
Teaching Data Visualization and Storytelling with Data Comic Workshops

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ABSTRACT

This paper presents a method for hands-on creation of data comics in a workshop context and includes a description of the results, lessons learned and future improvements. Data comics is a promising format for data-driven storytelling, leveraging the power of data visualization and visual storytelling with comics. However, authoring data comics requires a diverse range of skills that are both creative and analytical. The workshop was developed to refine a blue-print for future workshops; building in reflections on challenges and potential improvements. Within a 3-week assignment for an illustration class, we ran three 3-hour sessions. Our design was informed by the experiences of previous data-comics workshops. Results show the creative potential of data comics. Challenges to learn from the workshop include the stages to introduce data visualizations and journalistic narratives, the

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structuring of stories and the method of developing iterations of comic drafts. We close by reflecting on these challenges and how they can inform future improvements and adaptations.

CCS CONCEPTS

- **Human-centered computing → Visualization theory, concepts and paradigms;**

KEYWORDS

Data Comics; Data Visualization; Data-driven Storytelling; Creative workshop.

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INTRODUCTION

As a rather novel format, data comics leverage the visual language and storytelling concepts from traditional comics (panels, pages, characters, temporal change) to communicate insights about data and break down the complexity of visualizations [1, 19]. Creating data-driven stories [17], however, is a labor-intensive process that potentially follows many different paths and stages [14]. Moreover, data comics require skills and expertise from multiple disciplines such as data analysis for data exploration, visualization design, techniques for data-driven storytelling (e.g., [2]), storytelling in general, writing, as well as comic creation and drawing.

Workshops offer a unique opportunity to provide for active learning [6] and engage participants through hands-on exercises and feedback. Consequently, workshops have become an integral part of any teaching in data visualization [3, 5, 8, 11]. Visualization workshops usually involve types of data and visual variables, encoding principles [4, 12], design and ideation methods [7, 18], interdisciplinary collaboration [9] and long-term teaching [16]. On the other hand, workshops on storytelling involve methodologies about story creating [10], instructions to walk through the process [15]. However, there is currently no structured activity (e.g., workshop) that teaches data-driven storytelling specifically.

To explore this gap, we designed and ran a workshop on data comics, organized by an interdisciplinary team with expertise in data visualization, graphic design, data comics, and illustration. The workshop was part of a 3-week assignment in an undergraduate illustration class at the College of Art, Edinburgh University. The workshop aimed to provide students with experience in employing data-driven storytelling and human-centered design thinking. All of the students were asked to document and self-reflect on the design process from beginning to end to enhance their learning as well as act as feedback for the workshop itself.

Workshop 1—The very first workshop was organized to validate the use of our design patterns for data comics [3]. It lasted for 3 hours with 23 participants from various backgrounds (computer science, design). The workshop was structured into a sketching phase and a story-boarding phase. Students started with a curated collection of material (<https://datacomics925658343.wordpress.com/workshop>) for various topics including both raw data, sets of visualizations, and data stories in the format of videos and news articles.

Workshop 2—A second workshop was part of a 3-month collaboration between one of the authors and four comic artists and illustrators. The workshop set out with a brief introduction into visualization sketching and design patterns. Each invited artist worked on a specific data set with a respective external data collaborator. During the following months, we had individual check-ins with each group to discuss story, messages, visualizations, and design patterns. To help streamline the individual stories, we asked each group to define three types of messages:

- (1) **Take-home messages** were high-level messages that we want the audience to remember from the story, e.g., to change their behaviour.
- (2) **Insights** were facts to support the take-home message(s), communicated through data visualizations.
- (3) **Data-literacy messages** described general information necessary to understand visualizations and insights: medians, distributions, interpreting error-bars, or specific data transformations. This largely helped constructing the respective data stories.

This paper is meant to offer a detailed protocol of how we ran the workshop, so that others may reproduce it. We also present reflections and possible improvements for future scenarios. In summary, we found that the illustration students' confidence in drawing led to engaging and inventive imagery and narratives. Once they had found their data and wrestled with the story telling they really engaged and explored the key elements of data comics and began to touch on data journalism and info-graphics. We found that students had problems in: 1) the data visualization stage, in selecting visual variables or types of charts; 2) the story creating stage with a lack of clarity where students had a hard time in thinking about both the messages and the optimal method of visual narrative; 3) the story-boarding stage, especially when students did not have a concrete idea of a story or an efficient method to experiment quickly with the many design possibilities. Overall, our updated workshop design led to better results compared to two previous workshops. Our reflections led us to think further on data comics authoring and teaching methodology and provide guidelines for holding data comics workshop and data comics teaching in the future. Material and results for this workshop are available online: <https://datacomics925658343.wordpress.com/illustration-workshop>.

