Data Journalism Training – Data & Visualisation Challenges

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Abstract. Within the last years, an increasing use of data in journalism can be observed which is linked to the general datafication of society and the digital transformation of journalism. Especially during the COVID-19 pandemic, the competencies to successfully process, interpret and evaluate complex data and data visualisations have gained significance. This societal need to address a large-scale pandemic journalistically has led to an increased use of data stories. Despite a growing need for data journalism skills, the field lacks standardized education or a defined skill set. Training programmes are emerging, and this paper focuses specifically on the challenges that arise when such new offerings are created.

We conducted 10 interviews with data journalism trainers in Austria, Germany, and Switzerland (fall 2020 till spring 2021). Results indicate that among trainers working with data is seen as more challenging than designing and interpreting visualisations. Most challenges emerge at the very beginning. For instance, it is demanding for participants to understand and find a story in a data set, or to clean and process data. In addition, visualisations bring about their own challenges: They are often underestimated, as journalists expect quick solutions whereas the reality is much more complex and comprehending.

Overall, we see a great variety of needs and goals within data journalism training, ranging from simple challenges to complex tasks. Those are highly dependent on the usage of certain analytics methods and visualisation types. Therefore, in the training context sensitivity is mandatory to make a relevant contribution to the field.

1 Introduction

One of the most important responsibilities journalists ascribe to themselves is to act as the “fourth estate” in a democracy, exercising a control function by reporting critically on the legislative, executive and judicial branches of government. For decades, they have acted as gatekeepers between citizens and those in power, filtering and presenting news relevant to the formation of public opinion. Web 2.0 and social media (algorithms) have

drastically changed this by allowing anyone to create and distribute information. Although the circumstances have changed, there is still a societal need for journalism, especially when it comes to filtering information overload and presenting it in a way that the public can understand (e.g., Bruns, 2018).

In addition to this digital transformation, scholars attribute another trend to a changing society, which they refer to as the "datafied society". This term describes the increasing collection and use of (big) data, which has various societal consequences, from new research opportunities to data protection issues (Schäfer and van Es, 2017). COVID-19 encouraged these trends, as it is often presented through complex data visualisations (Ramsälv et al., 2023).

Both societal developments provide ideal conditions for data journalism. Data journalists explain complex data to the public through (digital) stories, fulfilling their role as gatekeepers in a "datafied society". They need to successfully analyse, interpret, and comprehend complex data and data visualisations – skills that "traditional" journalists with a background in humanities often lack. It is therefore crucial to create new training programmes that address the characteristics of data-intensive work to prepare future data journalists accordingly. This paper focuses specifically on the challenges of creating such new offerings by interviewing data journalism trainers. We also draw implications that could inform new training opportunities, such as onboarding, a self-learning method that considers the settings in which learning takes place.

2 Background: The Field of Data Journalism

2.1 Data Journalism Skills

Before considering data journalism training, it is important to define the general skills of a data journalist. The work of a data journalist can range from finding and creating stories (data storytelling), data-driven strategies for data research and analysis (data literacy), methods for visualisation (visualisation literacy), and generally the creative but critical use of data (Burns & Matthews, 2018; Feigenbaum et al., 2016; Graham, 2015, 2018; Heravi, 2017; J. Hewett, 2017; Zhu & Du, 2018). The need for these skills is confirmed by the annual data journalism survey, "The State of Data Journalism" (2022). According to these results, skills related to working with data seem to be rated slightly more important than those related to visualisations (State of Data Journalism, 2022). Also, more participants seem to work with data than with visualisations: Three out of four stated that they need to analyse data, 62% collect data and 45% clean data, while only 54% create data visualisations themselves and less than a third of them use technical or

programming skills. Furthermore, these are defined as new skills that could help journalists to be more agile towards new trends and changes in the field (Bradshaw, 2018; Kirchhoff & Renger, 2019).

