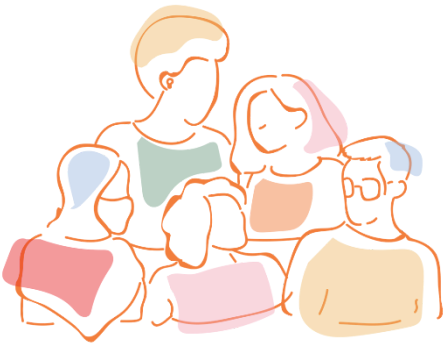

LEARNING DESIGN VOICES

PREPRINT

Design principles for developing critique and academic argument in a blended-learning data visualisation course

by Arlene Archer & Travis Noakes

Advance preprint version

How to cite this resource:

Archer, A., & Noakes, T. (2022). Design principles for developing critique and academic argument in a blended-learning data visualisation course. In T. Jaffer, S. Govender & L. Czerniewicz (Eds.), *Learning Design Voices*. Advance preprint. https://doi.org/10.25375/uct.20029130

Design principles for developing critique and academic argument in a blended-learning data visualisation course

By Arlene Archer & Travis Noakes

Chapter in brief

This chapter explores the challenges experienced by second-year journalism students in developing academic argument in a data visualisation course. The course focused on representing arguments that drew on aspects of educational inequality in Cape Town. Data is increasingly produced and circulated visually; and the means to generate data visualisations are becoming increasingly accessible. It is thus important to develop critical tools to engage with these kinds of texts. The chapter describes the principles for learning design that were employed to improve the blended-learning course into one that better supported students' development as critical designers and engaged citizens. Some of the principles included delimiting the scope of the task, encouraging the use of readily accessible design tools, introducing a process approach, developing meta-languages of critique, and acknowledging different audiences. The chapter ends by analysing the work of two students in light of these learning design principles. We discuss some of the gains and losses of moving from one digital format to another (PowerPoint to poster), the ways in which students adapt texts to different audiences and platforms, and the emergence of a meta-level critique of the data sources.

Keywords: academic argument, blended learning, data journalism, data visualisation, higher education, learning design, social semiotics

Introduction

Producing data visualisations with accompanying arguments is an increasingly important task for journalists (Engebretsen, Kennedy & Weber, 2018). Data visualisations comprise graphical representations of numeric data and are a "discursive resource used in the dissemination of statistical information" (Kennedy & Engebretsen, 2020, p. 22). At a South African university, second-year students in the Film and Media (FAM) production degree are introduced to data journalism in a five-week multimedia production course. Data journalism combines the traditional possibilities of journalistic storytelling with the scale and range of digital information now available (Bradshaw, 2012). According to data journalists, their emergent discipline is important for reasons that range from filtering the flow of data in the contemporary networked society (Meyer, 2012) to providing independent interpretations of official information (Matsunami, 2012). Through the activities in the data journalism course, students can explore the complexities of global economy, society and ecology, whilst discussing the ramifications of individual decisions.

Data is increasingly produced and disseminated visually and the means to generate data visualisation is becoming more accessible to a variety of people. There is thus a need to develop critical tools to engage with these kinds of texts. This includes considering the ways in which data visualisation can be used for a variety of rhetorical purposes, such as documentation, persuasion and manipulation. In order to construct an argument to a specific audience in an apposite way, design choices need to be made around size, shape, colour and composition. It is important to be aware of data journalism's limitations, such as the illusion of omniscience a data visualisation text seems to create, the perspectives it excludes and how it may preclude certain audiences by requiring complex visual and quantitative competencies (Walton, 2016).

This chapter demonstrates how a framework for argument in data visualisation (Archer & Noakes, 2020) was used to analyse students' texts and to inform design principles used to improve the second-year journalism course. Some of the changes in the course based on these principles included introducing a process approach to the teaching of academic argument, developing meta-languages of critique, and focusing on the criteria for selection when doing a comparison (a key aspect of academic argument). The final part of the chapter analyses the work of two students. It reveals the ways in which the learning design enabled these students to start critiquing data sources and develop critical academic argument.

