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Teaching the critical role of designers in the data society: the DensityDesign approach

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Abstract: In the modern 'data society', designers play a key role in the creation of artefacts that mediate our access to data and information. These artefacts include data visualisations and interfaces. Within this context, there is a growing risk of design educators training professionals who are indifferent to, or unaware of, the political power of the devices they contribute to creating. In this paper, we draw on our experiences in the DensityDesign course to identify and formalise a didactical approach providing students with opportunities to critically reflect on their work while gaining the technical skills they need as information designers. The paper describes the course's historical evolution, its didactical goals and its current structure. It then provides an overview of the didactical approach identifying practices that other design instructors can reproduce, entirely or partially, at three different levels: through the methodological framework, the situational tactics, and the research artefacts students produce throughout the course. Finally, a critical discussion evaluating the limits and risks of the proposed approach is provided based on our didactical experiences.

Keywords: *Information visualisation, information design, issue mapping, data publics, teaching tactics*

1 Introduction

Designing visual artefacts in the so-called "data society" requires a set of skills that traditional design education often fails to provide. Designers assume the role of "data intermediaries" (Baack, 2015) able to transform data into information and bring it closer to individuals' daily experiences. The rapid shift to digital communication and the rise of data infrastructures as main access points for information requires not only technical skills, but more importantly, a critical stance that avoids a-critical data enthusiasm or data-isms in general. As stated by Hankey and Tuszynski (2017,



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pp.53-54) the growing belief in techno-solutionism and in the infallibility of data has become a pervasive threat in today's data society:

Efforts need to be made to educate designers, technologists and engineers to more fully understand the contexts in which their designs are used and the impact they may have in the real world once they are implemented. This effort could begin at the educational level, ensuring that designers, technologists and engineers are taught not only to produce and create innovative and commercially viable technologies, but also responsible ones.

In the current time there is indeed a growing risk for design to become “weaponised” (Tactical Tech, 2018) also thanks to the work of designers who are unaware of, or indifferent to, the political power of the devices, interfaces and data structures that mediate access to information.

The DensityDesign course is a teaching lab that has aimed to make the complexity of social phenomena visible, accessible, understandable and manageable since 2004. Over the years, the course structure, contents and methods have been adapted to mirror the evolving nature of the technical and critical skills needed by design students entering the professional world. The overall goal of the course is to teach students how to design in a complex world, provoking them to reflect on the social and political implications of creating data and information intensive artefacts. By integrating statistics and semiotics into information design, the course also introduces students to the interdisciplinary collaboration required to manage complex issues through data and information.

With this paper, we formalise the current approach, showing the course's didactical goals, organisation and outcomes. In so doing, we seek to provide a modular educational model that can be replicated, entirely or partially, by other design educators.

2 History of the Course

The DensityDesign studio-course has roots in the visual communication of complex phenomena: since 2004, it has allowed generations of students to engage with and reflect on the role of information design and data visualisation in addressing complex issues. Through the years, it has evolved according to transformations in the communication landscape and the media sphere.

Deeply rooted in complexity theory (Ricci, 2010), the course originally focussed on creating visual artefacts seen as generative devices (Scagnetti, Ricci, Baule, & Ciuccarelli, 2007). After a few years, it reached maturity (Valsecchi, Ciuccarelli, Ricci, & Caviglia, 2010) moving towards the idea of social complexity, with reference to Actor-Network Theory and Controversy Mapping (Venturini, 2010). In 2014, we reflected deeply on the increasing availability of data through the Web and reframed the course's sources, methods and tools while taking cues from issue mapping practices (Marres, 2015). The current structure incorporates approaches from the aforementioned areas in order to present our students with design challenges that force them to engage with the issues inherent to the visual communication of information.

3 Course Structure

The course is a five-month studio attended by students in their last year of M.Sc studies in Communication Design; as such, these students already have a solid background in visual communication. The course typically enrolls about fifty students who work in groups of four to six; group work is essential to developing the skills required in the course.

To address the concepts of social complexity through data by designerly means, the course interweaves other disciplines that provide students with knowledge in statistics and semiotics. To do so, the course utilises individual exercises, such as “info-poetry,”¹ and hackathons in statistics. The course primarily relies on workshop sessions, in which teachers review and discuss students' work with them. Theoretical lessons are used to introduce the conceptual bases for designing communication devices with data. The faculty provides each group of students a theme that will be explored in different ways during a three-phase process. The provided themes are broad enough to allow students to choose their specific frame for addressing them.

¹ Info-poetris (in Italian infopoesia) explores the artistic side of data visualisation in order to stimulate an empathic reaction with the represented topic

Phase 1 DATA AS MATERIAL	Phase 2 DATA AS ARTEFACT	Phase 3 DATA PUBLICS
→ Exploring the issue	→ Mapping the issue	→ Public engagement
<ul style="list-style-type: none"> - Structured data - The 'official version' - Tools and methods (warm-up) 	<ul style="list-style-type: none"> - Digging the web (and the controversy) - Unstructured data (scraping) - Facing the complexity 	<ul style="list-style-type: none"> - Take (design) a position - (Data) experiences (interactive...) - Communicatin Design for Advocacy
Output: Infographic + webpage	Output: Web report	Output: Experience > webpage

Figure 1. Summary of the three phases and the student outputs at the end of each one.

The course is divided into three phases that gradually introduce students to the criticalities arising when communicating with data and information in complex scenarios. Each phase approaches data from a different perspective (see Figure 1).