However, there seems to be a gap between the skills, data journalists say they should have and the skills they think they possess. In the same survey, data journalists rated their skills in journalism as “advanced”, in data analysis and visualisation as “novice” and “intermediate” and in data wrangling, scraping and programming as little or none (State of Data Journalism, 2022).

2.2 Data Journalism Backgrounds

This lack of data-specific skills may be due to the different backgrounds of data journalists. Most are trained and work in “traditional” journalism, with only some having a background in statistics or data science (Graham, 2015; State of Data Journalism, 2022; Zhu & Du, 2018). Data journalism skills are still largely undervalued: Many have not received data journalism training in higher education and have had to learn the skills themselves, with many being completely self-taught (Heravi & Lorenz, 2020, Kennedy et al., 2021; Kõuts-Klemm, 2019; State of Data Journalism, 2022). This is reflected in the areas in which data journalists want to be trained: data visualisation, data analysis, machine learning, and data wrangling (State of Data Journalism, 2022).

2.3 Changing the Field of Data Journalism: COVID-19

The COVID-19 pandemic has led to one of the most rapid changes in the field of data journalism. Data journalism has not only been provided with major opportunities, such as the accessibility of large data sets, but it has also “gained significance and legitimacy during the COVID-19 pandemic“ (Ramsälv et al., 2023). Data journalists addressed the societal need to make sense of a global pandemic through complex data sets. However, new challenges were emerging, such as managing and addressing data uncertainty in their stories, presenting and explaining complex data and data connections as well as the risk of reporting fake news (Westlund & Herminda, 2021, Desai et al, 2021; Quandt & Wahl-Jorgensen, 2021).

2.4 Challenges in Data Journalism Training

These realities of data journalism present several challenges for training data journalists. First, there is a lack of time and economic opportunity in the daily work of journalists for upskilling or training: they must fulfil their duty to report daily stories first, and can only be trained in new skills after that (State of Data Journalism, 2022). The same applies to teachers. They are often former journalists with little or no experience in data work. They

often have to learn data journalism skills on the job, with little time or opportunity to do so. This is changing, however, as more data journalists offer training rather than having it done by journalism trainers. (Davies & Cullen, 2016; Hannis, 2018; Heravi, 2019; Hewett, 2016; Treadwell et al., 2016; State of Data Journalism, 2022).

Second, many challenges are related to the data-intensive work that journalists are often not used to. The reluctance of many journalists to work with mathematics and statistical data work is cited as one of the biggest challenges in teaching data journalism: "Journalists are trained to write stories, not in statistics or coding, however" (Reilly, 2017, p. 8). As a starting point, they need to find data to work with, often using open data sources (Aitamurto et al., 2011; Karlsen and Stavelin, 2014; Loosen et al., 2015; Reilly, 2017). The most common sources are government sources (Open Government), followed by non-commercial organizations such as universities, research institutes or NGOs, or press releases from private companies. Less frequently, leaked data such as the Panama Papers data or social media data are mentioned. In rare cases, data is collected by the media itself, but more often media-specific data comes from surveys or pre-existing data from archives or recipient counts (Beiler et al., 2020; Loosen et al., 2017; Stalph, 2018; Tandoc Jr. and Oh, 2015; Zamith, 2019).

Concerning the data itself, students and faculty alike face challenges in understanding the authenticity of data, as well as the ethical and legal issues surrounding data privacy (Burns & Matthews, 2018; Graham, 2015; Lewis et al., 2020). Data and statistical methods are often perceived as objective and independent, but on closer inspection, they are never completely unbiased because people create and (unintentionally) influence the data and have their own agendas. (Tandoc Jr. and Oh, 2015; Tong and Zuo, 2019). The absurdity of the supposed objectivity of data is demonstrated by Hill (2020): She examined graphs on abortion and showed how, for example, shortcuts, misleading interpretations, the use of far too small data sets, and the dehumanization of women can be used to manipulate recipients and force a strong negative emotion toward abortion. In particular, predetermined data categories and structures are rarely questioned by journalists (Lowrey et al., 2019; Lowrey and Hou, 2018): “Critical voices say that journalists depend on the information they get, and often the pieces of information they get are already ‘framed’” (Kõuts-Klemm, 2019, p. 301). The same is true for transparency: while data sources are sought and recognized as a quality feature, they are often poorly implemented (Loosen et al., 2015, 2017; Stalph, 2018; Tandoc Jr. and Oh, 2015; Young et al., 2018; Zamith, 2019). Also, by no means all data projects use at least two sources (Loosen et al., 2017; Stalph, 2018; Zamith, 2019).