Argument and critique in data visualisation: A social semiotic framework

Our approach to exploring argument is multimodal social semiotics, where meaning-making is seen as a social practice (Martinec & Van Leeuwen, 2008; Van Leeuwen & Jewitt, 2001). It is important that journalism students are able to use data visualisation to move beyond simple narratives; to gather, filter and visualise data in order to produce an "argument". Broadly speaking, argument is a logical set of ideas supported by *evidence*; "the existing accepted material that an 'arguer' agrees with, or resists, but nonetheless draws on to establish a position" (Archer, 2016, p. 94). Argument is often seen as impersonal or objective. However, a social semiotic approach views argument as a social process through

which texts reflect the methodologies, arguments and rhetorical strategies of situated authors adopting particular interactional positions for engaging their audiences.

Table 1 presents the Archer and Noakes (2020) framework for thinking about argument as a semiotic practice, specifically in relation to data visualisation and the teaching thereof. This framework investigates the semiotic encoding of ideational material in argument. Here the focus falls on students' *basis for comparison* in an argument (such as differences in levels of education obtained in diverse municipal wards) and the underlying classification identified for comparison. What is selected, including the chosen basis for comparison, is often as important as what is excluded. Students might choose to focus on social issues when comparing levels of education attained (such as pregnancy and single versus no parent households). Other students could focus on access issues (such as home language and income). We highlight these choices when we present the two student case studies.

The *discourses* that shape data visualisation are also important to explore. "Discourse" is understood here to refer to the ways social institutions define and regulate the practices within those institutions through the use of language or other semiotic modes. The analytical emphasis here falls on the location of semiotic resources (such as composition, size, shape and colour) within the discourses, practices and technologies that regulate their use. Zhao, Djonov and van Leeuwen (2014) highlight that normative discourses can be built into communication technologies, such as Microsoft PowerPoint or Excel. Our framework also prompts an exploration of the ways that interpersonal relationships are established within the discourse communities constructed in data visualisations. Here, the focus falls on how credibility is established, as well as the use of citation. In academic writing, credibility is often established through tentative assertions. These are realised through discourse markers such as "hedging" (Hyland, 1999, p. 104) which indicate the writer's decision to withhold complete commitment.

Table 1: Framework for analysing and producing argument in data visualisation (Archer & Noakes, 2020)

Meta-function	**Means through which argument is realised**	**Explanation**
IDEATIONAL – semiotic encoding of the world, concepts and processes in data visualisation	Basis for comparison	Selection of what is deemed comparable based on an underlying classification
	Discourses drawn on	Normative discourses, circulating societal discourses
INTERPERSONAL – establishing social relations in data visualisation	Establishing credibility	Use of data, hedging (confidence intervals), emphatics
	Citation	Choice of source, re-working of source,

		integration of source, placement of in-text referencing
TEXTUAL – the ways in which complexes of signs are combined to form coherent data visualisations	Choice of: ● Infographic ● Colour ● Font ● Size ● Shape	● Type of chart (e.g. bar chart, pie chart, line graph) ● Organisational or connotative uses ● Conventional or unconventional uses of font ● Size to indicate salience or growth ● Connotative or conventional uses of shape
	Composition	Minimalist versus “visual confection”; positionality and directionality: top/bottom, left/right, centre/periphery
	Relation between writing and image	Similarity, oppositional or complementary relations

The social semiotic framework outlined here provides a holistic view that is useful for providing feedback and recognising students’ work, as realised through the ideational, interpersonal and textual meta-functions. Next, we outline several principles for learning design informed by our analysis of student work using this framework.

Principles for learning design in a data visualisation course

The infographics poster design course is embedded in the five-week FAM production course In 2017, the students were required to design a poster using data visualisations that focused on educational inequalities in two geographical districts in Cape Town (Noakes, 2017). The course comprised introductions to (1) using youthexplorer.org.za[1] for data-based journalism, (2) learning Adobe Illustrator to develop an online logo and (3) using Microsoft Excel for designing charts and exporting data visualisations. Students were taught how to combine these three aspects within a poster design and to export the resulting text for blog publication. Students presented their posters to the class for assessment and shared their blog posts on social networks. The assessment criteria for the project were divided between analysis (40), design (30), innovativeness (20) and oral presentation (10).

[1] youthexplorer.org.za is a South African, open source, data-aggregated, map-based view of statistics concerning young people (aged 15–24). The site enables its users to explore the statistical differences between youths across a range of geographic areas (from electoral wards to district municipalities).

An analysis of the students' work (Archer & Noakes, 2020) provided an opportunity to refine the 2018 curriculum using insights from the multimodal theorising of argument in data visualisation (Archer, 2016; Prince & Archer, 2014).