BACKGROUND AND CHALLENGES

The design for this workshop was informed by two preceding workshops on data comics at the University of Edinburgh. Both prior workshops borrowed methodology from several related workshops [8] and are detailed on the sidebar (left). In these workshops, we found that participants appreciated the warming-up sketching practice and the data comics design patterns [3]. The provided data was appreciated but required significant time for participants to understand (Ch1). We found that participants had problems creating compelling stories and wanted more guidance on this (Ch2). Though we conducted a visualization sketching session at the beginning, participants new to visualizations still had some troubles using purposeful visualizations in their stories (Ch3). Designing compelling layouts that reflect the story-flow was not covered enough through the design patterns (Ch4).

The new workshop, described in this paper, was part of a 3-week assignment in an undergraduate course for illustration at the College of Art, University of Edinburgh. The course comprised 23 students, many of which had made classic comics prior to the workshop and experimented with variations of the design patterns. A few had also worked with data visualizations but more had experience of info-graphics. The students were confident in drawing so sketching and development was efficient though the challenge in balancing personal styles of drawing and comics with the audience and message of data comics was both one of the key challenges as well as the creatively stimulating elements of the workshop and the final data comics. The assignment asked each student to create one data comic on a subject of their choice using data collected or found by themselves. The comic size was set A3 landscape, allowing comics to be displayed both on screen and in print. The assignment

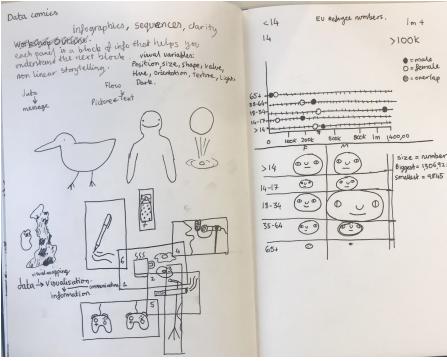


Figure 1: Practice in the sketching phase from one of the students.

Messages

High Level Messages

- What do you want your audience to know?
 - What do you want your audience to do with this knowledge?
- E.g.: "Inequality is multidimensional."

Facts

- How do you convince them with the data?
 - What do they need to know about the data?
- E.g.: "General inequality is increasing."

Data-Literacy Knowledge

- What do they need to know to understand your visualizations and message?
 - How to interpret it?
- E.g.: "Gini-coefficient.", "Median income"

Figure 2: This slide displayed a guidance for extracting messages from high to low level, and emphasized interpretation of visual literacy for the visualization to be used.

included three 3-hour sessions and a final presentation where students were asked to reflect on the process and results with feedback from peers and tutors.

WORKSHOP DESIGN AND IMPLEMENTATION

Session 1, Week1: Fast-forward

To quickly get into the concept of data comics and to provide students with an idea of all the steps involved in creating one, we designed a *fast-forward* data-comic workshop in session 1 in which students, in pairs, generated rough data comic storyboards. The fast-forward included 6 phases and lasted for three hours. Slides are linked online (<https://goo.gl/Xz5w43>)

Introduction of data, messages and visualization (30min): The goal of this phase was to introduce students to data visualization, with a strong focus on clarity and communication. We showed a spreadsheet and scatter plot to explain how to interpret data and tell stories about findings. Then we presented problems in effective communication of data visualization done wrongly (i.e. unreasonable design, improperly used visual variables and complex visual literacy).

Introduction to data comics (20min): Data comics were introduced as an approach to improve comprehension of visualizations and the clarity of a message. We then showed examples of data comics for education, personal stories and journalism (<http://datacomics.net>). After initiating the benefits that data comics bring for audiences, we present the features of sequence, presenting time and layout inspired by traditional comics. We then moved to the process of data comic creating.

Sketching (30min): The goal of this session was to warm up students and introduce them to sketching data. The warm-up phase started with some simple 3-second sketches (e.g., draw a bird, a human), then switched to a visualizing task: draw your home country (5sec), then draw the distribution of the population in that country (10sec). Eventually, we asked students to draw 7 random rectangles on a new sheet of paper. We asked students to number each panel in a logical sequence. This first 'comic' layout was the base for drawing the story of their past Sunday in those 7 sequential rectangles (left side in Fig.1). After this warm-up, we briefly introduced the notion of visual variables and the idea of visual mapping. To facilitate sketching data (Ch1), we provided students with predefined small data samples and story contexts, used in a workshop on physical data visualization [8]. We asked each student pair to sketch 3 different visualization designs (3min each, right side in Fig.1). At the end of this session, we gave students a 15min break.

Creating data story (40min): Scenario cards [8] were handed out randomly, and we displayed the list of messages (high-level, facts, data-literacy) identified in the previous workshop (Fig. 2). Each card described a context (street, office, etc.) and a persona (friend, peer, etc.) We also presented a story structure example (beginning/middle/end), and a data story example in the form of a video *Wealth*



Figure 3: 3-minute storytelling in group and get reflection.