Working with data is exactly where training should focus, but this is again complicated by the scarcity of classroom time. (Bradshaw, 2018; Davies & Cullen, 2016; Graham, 2018; Hannis, 2018; Hewett, 2016; Treadwell et al., 2016). Also, linking the lengthy data work

to the story at the end to increase student motivation is challenging. Results are often not visible until late in the process (Graham, 2015; Hewett, 2016).

2.5 Addressing Challenges in Data Journalism Training

It is therefore important that teaching addresses these issues and provides different approaches to working with data and visualisations (Bradshaw, 2018; Burns & Matthews, 2018). Many authors cite the need for more qualifications and regulated processes. Especially in the field of data and statistics, there is a lack of expertise and critical thinking. Investing in education and training here would raise the level of data handling skills (Lowrey et al., 2019; Stalph, 2018).

One possibility is to establish methods related to data work as journalism methods (such as the interview method), for example by starting with them at the beginning of training (Burns & Matthews, 2018; Bradshaw, 2018; Heravi, 2017; Hewett, 2016). Data handling, they argue, is the foundation for further steps such as scraping, data cleaning and analysis, visualisation and, ultimately, telling data stories (Constantaras, 2016). This approach can be summarised as teaching computational thinking from the very beginning: understanding computation and being able to critically question it (Burns & Matthews, 2018; Hewett, 2017; Lewis et al., 2020).

Another way to motivate students is the opposite of the previous one: To help students see that working with data is about telling stories, start the data journalism journey away from the goal and begin with visualisation and storytelling. This makes it easier for them to focus on topics and choose those that are of personal interest to them, increasing their motivation (Bradshaw, 2018).

In general, projects should be published and thus consumed by real recipients (Fuller, 2018; Graham, 2015). With these approaches data journalism can be introduced as an attractive career option (Weiss & Retis-Rivas, 2018).

3 Methods

To address the challenges of data journalism training, we conducted semi-structured interviews with journalism trainers in the German-speaking areas of Europe (Austria, Germany and Switzerland). We chose the interview method because of the possibility of having exploratory and in-depth conversations about the challenges trainers face. In addition, we know from our previous research on data journalism that it is easier to persuade data journalists to speak with us than to fill in a lengthy survey. 17 interview

requests were answered by 10 participants. The interviews were conducted via Zoom from autumn 2020 to spring 2021.

We aimed for maximum variation within the sample. We included participants from different German-speaking countries: 3 participants worked in Austria, 3 in Germany, and 4 in Switzerland. We also wanted to balance our sample as much as possible in terms of gender. It was very easy for us to reach male trainers, but our initial requests were only answered by one female data journalist. Therefore, we specifically searched for female trainers and managed to interview 4 female and 6 male trainers in total. This is in line with the annual data journalism survey "The State of Data Journalism" (2022), where 58% of participants identified as male, 40% as female and 1% as non-binary/genderqueer. 9 of the trainers we interviewed were working as a (data) journalist daily in addition to teaching data journalism.

The interviews lasted between 29 and 65 minutes and were recorded and subsequently transcribed using standard German orthography. The data was analysed using Kuckartz's (2018) content structuring content analysis with a priori categories and computer-assisted with QCAmap software.

For the sake of clarity, in the following results section, we use the term "trainers" to refer to the 10 participants in our interviews – data journalism trainers who gave us insights into their approach to data journalism and how they run training courses. The term "participants" is used to refer to those the trainers are talking about: the aspiring data journalists who attend their trainings. We translated direct quotes into English.