Table 2 provides an overview of the initial and revised five-week course structure. Two new topics were added to the course, namely "multimodal argument" and "creative ideas for infographic design". A midway assessment was introduced, in which students' infographic arguments were assessed as works-in-progress. The new sections and midway feedback proved helpful in supporting students to develop better arguments.

Table 2: An overview of the initial and revised FAM course

FAM course	**Course sections (2017)**	**Course sections (2018)**
Week 1	Introducing typography	Data journalism, visualisation and cha
Week 2	Designing an online identity using type, shapes and paths	Typography for the web
Week 3	Introducing infographics and preparing a poster template	● Designing an online identity ● Multimodal argument (NEW)
Week 4	Exporting data from youthexplorer.org.za and designi charts	● Preliminary poster argument assessment (NEW) ● Creative ideas for data visualisation infographic poster design (NEW)
Week 5	Short infographic poster presentations by students for assessment	● Presentation tips (NEW) ● Pre-recorded infographic poster presentations in PowerPoint

In the latter part of this chapter, we showcase two students whose posters presented meta-level critiques of data. First, however, we introduce the six principles for learning design that informed the new course structure.

Principle 1: Delimiting the scope of the task

One might think that giving students freedom in selection would enhance engagement, but many seemed to struggle with deciding on the starting point for their arguments. The freedom to choose can be an obstacle for inexperienced students. We saw this with students making arguments concerning a "broad range of factors" for educational achievement, rather than narrowing down the focus onto specific aspects, such as "attendance"or "crime". For instance, one student was interested in contrasting educational outcomes for "Newlands and surrounds" with "Woodstock and surrounds". When looking at the data, it was clear that Woodstock had a higher number of

20–24 year olds with matric passes than Newlands. While this might suggest "better educational" outcomes, students in Newlands have a much higher bachelor pass rate. The use of all three aspects (highest education level achieved, percentage of students currently in tertiary education and the bachelor pass rate) proved unhelpful for developing a tight argument, other than "a range of factors influence education". The course convenors thus narrowed down students' choices to particular themes rather than giving them wide freedom in their choices (cf. Walton & Archer, 2004).

Principle 2: Encouraging the use of readily accessible design tools

In 2017, and in previous years, FAM students were taught on iMacs in a relatively high-end computer lab at the university. Access to computers and lab space could, however, not be taken for granted in 2018, as the university campus was shut down for a prolonged period in response to sporadic #feesmustfall protests (Ndlovu, 2017). While software such as Adobe Illustrator and Photoshop could be drawn on for work during lessons in previous years, the 2018 course needed to be revised for students to work remotely at home or in university residences with accessible design tools. Instead of teaching students how to design posters in Adobe, students were shown how to use Microsoft Word and Google Docs. Assessment also shifted to support maximum flexibility in terms of software choice and remote submission. Students were taught to export their designs into a Microsoft PowerPoint presentation and add an audio commentary, rather than being expected to present in person.

Principle 3: Considering gains and losses in moving across digital formats

In shifting between digital tools, students were taught about the gains and losses of moving across different digital formats. Each phase involved information being synthesised and abbreviated in a process of simplification. In the first step, the students browsed Youth Explorer[2] to select two wards and used the "Rich Data" function to compare the data for each ward side. The Excel data export for the two wards was divided into a summary section and specific sections for demographics, education, living environment, economic opportunity and youth poverty. In selecting wards, students were cautioned that one ward could include data for very different suburbs. Students also had to bear in mind that data was presented for youth aged 15–24 (following the international definition) and 15–35 (adopting South Africa's definition). As disaggregation was possible for smaller age brackets for most indicators, students could select a cohort in isolating and cleaning the data. Students were urged to select aspects that were collected with a matching timescale, or to flag such differences.