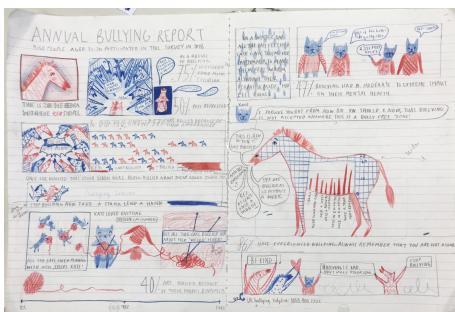


Figure 4: Annual bullying report. (data comic draft) presented in the group-crits

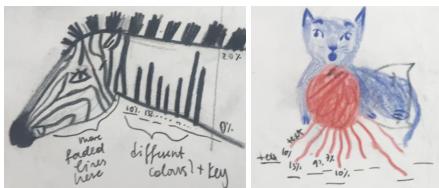


Figure 5: student explored innovative ways of visualizing in the sketch book.

Inequality in America (<https://www.youtube.com/watch?v=QPKKQnijnsM>). Students had 30min to create the story and then 10min to tell their story to their neighbor for self-reflection and feedback.

Storyboard sketch (20min): We introduced how panels work in comics, examples of design patterns and its usage in existing data comics. We suggested the method of using sticky post to structure the panels. Students were asked to draw a draft of the data comic on 1 to 2 A3-sized papers.

Exhibition and presentation (10min): Comics were stuck on a wall and students walked everyone through their drafts while getting feedback from the instructors.

Session 2, Week 2: Working with Own Data

For this 2nd session, students were asked to collect or search for data according to their own interests, as we believed a more personal connection to their data helps telling stories. This reminded students of the process outlined in the fast-forward (session 1) and aimed to yield a first comic draft for each student's individual comic. Slides for this session can be found online (<https://goo.gl/vRZ1Af>). For those students who came with complicated data, we introduced RAWGraph [13] for 10min, visualizing some examples from their website.

Story creating (140min): We reminded students to create a *persona* that would define the target audience of their comic. Then, we went through the same phases as in the fast-forward session; sketching, 3 types of messages, 3-minute storytelling in groups of 3 or 4 (Fig. 3), drafting layout. We provided students with printed cards of our design patterns [3] and students worked on the first rough draft of their data comic, followed by a walk around the room to look and share their work.

Session 3, Week 2: Group-meetings

Group-meetings were held three days after the second session with groups of 3-5 students. After students presented their drafts individually, instructors and peers offered suggestions for improvement with respect to stories, visualizations, and layout.

RESULTS

Results have been surprising, surpassing our expectations we had from previous workshops. A final gallery of workshop results is online (<http://datacomics.net>, e.g., Fig. 9). Data chosen by the students exhibited a great variety of subjects: environmental problems, social phenomenon and health related issues such as bullying (Fig. 4). Comics used a wide range of design styles where the choices of drawing materials from digital to colouring pencil and use of caricature and pattern added to the richness of the story telling. Students' personal drawing methods and interests influenced the style of the comics as much as the nature of the subject matter. Students sometimes blended fact and fiction to emphasize the story and/or clarify the data visualizations, e.g.'Sustainable Steve' takes us through data on recycling cups and a frog takes us through Mass Extinction (Fig. 8). Many students used



Figure 6: Mandelbrot set. The author used the *Question Answer* and *Visualization Build-up* to explain the mathematical principles with a coordinate system, used *Zoom* and *Multiple Facets* to engage audience to explore its richness.



Figure 7: Student explored using different variables to present the proportion of calories, sugar and juice concentrate in drinks

data-comics design patterns [3] including *Question Answer*, *Multiple Facets*, *Visualization Build-up*, *Zoom*, *Multiple Facets* (e.g., Fig. 6). Some students created visualization designs themselves, e.g., using stripes on a zebra and thrums as bar charts (Fig. 5) or creating cocktail-glass glyphs to report on ingredients in soft-drinks (Fig. 7). In summary, the success of the final work is relative to the function and context of the data comics but the importance of the workshop was in learning for the individual students. The diversity of research, processes and skills involved in making data comics made for a particularly rich learning experience. The full list of results can be found online: <https://datacomics925658343.wordpress.com/illustration-workshop>.

DISCUSSION

The following discussion aims at reflecting on future improvements and exercises that can further improve the learning of drawing data comics. Our reflections and interpretations are naturally constrained by the format of the workshop we ran. Specific challenges might not arise for different backgrounds of participants and more time available. Most reflections stem from direct observations, discussions with students, and a brief formal questionnaire.