3.1 First Phase: Data as Material

In the first phase, students approach data as a material to design with: as they would do with any other material, they obtain it, evaluate its quality and provenance, test its limits and eventually design with it. In this phase, students are introduced to the tools and technical skills needed to deal with data (e.g., visual variables, spreadsheets and visualisation software).

At the beginning of the course, students pick one theme among those proposed by the faculty. Proposed themes tackle societal challenges and span across different domains (e.g., the environment, migration, radicalisation and unemployment). The first task for each group is to select a sub-topic from the broader theme. Then, students are asked to explore the chosen sub-topic through the data provided by official sources. The first phase ends with the delivery of two communicational artefacts: an infographic and a webpage for a newspaper² meant to provide an overview of the sub-topic.

Alongside learning new methods and tools for data visualisation, students are confronted with many questions, such as, “Which visual models should we use?” “Which visual variables should we consider?” and “How can we decline a visualization on different devices?” During the process, students also are forced to think critically about data sources, questioning the nature of “official sources”. The didactical focus is indeed on the evaluation and use of data sources: How are datasets produced? By whom? With what goals? What assumptions were made in the production of the data? What is a reliable and official source? Can data from different sources be combined into a single visualisation?

3.2 Second Phase: Data as Artefact

In the second phase, the focal point changes, moving from the use of pre-built data to its collection. Here, students deepen their knowledge on their sub-topic by collecting, analysing, cleaning and formatting data from online platforms. The task is to locate a controversial issue³ on the web, identify its actors,⁴ and map their positions and alignments (see section 4.1). The process is question-driven (see Figure 2): each group starts with a set of research questions, defines a protocol for data collection and analysis, and produces research findings using data visualisations. At the end of the phase, students deliver an interactive research report (see section 4.3.3) and present it to the class.

In this phase, data visualisation supports the iterative research process: each exploration must have a research question that is answered through a visualisation. Students also are asked to trace the research process by designing protocol diagrams (see 4.3.2), thus allowing reproduction of the process. In addition to learning how to use data visualisation to answer a research question and to keep track of the research process, students also reflect on technical and ethical issues related to dataset design. Which data should be collected? Which biases do the chosen tools/methods bring? What should be considered an error and discarded? How can we make transparent the process of data collection? How should we deal with sensible information collected from the web?

² During the last three years, we have collaborated with a major Italian newspaper - “Corriere della Sera” - and its Sunday cultural supplement, “La Lettura”, which publishes some of the students' work.

³ In the course we use “controversy” as defined in Controversy Mapping literature: “controversies begin when actors discover that they cannot ignore each other and controversies end when actors manage to work out a solid compromise to live together” (Venturini 2010, p. 261)

⁴ We adopt the broad definition of “actor” from Actor-Network Theory: anything (people, groups or non-human beings) that acts or is activated by a social issue (Venturini et al., 2015).

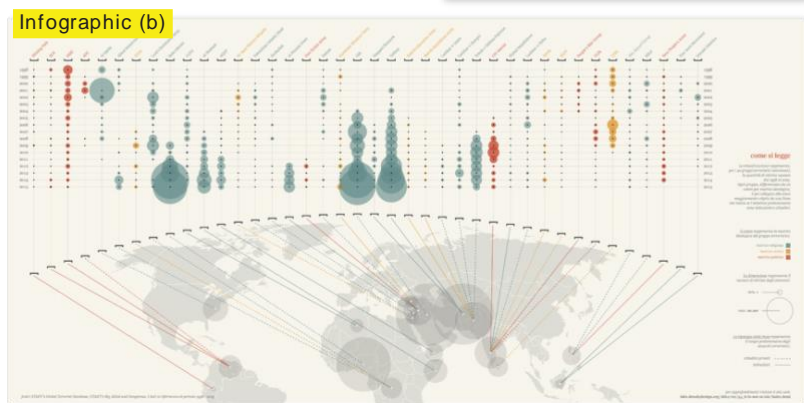
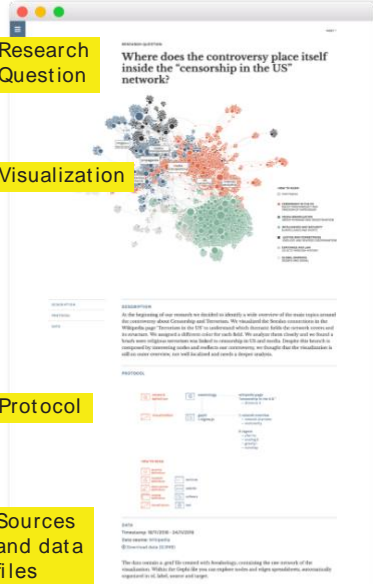
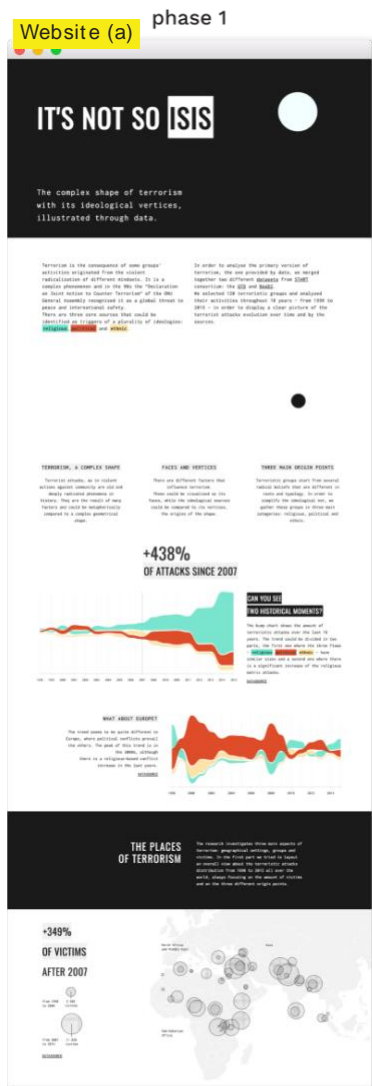