In creating charts, the course highlighted the influence of a particular format on the comparison's legibility. Students who selected an appropriate chart format and added necessary details (such as a legend and numeric values) assisted their audiences' comprehension. The students exported these charts as Picture Network Graphic (PNG) files for placement in their A4 poster designs. This export involved experimenting with the sizing of the charts in Excel and their export resolution. Exporting at a small size or poor resolution would result in charts losing detail and becoming difficult to read when the PNGs were resized on the poster. Likewise, the same considerations applied to the exporting the poster export as a graphic image for import into a

[2] https://youthexplorer.org.za/about

PowerPoint slide. Students also needed to ensure that their poster's portrait layout fitted within their slides' landscape orientation. Finally, the posters were exported in Adobe Portable Document File (PDF) format for embedding in a blogpost. The PDFs displayed in blog posts were shown at a smaller size and lower resolution, thus small fonts and chart graphics could become unreadable on blog pages. In shifting across digital formats, journalism students encountered the design challenges of making aesthetic choices that would preserve the legibility of content, even when working with "trimmed-down" formats not optimal for design purposes.

Principle 4: Implementing a process approach for developing argument and encouraging reflection

In order to enable critique and input on students' data visualisations and argument in process, students presented their thoughts midway through the course. The framework for analysing and producing argument in data visualisations discussed earlier informed our feedback to students.

Cases where correlation was confused with causation were identified and discussed (Archer & Noakes, 2020). Examples of this included cases where students selecting a ward, could easily blur the categories of their argument by equating a ward with a suburb, when the ward encompassed several suburbs. They could also presume that a suburb is a singular community with a uniform demographic and ignore the very different contexts of its constituent communities. In selecting aspects of inequality to explore, students could also blur categories by selecting different data populations without contextualising differences by age group (such as in the two roughly comparable categories of "grade 8 to matric" learners and "18 to 24"year-olds) or using data collected by different organisations with differing timespans (such as Statistics South Africa's 2011 census data versus 2017 statistics from the South African Police Service).

As there were many opportunities for students to make such errors, the course recommended students consider appropriate hedging strategies. For instance, poster designers should avoid formulations such as "x is (only) caused by y" and instead hedge statements, as in "x seems to be correlated with y (and z)". Students were also prompted to reflect on their own personal limitations as observers and to critique their data sources.

The midway feedback process was an opportunity for students to reflect on their progress towards developing an argument. They considered how their own life history, community background and experiences of social interaction might influence their argument selection and framing. The designers were encouraged to interrogate their own positionality and question their chosen stance towards both the subject matter and the data. The time constraints of the short course did not allow for written reflections for assessment. Instead, the midway feedback process was the main opportunity for reflecting on each student's self-awareness or lacunae in contextualising a line of argument.

Principle 5: Developing meta-languages of critique and argument

In order to improve their arguments, students were urged to read recent South African educational sociological research iand topical press articles as sources. The course flagged the dangers of qualitative complexity being simplified into numbers and analyses that ignored how

such data might be inaccurate. For example, both undocumented and illegal immigrants were unlikely to be included in South African census data. The data for immigrants who avoided census officials out of concerns for deportation would thus be “invisible” to Youth Explorer users. As aspirant journalists, it is important that students do background research into the aspects they describe and explore surrounding discourses. To ground their arguments, students were urged to foreground contextual information and flag omissions in their data sources.

Principle 6: Acknowledging different audiences and the risks of sharing work as novices

Each student’s PowerPoint presentation was expected to highlight some of the processes involved in making their poster, the digestion of the statistics and reflections on the complex social issues engaged with in thinking through the task. Unlike embodied, synchronous presentation to a co-present audience, the audience in a narrated PowerPoint needs to be explicitly evoked. Designs aimed at classroom assessment might preclude non-academic and other online audiences. The students thus needed to clearly define the ideal audience(s) for their posters, whether local or global. The course provided guidance on choosing an infographic design that was fit-for-purpose and audience by showing a variety of infographic types and highlighting the different roles of diagrams, charts and maps in constructing an argument.

Students were encouraged to share their blog posts with audiences on social media via Twitter and Facebook. Such sharing was intended to help students experiment as aspirant journalists who share infographic content directly to online audiences. Sharing also confronted students with the challenge of negotiating “context collapse” online. This term refers to the flattening of mutual distinct audiences in one’s social network, such that people from different contexts become part of a singular group of message recipients (Vitak, 2012). The “collapse” phenomenon necessitated thinking through how work as novice designers might be interpreted by potential audiences outside the academic context. This could range from a known audience of friends to more dangerous unknown audiences, such as critics and stalkers. Of the 20 students who completed the course, over half chose not to share on social media. A few chose Twitter for sharing, but only two shared content on Facebook, which, despite its popularity in South Africa, was considered to be more likely to create “collapsed contexts”. By contrast, students could readily create anonymous accounts under Twitter that were not linked to audiences of family, friends and peers.