4 Results

4.1 Data Journalism Training – An Overview

In general, trainers describe two types of training: The first type involves working with data analysis and data visualisation tools. These courses tend to be shorter and provide an overview of the field of data journalism and the methodologies used. In the second course type, participants learn programming – mostly for data processing and analysis but also for data visualisation. These tend to take more time and effort than courses that work with tools that guarantee faster results but are limited in their functionality.

Most courses have a general data journalism knowledge base at the beginning. They offer practical examples of stories, but there are also meta-discussions about the field, i.e., about approaches, tools, forms of presentation or methods. Although there is no set workflow for data journalism, there are certain steps that practitioners and scholars agree

on (Bradshaw, 2011; Lee et al., 2015; Riche et al., 2018; Stoiber et al., 2019; Uskali und Kuutti, 2015). Courses tend to follow these steps, from an initial idea to publication:

1. finding and researching stories and data sets,
2. source criticism,
3. data sourcing/gathering/collection and preparation,
4. (visual) analysis and basic (descriptive) statistics,
5. building visualisations for readers and telling the final story.

This workflow is presented at the beginning of the course but will not be strictly followed later, as participants should learn to use techniques and tools in a variable and flexible way. For example, sometimes the starting point may be an interesting data set or a type of visualisation a data journalist wants to use.

4.2 Challenges of Data Journalism Training in General

The first major challenge in data journalism training mentioned was dealing with the different backgrounds of the participants. Trainers describe that some participants have a basic understanding of working with data or basic statistical skills. Others have an aversion to mathematics and data, and corresponding difficulties in abstract thinking, or even problems in finding suitable data sets, or in dealing with operational software such as Excel. When students face such difficulties, the already high effort required to familiarize oneself with the complex topic of data journalism becomes even higher and, in some cases, unattainable. These different backgrounds are also frequently mentioned in the literature as cited in Sec. 2.2, with the literature further highlighting that more people have a journalism background than a background in statistics or data science.

4.2.1 Frequently Asked Questions

The diverse backgrounds are reflected in the frequently asked questions by participants. Questions are very individual and relate to specific problems in their process, i.e., concerning tools and how to use them. It is essential to answer those questions because if someone loses the thread, they will not be able to keep up later, and some people will not be able to complete tasks without this individual support. Trainers cite specific questions such as: How do I get out of a row in Excel? Why are the numbers separated by a period and not a comma? How does a formula work? Why does my visualisation tool incorrectly recognize numbers as text? How do I adjust colours? How do I integrate the final visualisation into my own blog or editing tool?

Again, trainers mention that participants often lack basic skills, such as technical computer literacy or (creative) storytelling with data and visualisations. Participants also frequently ask questions about abstraction and orientation: They lack the ability to navigate large data sets or to reproduce a task in a similar way. This would be easier if

they could program. However, they often do not see the benefit of learning programming skills when – at least at first glance – it is so much easier to work with spreadsheets.

4.2.2 Building a Common Ground

Accordingly, it is challenging for trainers to create a common ground for all participants to work together and to find the right pace in the course. It is a challenge not to leave anyone behind, but also not to bore the participants. One trainer described: "It's quite difficult to teach everything they actually need to be able to use it and still not do too much." (IP 8). The right amount and the right form of input were also mentioned: For example, creative problem-solving is better learned through examples than through pure theory.

4.2.3 Data Journalism in a Daily Work Routine

The transfer of knowledge to the participant's daily work routine is particularly important in training: No journalist attends a training course out of pure interest in data journalism. They expect a direct benefit for their daily work as journalists. Trainers, therefore, face the challenge of selecting content and difficulty levels that are frequently encountered in everyday journalism. They also need to motivate participants to apply their knowledge later: No matter how intensive a training program is, participants have to teach themselves, make mistakes, and research how to solve problems, in order to become familiar with the complex field of data journalism and become data journalists. This point is also supported by the literature, which states that a key point for the successful training of data journalists is to establish methods related to data work as a journalism method that is used regularly, similar to other methods such as interviews (see section 2.5).