Figure 2. The figure shows a group's output for each of the three phases on the theme of radicalisation. Delivery outputs of phase 1 are a single page web report (a) along with an infographic for a newspaper (b), both based on data provided by official sources (here an example: <https://densitydesign.github.io/teaching-dd12/es01/>). Following phase 1, students deepened the subtopic using digital methods. In phase 2, students have to illustrate their research using a web template (c) delivered by the instructors (<https://densitydesign.github.io/teaching-dd12/es02/>). The output of phase 3 was the materialisation of their research in phases 1 and 2 by means of a third website (d) and a physical installation (e) (<https://densitydesign.github.io/teaching-dd12/es03/>).

3.3 Third Phase: Data Publics

In the third phase, the focus shifts from data to publics. Here, students learn how to foster public engagement when designing data experiences. Building upon the results of the second phase, students are asked to choose a position among the ones represented by the different actors identified in the previous phases. From (and with) that point of view, students develop a public engagement strategy designing data experiences and communicating them through the Web. In this process, data are used both to understand and communicate the complexity of social phenomena (similar to previous phases) and to trigger a response from their public. The technical choices communicating artefacts are left open and may include interactive websites, performances and physical installations. All of the outcomes are presented to the public during the Open Day, the final exhibition of the course, which usually takes place at the university.

The challenge of the third phase is to use data in order to share the complexity of an issue and to create public engagement. How do we engage a public that might be resistant to dealing with data? How can we take a position providing a specific point of view while respecting the complexity of the entire issue? How do we create interest and find a suitable balance between simplicity and completeness? In this phase, students also are motivated to reflect on what the “public” means, how different groups are mobilised around various issues (DiSalvo, 2009) and how data might play a central role in the process of public formation.

4 Didactical Approach

By asking students to describe, analyse and visually communicate one chosen issue, as mediated by available data, we seek to instruct students not only in visually communicating data and information, but more importantly, in reflecting on data's effects on such issues. At the same time, students engage with the larger role of communication design in a data-intensive society. To achieve this twofold didactical goal, we have adopted a strategy based on critical making (Ratto, 2011). Through various design tasks, students mature a reflective stance towards the political role of their practice. The devised approach entails a didactical infrastructure that guides students in their work, pushing them to react to the limits, risks and challenges of designing in our data society. This infrastructure involves three levels:

1. A theoretical and methodological framework that informs the research and design activity;
2. An array of situational tactics: work settings that encourage particular activities among work groups; and
3. A set of research artefacts that students produce throughout the course in order to guide the research process.

4.1 Methodological Framework

The didactical goal of the course involves teaching students to design and build communication artefacts both from the technical and the conceptual points of view. Students learn by doing while simultaneously becoming aware of their role as designers and the implications of their design decisions.

The methodological framework identified to achieve this goal is based on two main pillars: the proposed themes and the adoption of non-design concepts to guide the research design.

The first pillar is related to the themes students are invited to explore. Working with “wicked problems” (Buchanan, 1992) or broad societal challenges that are in the process of definition or redefinition (such as poverty, immigration and freedom of speech), students face cases in which no prior visual representations have been attempted, therefore requiring a new visual language (Latour, 2008). Since as teachers we are not expert in such themes, we identified two possible strategies to choose them: the first one is involving ‘issue experts’, persons that work in a given field and are able to point the students in the right direction (see section 4.2.1). The second strategy is to rely on intergovernmental organizations that identify societal challenges: in our case we relied on studies from the European Commission⁵. From those broad topics, we are confident enough that students will be able to identify and study one controversial issue that is close to their context or that they care about. As an example starting from the theme of climate change, a group composed of Chinese and Italian students studied how the debate related to nuclear energy unfolded in Western and Chinese society (see figure 5).

The second pillar involves adopting concepts and methods that appear distant from the design field, namely Controversy Mapping, Digital Methods and Issue Mapping—all of which are applied primarily during the second phase (see section 3.2). We borrowed these concepts not out of a desire to teach sociology or turn our students into media

⁵ To identify topics for the course, we draw on the “societal challenges” identified by the European Commission (see <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges>)

studies experts; rather, we introduced them into the course in order to force students to recognise the criticalities related to data mediation in our daily lives. Through these two pillars, the framework provides a setting (or better, a design challenge) in which the students are pushed to use all of the knowledge acquired in their design studies.

More specifically, we use Controversy Mapping to adopt the metaphor of maps (Venturini, Ricci, Mauri, Kimbell, & Meunier, 2015). Maps ultimately are visual devices that help explorers communicate what they have seen. They are also tools for other people who want to visit those places. The notion of the map also resonates with the idea of an evolving artefact, one that can be modified, annotated and improved (Mauri & Ciuccarelli, 2016). From Controversy Mapping, we inherited the concept of ‘actors’ to include everything that ‘acts’ within the analysed sub-topic (Venturini, 2010). From Digital Methods, we learn that all of our online actions produce digital traces that can be used to form a mirrored image of what is happening in society (Rogers, 2013). From the same methods, we also take on the concept of platform specificity; that is, every web platform provides different digital objects, each one with its own unique, medium-specific characteristics. From Digital Methods, we incorporate as well the important concept of the ‘repurposing’ approach,⁶ which resonates in the design field. Finally, following the Issue Mapping approach, rather than trying to mitigate the effects of digital bias, we embrace the idea that media technologies actively participate in the formation of the issues under study, and therefore need to be included as well in the study of controversies (Marres, 2015).