Students had different strategies in their self-presentation styles. Most chose to create blogs and share social media under their real names and as students. This followed the norm of formal, genuine identities in the academic and journalistic fields. However, it was noteworthy that several female students chose to hide their real names to manage online visibility risks given South Africa’s high rates of sexual violence (Noakes, 2019). These students used generic roles (such as “movie fan”) for their blog titles. This privacy strategy was however undermined when a poster was shared featuring a real name. After the poster projects were assessed, a few students decided to reduce the risks of online visibility by removing their poster blog posts and shares.

In the next section, we analyse the work of two students and the ways in which the learning design outlined here enabled them to start critiquing the data sources and developing critical academic argument.

Academic argument and meta-level critique of data and sources

Here we look at the work of two students, Tumi and Mark,[3] who followed different approaches to meta-level critique in their data visualisations. Tumi's presentation critiqued the usefulness of Youth Explorer for exploring education in a peripheral township community versus a suburban "core community". By contrast, Mark's poster critiqued the statistics available for understanding "poor grade 8 systemic results" and the reasons for higher dropout rates in schooling between suburbs.

Tumi's presentation: Critiquing the sources

Tumi's poster (Figure 1) presented a critique of Youth Explorer's use for exploring education in the "peripheral community" of a Langa township versus a "core community" in suburban Pinelands. Tumi selected both suburbs due to their close proximity – "about 7km apart". She framed Pinelands as representing a core community, since it is "where most people work" and "children attend school". By contrast, Tumi described Langa as representing a peripheral community, which provides the "economic labour of circular migrants to Pinelands". Tumi's description reflects how the sorry legacy of apartheid spatial planning remains evidenced in the racially and economically skewed demographics of Cape Town's neighbourhoods. This legacy stubbornly shapes the contrasting educational opportunities offered to suburban and township residents. In this context, black children in peripheral locations often travel long distances for better opportunities in core suburbs.

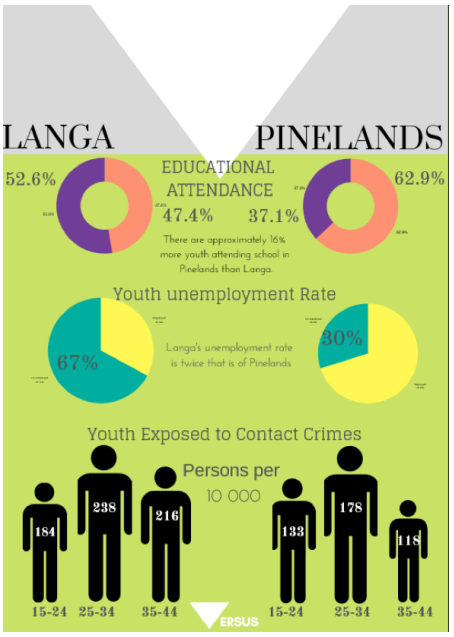

Figure 1: Tumi's poster presenting data on Langa versus Pinelands[4]

[3] Although each student agreed to be a research participant, pseudonyms are used for each student name for privacy protection.

[4] All visual representations of student's work are reproduced with their permission.

Tumi's poster featured school attendance, employment status and the number of youths affected by crime. The poster employs ring graphs and pie charts in different colours to indicate educational attendance and unemployment rates. Person graphics represent the number of individuals "exposed to contact crimes". They are visually innovative, but not drawn to scale, so difficult to read at a glance. By contrast, Tumi used a bar graph in her PowerPoint slide which is a better representational choice for such comparisons (Figure 2). However, it is still difficult to compare Langa with Pinelands here as the different scales of the bar graphs are not equivalent in size. In addition, both "contact crime" images do a straightforward comparison rather than addressing crime relative to population size.