Creating stories required students moving back and forth between the story, visualizations, and the data. During story creation (Session 2), some students realized they required more data. We believe this is an important message to teach/learn. Also, students could effectively organize the layout, develop clear reading sequences and apply design patterns. Personas and scenarios helped students set their language tone or comic style and make informed design decisions (e.g. color usage and characters). We also conclude that the fast-forward (session 1) was very useful and students found the provided data helpful. From the interviews and observations, we obtained further insights into challenges and suggestions of potential solutions.

Tutorial material: In our first workshop, we started from visualizations, data sets, or stories on specific topics (immigration, CO₂ pollution, inequality, etc). As we decided to run a fast-forward workshop this time, we wanted to rely on similar data that was easier to grasp and to work with. While still considered useful by students, we found two problems with this: students struggled coming up with good 'stories' in the sense of describing the data and report simple insights. The reasons may have been the nature of the data itself, but more likely the missing personal relationship to the data. In other words, we believe it is crucial for storytelling to a) choose the data set one wants to work with (other than randomly getting data assigned) and b) choosing data that matches personal interest and knowledge to connect and comprehend audience and message. This was evident in the second phase, where students worked with their own data. Deciding which material to start with eventually depends on the participants and their background, as well as on the nature and intended outcomes of the workshop. Ideally, participants come with a good understanding of their data. If this is not possible, providing simple data sets to chose from and giving aids to their understanding is helpful.



Figure 8: Examples of using character to guide through the story.

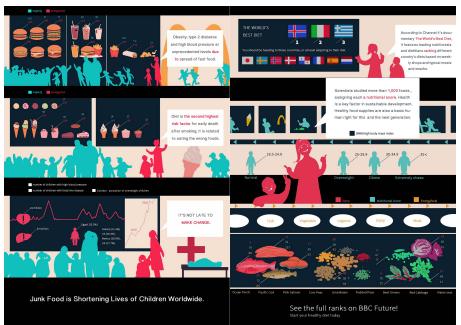


Figure 9: A polished example by one of the student.

Extended versions of a data comics workshop should include more time for exploratory data analysis, e.g., using Tableau.

Visualizing data effectively: Most comics involved characters and descriptions of the data context (e.g., Fig. 8) such as a characterful endangered frog trying to comprehend and come to terms with the sixth global mass extinction! However, some comics showed a few data visualizations only. In the future, we would put more emphasis on visualizations and visualization design. Perhaps the most compelling challenge for students is to explain visualizations properly. With more time, we need to emphasize that visualizations are complex constructs that often require explicit explanations to guide the audience through an argument rather than illustrating a number.

Creating narration: Some students reported problems with creating stories, which given their background, was not surprising. One obvious solution is to provide more guidance on how to develop and structure a story; experimenting with beginning-middle-end, providing context, describing data, introducing visualizations, report on insights (using visualizations), build a climax, formulate a conclusion and an outlook. Potential material may include narrative design patterns [2]. However, we see a general lack of understanding and appropriate literature in this field.

Creating repeating comic drafts: Some students had problems with creating multiple drafts for their storyboards and layouts. The reasons being the additional workload of redrawing existing panels. A possible solution would be to use movable cards or post-its to draw individual panels onto them—exercises we did not manage to perform as during the workshop we had to attribute more time than expected to certain exercises. Moveable cards can easily be re-arranged and extended in timed exercises. An alternative could be to use tracing paper, placed on top of the previous draft, to aid roughly sketching new drafts. Given the troubles in creating stories, we believe experimenting with the storyboard (sequence of panels) is a crucial feature that will have to occupy significantly more time in future workshops as we are building our knowledge base in critically analyzing data comics.

Working with design patterns: Design patterns aimed to structure the creation process by providing participants with design templates. However, we found it hard for participants to understand patterns in that short amount of time as patterns are learned through (re)application. We had planned, but could not do more specific exercises on the patterns themselves due to time constraints. However, in future iterations of this workshop, we encourage short, yet precise exercises with the patterns and participants own data. For example, “create a *build-up* for your visualization”, “describe change in your data through *annotated transitions*”, or “split your argument into individual panels using *multiple explanations*”. Exercises could be very brief, e.g. 5min each. Eventually, higher-level narrative patterns [2] could help as well, but would require significantly more time to present and internalize.

CONCLUSION

In this paper, we detailed our methodology for a revised data comics workshop, informed by two previous workshops. Participants results were promising, showing that they actively engaged with the three main aspects of data comics: data, visualization, and stories. Working with illustrators introduced an emphasis on style and genres of data comics that can be considered in future workshops and research. Our reflections highlight future improvements and design considerations for data comics workshops, and hopefully will pave the way for more workshops and teaching methods for communicating and engaging with data.

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