4.3 Challenges Related to Data and Data Work

When comparing specific challenges related to data and data work with challenges related to visualisations, trainers rated the former as more challenging than the latter. One reason for this may be that a large part of data journalism work, in general, involves working with data – from researching data and finding stories in data to analysing data and testing hypotheses, etc. The literature also sees data handling skills as slightly more important than visualisation skills (see Sec. 2.1) and cites many journalists' aversion to mathematics as a barrier to training data journalists (see Sec. 2.4).

Challenges related to data work start at the very beginning of a data journalism process: finding the right data set. In terms of source, trainers use 1) provided data and open source data (government, offices, open data portals), 2) researched data (through calls, queries) and collected data (scraping, building database), 3) self-collected data (together with scientists or through a call for a story), and 4) data from platforms or sensors (overall

similar to the sources mentioned in Literature, see Sec. 2.4). Different story angles or questions require different data sets. Often, there is no one perfect data set for a story, and participants will need to be creative in approaching their questions, for example by combining datasets. In particular, critically analysing a source, as well as questioning and understanding the context of a source (who provided the data and what was the intention) is very challenging for students. As they often have problems finding a source, finding a second one for corroboration is equally challenging.

Once a data set has been selected, the challenges become even more demanding. Almost all trainers cited data cleaning and processing when data formats are unstructured or non-machine-readable as key challenges for participants. Data cleaning in particular can be time-consuming and is often underestimated by participants. As a result, many fail to get the data into the right form for further analysis.

Next, the analysis must be done correctly. Many trainers recommend not using complex statistical methods. It is very difficult to choose the right one and it is too easy to make mistakes. This should be the job of scientists who have been properly trained and know how to use statistical methods correctly.

Usually one must "jump in at the deep end" (IP 3) with data work, since there are no predefined approaches for learning data work. One reason for this might be that questions and problems in data work are very individual and vary from case to case, both in terms of the data itself and the chosen method of analysis. For this reason, training is often self-study.

4.4 Challenges Related to Visualisations

As mentioned above, trainers describe working with visualisations as less challenging than working with data. Also, the literature tends to describe barriers more in terms of data and less in terms of visualisations (see Sec. 2.1). This may be due to the role of visualisations in data journalism work. They are used for two reasons: first and foremost as an output format to tell a data story and to make it understandable. For this purpose, less complex visualisations are used so as not to overwhelm readers (e.g. Beiler et al., 2020; Loosen et al., 2017; Stalph, 2018; Tandoc Jr. & Oh, 2015). Second, visualisations are used as an analytical tool (visual analytics), i.e., when data is very complex, to get an overview of the data (Keim et al., 2010; Mathisen et al., 2019; Stoiber et al., 2019).

However, trainers still describe difficulties with visualisation work. First, it is a challenge to find the right visualisation for a data set and the story a data journalist wants to tell. This is especially challenging for new data journalists who may not have experience with which types of visualisations are understandable to readers or what their informative

value is. Especially design and colours have a great impact and can strongly influence statements.

Second, data journalists must decide whether to use a tool or create a custom visualisation. Tools offer quick results, but data must be processed correctly to use a particular tool. Also, tools can be expensive and are limited in the types of visualisations or designs that can be created. Programming offers many more possibilities but requires certain skills and can be much more time-consuming.

In conclusion, the participants' expectation of visualisations is that they can be created fast and effectively, but the reality is much more complex and demanding.

4.5 Methods to Meet the Challenges

Finally, trainers note that there is no perfect support when it comes to the challenges of working with data and visualisations. However, trainers identify guidelines that they use throughout the process and adapt to individual questions. They agree with the literature that data work should be established as another research method in journalism (see Sec. 2.5).

First, they describe the added value of a live presentation over a recording. Here it is particularly important to address examples (best and worst practices) and to demonstrate the data journalism process live. The focus is on trying out methods yourself, researching errors yourself, or learning from peers in small groups through a personal exchange. It is important to create a culture where questions can be asked at any time during and after the course.