Weaving these concepts together, we ask students to understand what can be found about their sub-topics on the web. From there, we ask them to design approaches to collect relevant traces while keeping in mind the specificity of the medium and the platform analysed. The results are then collected in “visual reports” (see section 4.3.3).

The mentioned pillars are used across all the three phases, even though they are explicitly visible only in part of them. While in the third phase they are not mentioned, the described concepts are widely used to address the students work.

4.2 Tactics

In addition to the methodological framework described above, we make use of a number of didactical tactics. We create a series of semi-structured moments, or situations, that promote particular ways of working while training specific skills. The same tactic may be deployed at different stages of the course, with slightly different goals. For example, hackathons (see 4.2.2) are used in the data visualisation module as well as in the statistics one. Another example is peer-to-peer learning (see 4.2.3), which is consistently promoted throughout each phase of the course.

4.2.1 Issue Expert Symposium

During the initial phases of the work, students are asked to explore their chosen theme and to identify the sub-topic they will analyse through the course. To support this task, the student groups, supported by the “statements and dataset map” (see 4.3.1), present and discuss their themes with experts on the topic. This discussion is not a project pitch by the expert to the students or a presentation made by the students to the experts. Rather, it is a collective moment of knowledge transfer.

The map becomes a space for discussion: students use it to show what they found and which issues they identified. For their part, the experts can highlight the most interesting ideas and ‘fill’ the map with their knowledge on the topic, helping students in their process of sub-topic framing. At the same time, like many of the other tactics, this step also forces students to reflect on useful concepts. First, because the issue expert review happens with the help of the “statements and dataset map,” the moment is also a way to appreciate the role of visual languages in fostering interdisciplinary conversation. Secondly, talking with a domain expert in person shortens the distance between the group and their theme, which otherwise only would be approached with, and mediated by, various datasets.

4.2.2 Hackathon

During the course, students participate in a series of hackathons, time-boxed efforts during which students are asked to perform a task. For example, students approach the task of visualising a dataset during one half-day hackathon. The hackathon begins with each group picking a random dataset; then, each of them has to find one question to ask the dataset before designing a visualisation that is able to answer that question. The hackathon ends with a collective

⁶ In the Digital Methods context, the term means to analyse the original use of a device, identify the digital objects it provides and understand how this information can be used for a different purpose. It is a common operation done to understand how different web platforms can be used for social research, understanding their role, their limits and biases (Bounegru, 2012).

presentation (see section 4.2.3), during which students share their results and groups discuss the criticalities encountered during the hackathon.

Hackathons often aim to design a prototype that then is developed in a second stage. In this course, we use hackathons as sandboxes, spaces for error: students are provided with the very rare opportunity of “throwing away” a project. Having to produce a visualisation in half a day and publicly present it, they encounter several problems related to data visualisation: how to deal with data, how to set up strategies to avoid errors in the encoding, how to make something legible and how to add decoding instructions (legends). Through this practice, we have seen that hackathons are more efficient than teaching the same concepts in theoretical lessons. We also adopted this format in the statistics module in order to engage design students in the subject while showing its practical uses.

4.2.3 Peer-to-Peer Learning

During the course, students present on the progress of their work to the rest of the class and receive feedback. These presentations have a twofold objective: to help students reach a clear understanding about the state of their work and to underscore problems shared among groups. In terms of format, one group presents its work in front of the whole class, while another group asks questions and provides feedback.

Since students are not experts in their subjects, verbalising to an audience requires them to do critical editing and preparation. This exercise also encourages them to anticipate possible weaknesses in their project ideas. Meanwhile, the group of students who must ask questions of the presenters is compelled to listen critically to their colleagues’ work. Therefore, the dual role of students—to present and to listen—allows them to reflect critically on how to present in order to be criticised and how to listen in order to build critiques. Opening up the work process among students allows them to share successes and failures. At the same time, it helps to position students as micro-experts on their topics, serving as points of reference for the other groups.

4.3 Research Artefacts

During the three-phase research process, students are asked to produce various communicative artefacts. Alongside the three main outputs delivered at the end of each phase, we ask them to design a series of (minor) artefacts during the entire research process, with the goal of guiding their process. These research artefacts, like methodologies and tactics, force students to reflect on various issues while assisting them in developing data-related skills. In this paper, we propose the three most interesting and reproducible of these artefacts.

4.3.1 Statements and Datasets Map

In the first phase of the course (see 3.1), we ask each group to research and design a “statements and datasets map”. The map (Figure 3) visually connects actors’ statements with available datasets describing the issue under study. Students look for statements and datasets online (on blogs, news sites or social media) and connect them based on their affinity. Later, they search for datasets available from official sources and connect them to the statements. The map offers a visual overview of the various positions and sources composing a social issue.

