, 2020. doi: 10.1109/TVCG.2019.2934790 1

[12] M. Hearst, E. Adar, R. Kosara, T. Munzner, J. Schwabish, and B. Shneiderman. IEEE VIS 2015 panel: Vis, the next generation: Teaching across the researcher-practitioner gap. http://www.cond.org/teachvis.html, 2017. 1

[13] S. Huron, B. Bach, U. Hinrichs, M. Keck, and J. Roberts. 1st IEEE VIS workshop on data vis activities to facilitate learning, reflecting, discussing, and designing. In *IEEE VIS 2020*, 2020. 1, 3

[14] S. Huron, B. Bach, G. Panagiotidou, M. Keck, J. Roberts, and S. Carpendale. 2nd IEEE VIS workshop on data vis activities to facilitate learning, reflecting, discussing, and designing. In *IEEE VIS 2021*, 2021. 1, 3

[15] A. Joshi, E. Adar, E. Bertini, S. Engle, M. Hearst, and D. Keefe. 2nd IEEE VIS workshop on pedagogy of visualization. https://vgl.cs.usfca.edu/pdvw/2017/, 2017. 1

[16] A. Joshi, E. Adar, S. Engle, M. Hearst, and D. Keefe. 1st IEEE VIS workshop on pedagogy of visualization. http://vgl.cs.usfca.edu/pdvw/2016, 2016. 1

[17] M. Keck, R. Groh, and Z. Vosough. A didactic methodology for crafting information visualizations. In *2020 IEEE Vis Conference (VIS)*, pp. 186–190, 2020. doi: 10.1109/VIS47514.2020.00044 3

[18] M. Keck, S. Huron, G. Panagiotidou, C. Stoiber, F. Rajabiyazdi, C. Perin, J. C. Roberts, and B. Bach. Eduvis: Workshop on visualization education, literacy, and activities, 2023. 1, 3

[19] M. Keck, E. Lapczyna, and R. Groh. Revisiting graspable user interfaces: A design process for developing user interface metaphors. pp. 130–141. Springer, 2014. doi: 10.1007/978-3-319-07668-3_14 3

[20] M. Keck, E. Stoll, and D. Kammer. A didactic framework for analyzing learning activities to design infovis courses. *EEE Comput. Graph. Appl.*, 41(6):80–90, 2021. doi: 10.1109/MCG.2021.3115416 3

[21] C. Perin. What students learn with personal data physicalization. *IEEE Comput. Graph. Appl.*, 41(6):48–58, 2021. doi: 10.1109/MCG.2021.3115417 1

[22] H.-O. Pörtner, D. Roberts, M. Tignor, E. Poloczanska, K. Mintenbeck, et al., eds. *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. IPCC, Geneva, Switzerland, 2022. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. 1

[23] F. Rajabiyazdi, M. Keck, C. Stoiber, J. C. Roberts, H. Subramonyam, L. Ge, M. Boucher, and B. Bach. EduVis: 2nd IEEE VIS Workshop on Visualization Education, Literacy, and Activities. St. Pete Beach, Florida, USA, 2024. 1, 3

[24] J. C. Roberts, C. Headleand, and P. D. Ritsos. Sketching designs using the five design-sheet methodology. *IEEE TVCG*, 2015. 3

[25] J. C. Roberts and P. D. Ritsos. Critical Thinking Sheet (CTS) for Design Thinking in Programming Courses. In M. Romero and B. Sousa Santos, eds., *Eurographics 2020 - Education Papers*. The Eurographics Association, 2020. doi: 10.2312/eged.20201029 3

[26] B. S. Santos and G. Domik. Eurographics conference 2021 - call for education papers. https://conferences.eg.org/eg2021/for-submitters/education-paper-submission/, 2021. 2

[27] K. Schönborn and L. Besançon. What can educational science offer visualization? a reflective essay. In *2024 IEEE VIS Workshop on Visualization Education, Literacy, and Activities (EduVIS)*, pp. 30–37, 2024. doi: 10.1109/EduVIS63909.2024.00009 1

[28] C. Stoiber. *Visualization Onboarding - Supporting Users in Understanding Unfamiliar Visual Representations*. PhD thesis, TU Wien, Wien, Österreich, 2023. 3

[29] C. Stoiber, M. Wagner, F. Grassinger, M. Pohl, H. Stitz, M. Streit, B. Potzmann, and W. Aigner. Visualization Onboarding Grounded in Educational Theories. In *Visualization Psychology*. Springer Nature, 2022. 3

[30] A. Ynnerman, J. Löwgren, and L. Tibell. Exploranation: A new science communication paradigm. *IEEE Comput. Graph. Appl.*, 38(3):13–20, 2018. doi: 10.1109/MCG.2018.032421649 1