Second, handouts or cheat sheets are also distributed after the course. These include specific commands, solutions to common problems, uses of different diagram types, ways to access data, pitfalls in data cleansing, etc. If programming is taught, coding notebooks (including documentation) in a particular programming language are used. In addition, most trainers hand out collections of links to tutorials, videos, articles, literature, applications, tool collections, etc. These resources help participants to learn on their own and integrate data journalism into their daily work, which is a crucial step after the initial training to become a data journalist.

4.6 COVID-19 – Changing the Field?

For COVID-19, the trainers are divided on the extent to which the pandemic has changed the field of data journalism. In any case, data journalism and data itself have become more visible, which inevitably triggers discussions and debates – also about the role of the media in society and the responsibility and power of journalists. Data literacy among journalists has presumably increased, as the pandemic has increased the need for data-

driven stories. Awareness of what data means, what challenges data can bring, what a meaningful visualisation entails, and how to read data visualisations are also being discussed more broadly in some cases. Trainers disagree about whether readers' data and visualisation literacies have increased. To some extent, it is possible to "expect" (IP 10) more from readers, for example, data journalists include R-values or exponential growth in their stories. In this context, it is particularly important to critically examine and explain the limitations and possible errors of data (analysis) and visualisations. Here, too, scientists address the new challenges posed by the pandemic, but overall they seem to see greater opportunities for data journalism than the trainers we interviewed, who were more cautious in their optimism (see Sec. 2.3).

5 Conclusion

In conclusion, the field is very diverse in terms of, needs, tasks, tools and resources used. The literature and our interviews show that data journalists come from different backgrounds and have different approaches to doing data journalism, i.e. focusing solely on tools or programming. As a result, the challenges related to data and visualisations are also highly dependent on the use of data, data sets, analysis, visualisation methods, etc. Nevertheless, some conclusions can be drawn for the further enhancement of data journalism education.

Our interviews as well as the literature show that there should be a combination of training in the beginning followed by autodidactic learning. Initial training is important to make data journalism more accessible and to avoid beginners feeling overwhelmed by the complexity of working with data and visualisations. These initial training should:

- Have a focus on data work as this is more challenging than creating visualisations, especially in the beginning.
- Still include a part where visualisations are discussed. Beyond the question of how to properly visualise a data story, visualisations could play a role earlier in the process, using the method of visual analysis, where visualisations can be used to get (quick) results or to get an overview of a data set and the stories it might contain.
- Allow enough time for open questions, which can vary depending on the story, the data set, the approach, the background of the participants, etc.
- Prepare different resources to bridge the gap to the second part of learning data journalism: self-learning.

Later, there is the process of self-learning, in which the knowledge acquired in a training course must be applied to everyday (data) journalism work. Trainers and literature agree

that one training course does not make a data journalist. Skills can only be internalised and developed if they are used frequently. A concept that could enhance this process is “onboarding”. Onboarding is a self-learning method that considers a person’s environment, such as the tools they use. Basically, people learn how to use something while simultaneously using it. This could be particularly well suited to data journalism, as context sensitivity is often cited as very important in learning: providing help and training at the very moment a question arises.

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6 Limitations

This paper focuses on challenges in data journalism training by using the method of semi-structured interviews with trainers in the field of data journalism. Our sample is limited to the German-speaking area and could be extended or compared to other areas. Also, the results could be verified using another methodological approach, such as a survey or newsroom observations. In our interviews, we focused on the challenges of data journalism training and the COVID-19 pandemic but did not include topics such as artificial intelligence (AI) and its impact on data journalism. Some articles have already discussed the opportunities and challenges of AI for data journalism, i.e. in terms of objectivity, accuracy, speed, combating fake news, etc (Biswal, 2023; Frąckiewicz, 2023). Research on the use of AI in data journalism could yield interesting results for the future of data journalism education.

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