The main didactical goal of the map is to help each group move from the broader theme to a specific sub-topic: each group uses the visual overview provided by the map to locate an interesting focus. At the same time, the design of the map should stimulate critical reflections about the diversity of points of view around a particular topic, and the related sources and datasets. Collecting and analysing very different and sometimes antithetical statements is a way to experience the impossibility of total objectivity. As such, we should explore multiple stances to gain so-called “second-degree objectivity”.⁷ The availability of multiple sources providing data about a given issue encourages students to evaluate the quality of each source and to make an informed decision on which to use. Finally, comparing the features of various datasets describing the same phenomenon represents one way of reflecting on the notion of measurements: a single phenomenon might be measured in very different ways.

⁷ “‘Second-degree objectivity’ is an objectivity obtained by the multiplication of different viewpoints; an objectivity that comes from diversity rather than from uniformity; an impartiality that comes from exploring a multitude of partial bias, rather than abstracting from them” (Venturini, 2012).

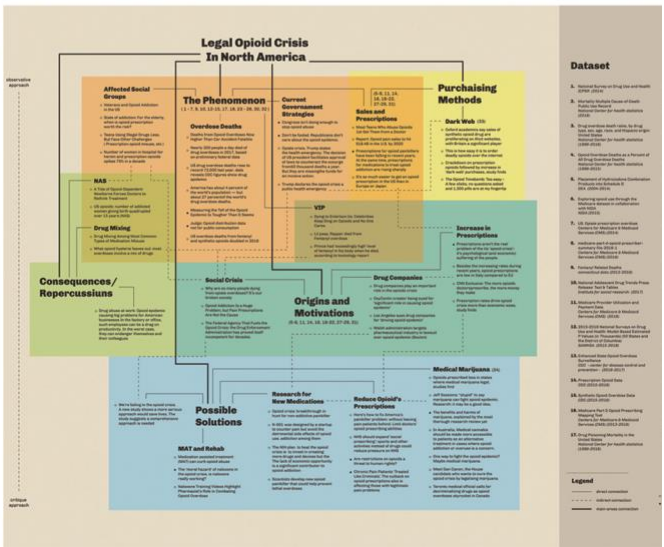
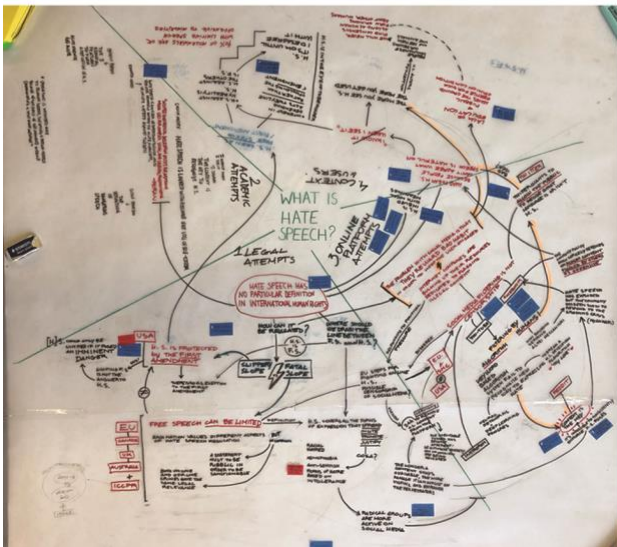
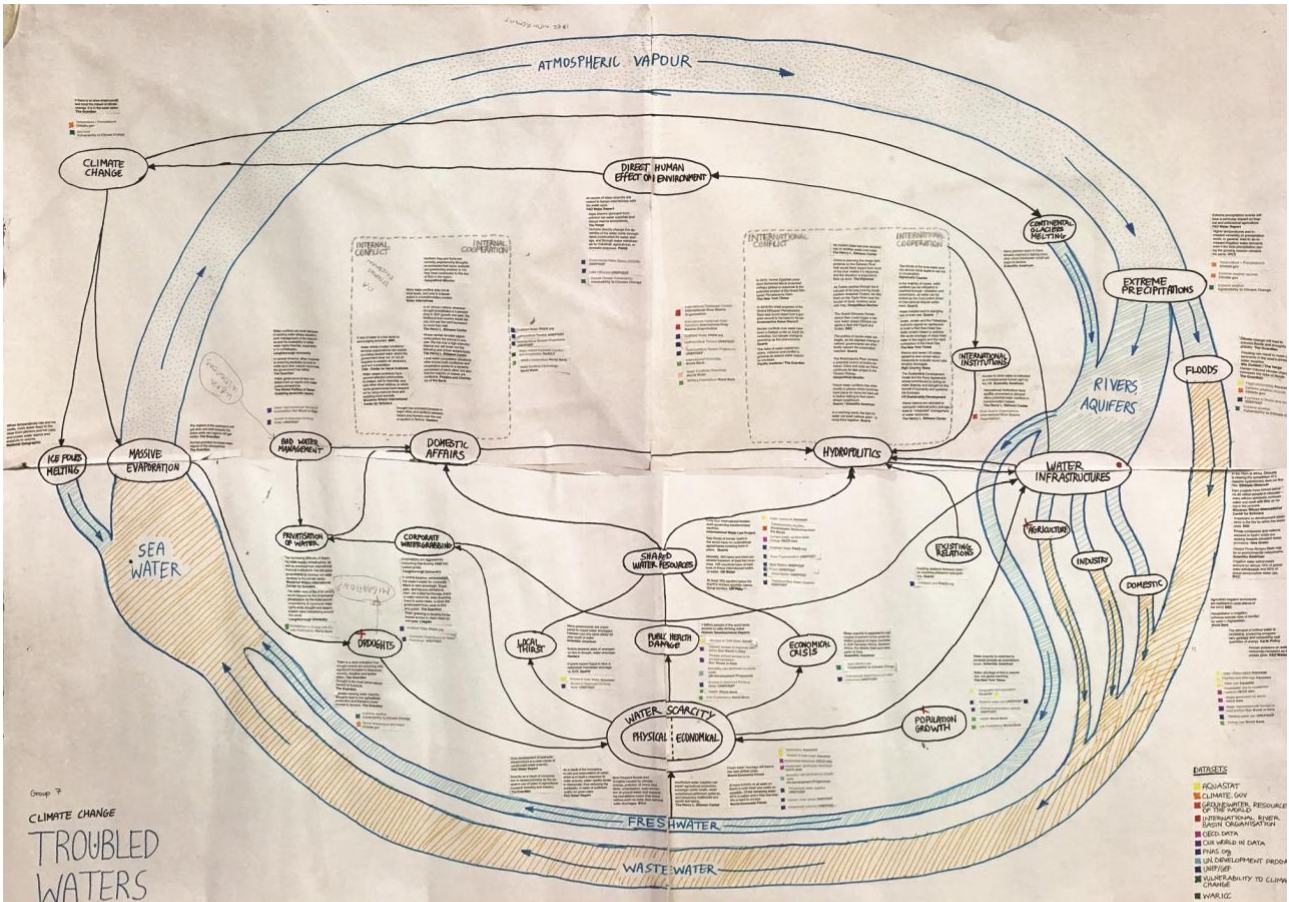