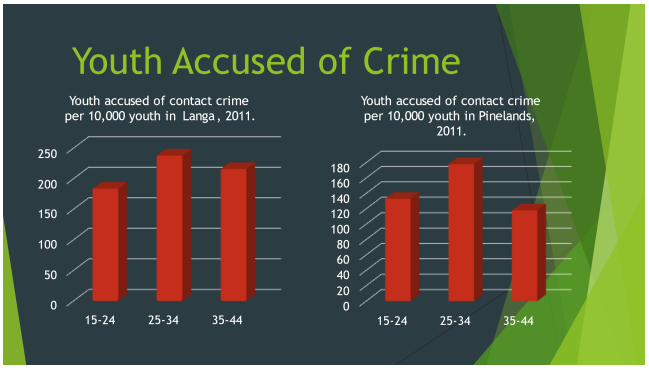

Figure 2: Bar graph from Tumi's PowerPoint presentation

It is unclear what the argument is in the poster alone, which perhaps needs more written text. The argument is however clearly stated on the written text of a slide: "Historically disadvantaged communities still experience higher crime statistics because of the lack of educational facilities and economic opportunities available to them". Interestingly, the presentation's context slide predominantly uses images rather than writing to convey the argument (Figure 3). This is perhaps an affordance of PowerPoint. The images illustrate the economic standing of each area. The top image of Langa shows dense housing and poor roads. The bottom image for the leafy suburb of Pinelands suggests lots of open space and well-kept verges.

Figure 3: Images and text used in Tumi's PowerPoint presentation to convey argument

In presenting her poster, Tumi argued that historically disadvantaged communities experience higher crime rates. In comparing Langa's data to Pinelands, Tumi argued that the latter has "better schools and employs far more people". Like many other core communities, it benefits from "the labour of peripheral communities". Tumi added a caveat statement that, "the level of crime in a community is not solely depended on availability of adequate educational facilities and

economic opportunities" and that these were just the variables chosen for this study. Poverty and lack of quality education are, however, the major factors cited for increased crime rates, especially in historically marginalised communities.

One of Tumi's slides raised two critiques of the data she had collected. Firstly, the educational attendance data may be skewed unfavourably against Langa. Children from peripheral communities often travel to core communities for schooling, so data for both core and peripheral communities "can be blurred to some extent". Secondly, Tumi flagged that youth accused of contact crime were not necessarily "convicted or found guilty". Both critical limitations were raised in her presentation, but not described in the poster. In this case, the PowerPoint slides would seem better for complex argument than the infographic poster's more condensed form. It was essential to consider these texts together in the final assessment of the project. This recognition of the multimodal nature of meaning-making encourages more equitable assessment practices.

Mark's poster: Critiquing the sources

Mark chose to compare two very different areas in Cape Town, namely Athlone and Rondebosch. Athlone is a poorer area, whereas Rondebosch is somewhat affluent, with a large selection of good (and more expensive) schools. Mark's poster explored the limitations of what Youth Explorer can tell us about systemic tests and how these link to dropout rates and final-year pass rates (Figure 4). He argued that a shortcoming is the dataset's failure to convey "the role that extra-curricular support plays" in shaping learners' results. Mark managed to represent this critique on the poster through visual and verbal means, whereas other students (like Tumi) highlighted the shortcomings of the data solely in their oral presentations.

Mark presented his critique mainly through the semiotic resources of layout, colour and bold font. He wrote two paragraphs for each data visualisation. The top paragraph presents the data, whilst the second critiques or points out the omissions in the dataset. The top paragraph is written in black in a bold typeface, whereas the second is not bolded, but written in red. This use of colour creates a visual contrast between the two paragraphs, highlighting the difference of perspective in each, thus conveying an argument. The following quote from the second infographic highlights this difference:

> **After peaking at 49.3% in 2012, the drop-out rate in Athlone schools exhibits a downward trend in subsequent years. Yet at an average of 31.5%, the average annual drop-out is representative of the average annual country-wide drop-out rate of 36%. By contrast, the drop-out rate within Rondebosch schools remains at 0% for the duration of the seven-year period.**
> This dataset fails to highlight the variety of factors influencing such a high drop-out rate among Athlone pupils. It is thus difficult to suggest that results in Grade 8 systemic tests play any more of a casual role than the need to contribute financially to income-poor households, for example, of which 8.7% of Athlone households are categorised as such.

As Mark highlights in red, there are gaps in what the data can tell us, including the range of factors influencing the high dropout rates in Athlone. As this argument is predominantly carried in the written mode, the poster appears to be quite wordy. However, it would be very difficult to critique the data source in the way he does using only the visual mode. Mark integrates the

statistics into the written argument, by showing that the average dropout rate in Athlone (31.5%) is still lower that the average annual country-wide dropout rate (36%). His comparison of a specific instance with a general one is good practice in academic argument.