Figure 3. Examples of statements and dataset maps made by students on issues of worldwide significance: water conflicts, online hate speech and the opium crisis in the U.S. Using different techniques, they produce maps in which they visualise the relationships of the actors and their statements, connecting databases available from official sources. (see other examples at this link: <https://archive.org/search.php?query=subject%3A%22DD14+statements-map%22>)

4.3.2 Research Protocols

In the second part of the course (see section 3.2), students document their process by designing and updating a protocol diagram (Figure 4 and figure 5) for each analysis performed. A protocol diagram is a visual explanation of the steps undertaken during the research process. It includes research questions, analytical steps, tools used and designed outputs. The diagram is continually updated as the research process goes on, and it is meant both for internal use and for communicating the research process to others.

The task of keeping track of the research process in graphical form stimulates students to expose their analytical choices to public scrutiny. The protocol diagram works as visual evidence of the personal, subjective and arbitrary choices undertaken during the research process, thus teaching students about the non-objective, situated and interpretative nature of any data-driven study.

4.3.3 Research Template

During the second phase (see section 3.2), students learn to “design a dataset”. The focus of this phase is not so much on visualising a dataset, but on making choices during the process of dataset creation. In this phase, students are provided with a template: an interactive report structure that they need to fill in with content (i.e., text and diagrams). The template has a modular structure, and each main section is composed of four parts: a research question, a visualisation, a text describing the findings and a diagram of the research protocol.

The layout shifts the focus from the output to the process. With a pre-designed structure, students can put their effort into the design of the research process, focussing on how to build a dataset and how to operationalise a research question. Furthermore, the fixed structure of the layout forces students to proceed in a “question-driven” fashion: every visualisation included in the website should serve the purpose of answering a research question.

5 Discussion

Having tested the described approach with our students, we identified a few criticalities that design educators should keep in mind when adopting parts of the didactical scheme presented in this paper. The first critical aspect relates to the cross-disciplinary nature of the course and the involvement of disciplines relying more on lectures than studio-based activities. This fundamental difference can cause difficulties for professors from other disciplines when engaging with students in weekly reviews and providing feedback through a project-oriented mindset. As one solution, we paired professors from theoretical disciplines with tutors coming from a design background. A second difficulty emerges in integrating these disciplines into the course in such a way that students do not view them as independent (and less relevant) modules. Finally, because students mainly come from design backgrounds, they usually are more interested in project work and less willing to engage in more theoretical disciplines. To manage these issues, we identified assignments that put the concepts discussed by the professors into practice.

A second problem is that proposing broad and complex themes (see section 3.1) could cause students to get lost. When they fail to frame a specific sub-topic, it becomes difficult for teachers to help because the topic is outside their areas of expertise. Also, when students manage to identify possible sub-topics, it remains difficult to choose the one that will be most fruitful. As such, they risk spending too much time on exploring and looking for data, possibly discovering too late that the sub-topic is not sufficiently interesting. More generally, the students who are accustomed to receiving clear instructions on what they are supposed to do can become frustrated about being responsible for defining their own sub-topics. A possible solution would be to involve “issue experts” (see section 4.2.1) more in the process. However, more sustainable strategies should be identified because it is difficult to ask these experts to take the time to follow a course. They also may have their own points of view on the topic, which could heavily influence the students.

Another problem inherent to design education activities concerns the teacher-student ratio. Exceeding a certain number of students may make the professor-student relationship discontinuous and cause distress. In our case, the team includes five professors and five assistants, and more than 50 students has proved to be problematic.

Many parts of the described approach borrow concepts and practices from disciplines distant from design, making them sometimes hard to grasp for students. The course is heavily focussed on data, which, at the time of this writing, is not a topic introduced in our university’s design curriculum. These factors may intimidate students. They might be scared to show that they haven’t completely understood the topic; afraid of doing something wrong, they might limit themselves by mechanically reproducing examples provided by the teachers.