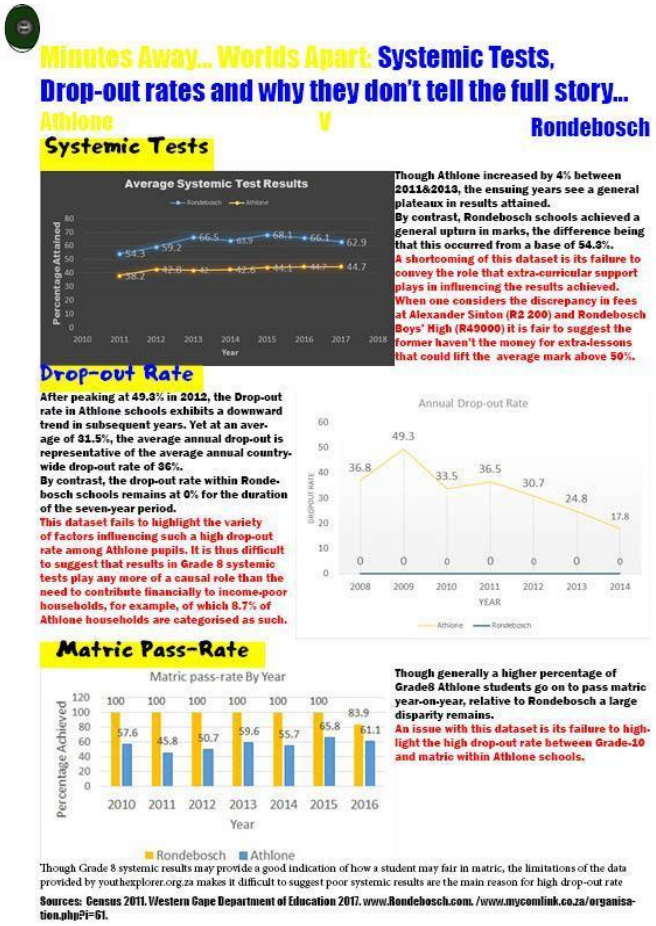

Figure 4: Mark's poster

Incorporating process in the task gave Mark the time and space to consider the relationship between the larger societal context, his own experience and the data that he was interrogating. The feedback received midway through his process led Mark to temper his original thoughts. In his initial argument, he suggested that poor grade 8 systemic results were the reason for a high dropout rate. He revised that statement to argue that "while it may be a factor, it is not the only factor". Mark emphasises the fact that many children from affluent homes go for extra lessons after school to improve subject results. This knowledge of concerted cultivation was based on his personal experience but is unaccounted for in most official accounts of educational input.

Mark highlighted the cost of these extra lessons and flagged the fact that only people in a certain income bracket can afford them. He based this argument on additional research which contrasted the annual school fees of two of the main schools in the area: R2 200 in Athlone versus R49 000 in Rondebosch. Mark is very aware of his own positionality in researching something as complex as inequality in South Africa. He writes in his rationale that he grew up in an upper middle-class family that "afforded access to certain resources and opportunities" that households of a lower

socio-economic standing could not afford for their children. One such resource he described was three hours of extra maths lessons a week.

Mark's story highlights the "complex entanglement" (Kennedy & Hill, 2017) of aspects of data visualisation: knowing how to physically create these texts; the pleasure and aesthetics of data visualisation; and the underlying discourses and ideological work of data visualisations.

Conclusion

It is clear that the choice of how to represent data or create an argument presents complex choices about conjunctions of meaning and form. This chapter has shown how a social semiotic approach to analysing and producing argument helped to develop a data visualisation poster course into one that better supported students' development as critical designers and engaged citizens. The course was adjusted to teach how comparisons can be erroneously based, how correlation can be confused with causation and the ways that categories can become blurred. In particular, the revised course emphasised the ways in which qualitative complexity can often be simplified into numbers.

We hoped to emphasise that data visualisations are "abstractions and reductions of the world" and that they are the result of "human choices, social conventions and technological processes and affordances, relating to generating, filtering, analysing, selecting, visualizing and presenting data" (Kennedy & Engerbretsen, 2020, p. 22). As a result of some of the curriculum interventions outlined here, students began to engage with the normative attitudes and societal discourses that shaped the information they shared. They began to flag how the graphs might represent a numeric simplification of a qualitatively complex situation and to point to the ways in which the categories for comparison may be blurred. We have shown how two students delivered meta-critiques of the data sources. Their cases speak to the revised curriculum's success in helping students develop as critical designers who also leverage their knowledge as engaged citizens.