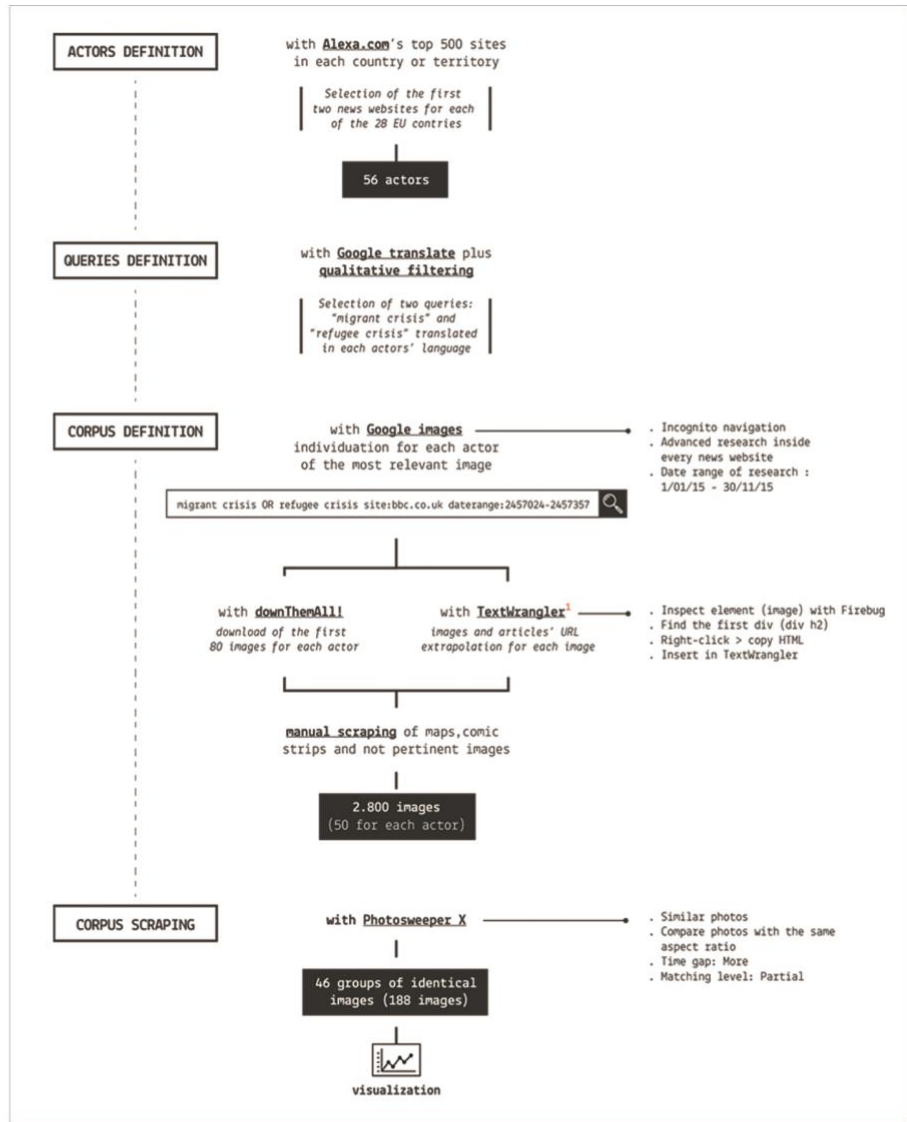
Finally, because the course introduces a series of tools to the student (e.g., Gephi, RAWGraphs, Excel, Tableau), they might design on the basis of functions provided by these tools, rather than think how to use them for their own research goals. Relying on tools brings about other criticalities, such as obsolescence and outdated status. As such, we continually update the course content and its tools.

THEME: MIGRATION CRISIS

Research question

Which photographs circulate the most in each EU country?

Protocol



Visualization that answers the research question

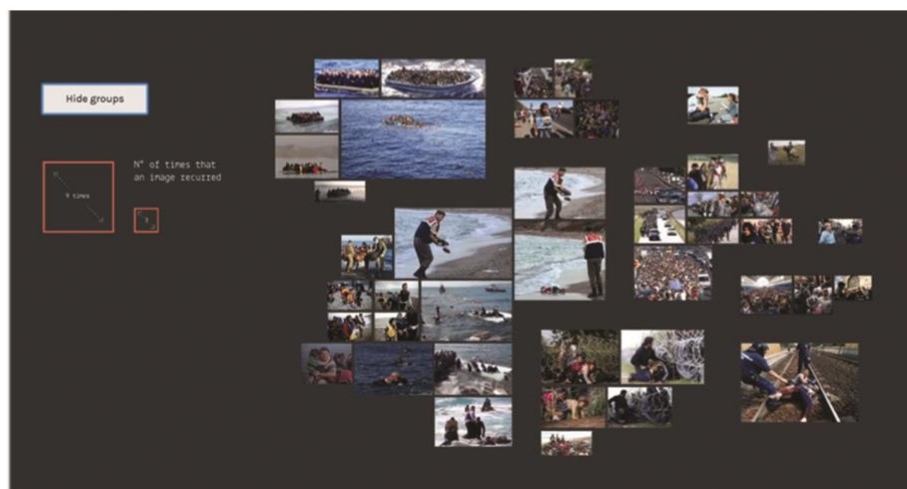


Figure 4. Based on a research question, the students experiment with digital methods in order to investigate different topics with the data. Visualisation is the visual device that answers the question. The image shows the protocol followed by a group of students and the resulting visualization in the topic of the migration crisis in Europe. The project is available online at https://densitydesign.github.io/teaching-dd11/es2/q4_migration_images/introduction.html

THEME: NUCLEAR POWER

Research question

Which kind of images were used by Chinese and American media in these particular times?

Protocol

Visualization that answers the research question

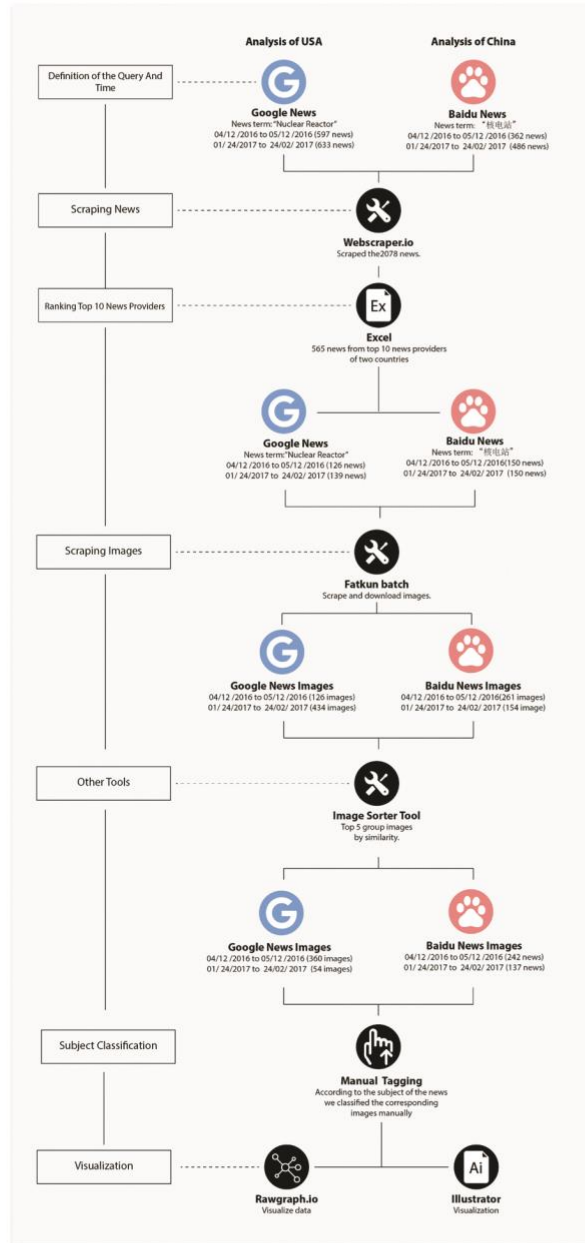


Figure 5. The image shows the protocol and the resulting visualization made by a group of Italian and Chinese students in the "nuclear power" debate. The protocol followed shows the use of tools that confront Western approaches with China (e.g. Google News and Baidu News). The project is available online at <https://densitydesign.github.io/teaching-dd13/es02/group06/>

6 Conclusions

This paper formalises the approach used in the DensityDesign course in order to make it replicable, partially or entirely, by other design teachers. The didactical approach has been formalised on three levels, from the theoretical framework, to situational tactics, to the artefacts used during the course (see section 4). On one hand, the goal of this approach is to train strong information design professionals. On the other, it aims to stimulate reflection on a designer's role in the information society by highlighting three possible perspectives: data as material, data as artefact and data publics (see section 3). The overarching goal is to encourage students' critical approach to data, opening up reflection, through practice, about the criticalities related to the visual communication of data and information.

Though we have yet to conduct a structured evaluation of this didactical approach, we can extract qualitative insights from the questions posed by students. For example, in the first phase, many students started to ask questions like, "Is this a proper source? What makes it more reliable than others?" Such questions demonstrate actual reflection on sources. More fundamentally, some asked, "I'm a designer, why should I define the structure of a dataset? Why should I define the most relevant aspects of a topic?" Such questions are actually the starting point for understanding designers' authorial role in communicating data and information.

To conclude this paper, we would like to identify future steps to address the limits and criticalities found in applying this approach. First, it could be beneficial to find a more structured way to involve issue experts during the entire course, in order to reassure students about their topical choices. Second, we would recommend stronger involvement from the other disciplines in the course, defining research artefacts that highlight the relevance of such disciplines to the information design profession. Finally, it could be beneficial to extend the training of design students to data-related software with ad-hoc courses or workshops in order to overcome the risk of a tool-driven approach to data and information communication.

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Below, credits for the images included in the paper.

Figure 2: project "Is so Isis" by Francesco Cosmai, Giacomo Flaim, Francesco Giudice, Barbara Nardella, Giulia Zerbin.

Figure 3: project "Water conflicts" by Alessandra Facchin, Alessandro Ferrari, Jingjing Gui, Paula Lozano, Nicolò Marchetti, Valeria Quiroga; "Hate speech": Nicola Brignoli, Francesca Brotto, Lea Mara Fabiano, Elena Filippi, Edoardo Guido, Jacopo Poletto; "Opioid crisis": Luisa Cadelli, Yixiao Cai, Eleonora Cappuccio, Francesca Grignani, Paolo Vernocchi, Carlotta Xiao.

Figure 4: project "When a picture is worth more than 950.317 words" by Agata Brilli, Giacomo Ciurlo, Michele Invernizzi, Giulia Piccoli Trapletti, Laura Toffetti, Hou Xuanxuan.

Figure 5: project "Do we need Pandora's gift?" by Manli Zhu, Simone Casartelli, Xiaoxi Huang, Xuechun Zhao, Yue Qiu.

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