Acknowledgements

This research is based upon work supported by the British Academy Newton Advanced Fellowship scheme. Travis' research was supported by a Postdoctoral Fellowship (2019–2021). Both authors thank the University of Cape Town's Centre for Film and Media Studies for facilitating the research process with students in 2017 and 2018.

References

Archer, A. (2016). Multimodal Academic Argument: Ways of Organising Knowledge across Writing and Image. In A. Archer & E. Breuer (Eds.): *Vol. 33. Multimodality in higher education* (pp. 93-113). Brill.

Archer, A., & Noakes, T. (2020). Multimodal academic argument in data visualization. In H. Kennedy & M. Engebretsen (Eds), *Data Visualization in Society*, 239-256. Amsterdam University Press. https://doi.org/10.5117/9789463722902_ch15

Bradshaw, P. (2012). What Is Data Journalism?. In J. Gray, L. Bounegru & L. Chambers (Eds.), *The data journalism handbook* (1st ed). O'Reilly Media, Inc. http://datajournalismhandbook.org

Engebretsen, M., Kennedy, H., & Weber, W. (2018). Data visualization in Scandinavian newsrooms: Emerging trends in journalistic visualization practices. *Nordicom review*, *39*(2), 3-18. https://doi.org/doi:10.2478/nor-2018-0007

Hyland, K. (2014). Disciplinary discourses: Writer stance in research articles. In C. N. Candlin & K. Hyland (Eds.), *Writing: Texts, processes and practices* (pp. 99-121). Routledge.

Kennedy, H., & Engebretsen, M. (2020). Introduction: The relationships between graphs, charts, maps and meanings, feelings, engagements. In M. Engebretsen & H. Kennedy (Eds), *Data visualization in society*, 19-32. https://doi.org/10.1515/9789048543137-005

Kennedy, H., & Hill, R. L. (2017). The pleasure and pain of visualizing data in times of data power. *Television & New Media*, *18*(8), 769-782.

Martinec, R., & Van Leeuwen, T. (2008). *The language of new media design: Theory and practice*. Routledge.

Matsunami, I. (2012). Providing Independent Interpretations of Official Information. In J. Gray, L. Bounegru & L. Chambers (Eds.), *The data journalism handbook* (1st ed). O'Reilly Media, Inc. http://datajournalismhandbook.org

Meyer, P. (2012). Providing Independent Interpretations of Official Information. In J. Gray, L. Bounegru & L. Chambers (Eds.), *The data journalism handbook* (1st ed). O'Reilly Media, Inc. http://datajournalismhandbook.org

Ndlovu, M. W. (2017). *# FeesMustFall and Youth Mobilisation in South Africa: Reform Or Revolution?*. Routledge.

Noakes, T. (2017, November 17). *Designing infographics on educational inequalities in Cape Town's wards- a new #UCT Media Studies project*. Travis Noakes. http://www.travisnoakes.co.za/2017/11/designing-infographics-on-educational.html

Noakes, T. (2019). Young black women curate visual arts e-portfolios: negotiating digital disciplined identities, infrastructural inequality and public visibility. *Learning, Media and Technology*, *44*(3), 299-314. https://doi.org/10.1080/17439884.2019.1640738

Prince, R., & Archer, A. (2014). Exploring academic voice in multimodal quantitative texts. *Literacy and Numeracy studies*, *22*(1), 39-58.

Van Leeuwen, T., & Jewitt, C. (Eds.). (2001). *The handbook of visual analysis*. Sage.

Vitak, J. (2012). The impact of context collapse and privacy on social network site disclosures. *Journal of broadcasting & electronic media*, *56*(4), 451-470. https://doi.org/10.1080/08838151.2012.732140

Walton, M. (2016). 'Visualising data' - The Centre for Film and Media's FAM2017S course [Teaching presentation]. University of Cape Town, South Africa.

Walton, M., & Archer, A. (2004). The web and information literacy: Scaffolding the use of web sources in a project-based curriculum. *British journal of educational technology*, *35*(2), 173-186.

Zhao, S., Djonov, E., & Van Leeuwen, T. (2014). Semiotic technology and practice: A multimodal social semiotic approach to PowerPoint. *Text & Talk*, *34*(3), 349-375.