Map-based Dashboards versus Storytelling Maps

Chenyu Zuo*, Linfang Ding*,**, Edyta Paulina Bogucka*, and Liqiu Meng*

* Chair of Cartography, TU Munich, Arcisstr. 21, 80333 Munich, Germany

** KRDB Research Centre for Knowledge and Data, Faculty of Computer Science, Free University of Bozen-Bolzano, piazza Domenicani 3, 39100 Bozen-Bolzano, Italy

Abstract Map-based dashboards and storytelling maps have been increasingly used in data management, information communication, and decision-making support. In this study, we systematically investigate the state-of-the-art map-based dashboards and storytelling maps to identify and categorize their purposes, user interfaces, contents, and their evaluations. We design a framework for the comparative study to support outlining the characteristics of map-based dashboards and storytelling maps, and summarizing the strengths and weaknesses of these two visualization methods in various scenarios. The survey results will provide insights for future multi-granularity and multi-variable geodata information visualization and communication using these two methods.

Keywords: geodata visualization, map-based dashboard, storytelling map, web-based mapping

1 Introduction

The volume and the complexity of various data are rapidly increasing as the progress of digitalization. To solve the problem with low data readability caused by data overload and to reveal the hidden information of various data, Keim (2010) proposed visual analytics leveraging the strengths of human and computer data processing, for a better understanding of information. Map-based dashboard and storytelling map are two innovative geovisualization methods, which support the public to gain geographical knowledge and boost the geo-information dissemination. More specifically, map-based dashboards and storytelling maps are dedicated to the

LBS 2019
15th Conference on Location Based Services
Vienna, 11–13 November 2019

Published in "Adjunct Proceedings of the 15th International Conference on Location Based Services (LBS 2019)", edited by Georg Gartner and Haosheng Huang, LBS 2019, 11–13 November 2019, Vienna, Austria.

This contribution underwent double-blind peer review based on the paper. https://doi.org/10.34726/lbs2019.33

communication of organized and systematic geo-information in an intuitive design.

Few (2006) described a dashboard as "a visual display of the most important information needed to achieve one or more objectives that have been consolidated on a single computer screen so it can be monitored and understood at a glance". Dashboard is widely used to visualize geo-data. For instance, a map-based dashboard (Cao et al., 2017) has been designed to uncover spatiotemporal patterns and detect the anomaly of urban traffic.

In terms of visual storytelling, comparatively, Kosara and Mackinlay (2013) pointed out that "a story is an ordered sequence of steps, each of which can contain words, images, visualizations, video, or any combination thereof". Chen et al. (2018) proposed a concept of a story slice, being a "structured representation of a finding or a combination of findings or, generally, an information construction obtained from original data in the course of analysis". The story creation process focuses on organizing the findings, rather than states and steps, into meaningful layouts.

The abovementioned storytelling methods have been widely implemented in the interactive geodata exploration. Schell et al. (2007) illustrated the correlation between socioeconomic and infant mortality in different income countries by storytelling. Lundblad and Jern (2012) build a snapshot-based mechanism to capture stories on performance indicators stored in the World dataBank, such as demographics, healthcare, and economics. However, there is a further need of research on how to build, interpret and evaluate narratives for geo-spatial visualizations (Tong et al., 2018).

In this study, we aim to outline the scopes of map-based dashboards and storytelling maps, identify their design space, evaluate their visual elements, and discuss the feasibilities of different insights communication. More specifically, we conduct the survey in three steps: 1) we collect and select the state-of-the-art scientific samples in a defined iterative scheme; 2) we design a framework for the comparative survey with four categories and 12 subcategories; 3) we present and discuss the preliminary results. The findings help future studies for a better design of those two visualization methods to serve their purposes.

2 Survey Methodology

An iterative searching scheme is designed to collect relevant map-based dashboard and storytelling map samples. The scheme consists of three main steps: keywords defining, searching from databases, preliminary results filtering. The results of each step serve as feedback to the previous steps, which means we adjust the keywords, databases and filtering criteria according to the findings iteratively. Figure 1 shows the iterative collection process with the query keywords, databases and the numbers of results. Specifically, the sources of the samplings are (1) academic databases and Google Scholar, (2) the references of the related research papers, (3) research papers in the domain review, (4) research papers from Google Alerts[1] push, (5) online media[2] and blog[3], (6) Tableau Public[4], (7) Google search and Google image search. We search the related materials with the query keywords, e.g. “dashboard” AND “traffic” OR “education”, “map” AND “storytelling”. A set of filters is applied to find the relevant, mature, and typical samples of various backgrounds and designs. Firstly, the content must include geographical information. Secondly, the sample should be mature and completed, which means it serves for clear purposes, has a coherent design and is publicly available. Thirdly, we want to cover a wide range of scenarios and designs. Thus, the samples shared too many similarities are excluded.

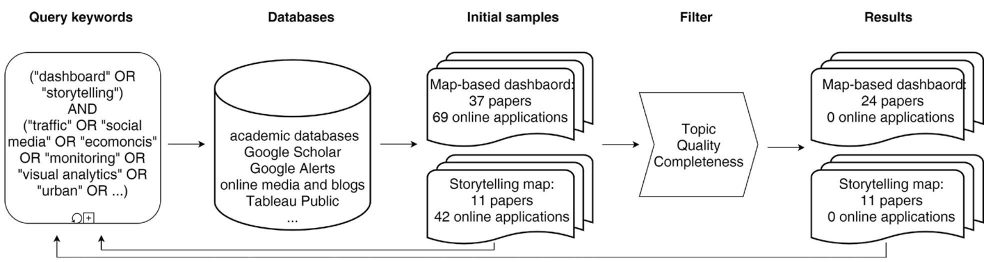

Figure 1: The flowchart shows the iterative scheme for the sample collection. After every searching loop, the fund results help to update the query keywords to expend the searching scope. The searching is conducted iteratively until enough results are found.

Until the time of the paper writing, a total number of 106 map-based dashboards and 53 storytelling maps were captured from the initial searching. Among these, a lot of the samples are web applications. For example, the stories published by online newspapers and examples from Tableau Public. However, these sample are often without any explanation of the design purposes, data selection and processing. Therefore, we exclude the online samples and focus on academic papers.

[1] https://www.google.com/alerts
[2] https://www.washingtonpost.com/
[3] http://www.visualisingdata.com/
[4] https://public.tableau.com/en-us/s/

3 The framework design

Both map-based dashboard and storytelling map cover a wide range from purpose, design and data feature. Moreover, the purpose, and data feature influence largely the interface and interaction design. However, it is not clear what types of interfaces and interactions serve a specific purpose and data feature better. To tackle this issue, we design a framework for categorizing the map-based dashboards and storytelling maps systematically. The framework is shown in Table 1, consists of four categories, i.e., *purpose*, *user interface*, *content* and *evaluation*. Each category has several subcategories. Following the framework, we measure and document the collected samples, compare the differences between map-based dashboard and storytelling map, and identify the advantages and disadvantages of both visualization methods.

Table 1: The framework design for the comparative study.

Category	Item	Description
Purpose	Analysis	Revealing hidden insight
	Data management	Providing visual data filtering, selection, updating, import and export services
	Decision making	Offering a collection of multi-dimensional information
	Monitoring	Detecting the changing of data, alerting of the anomaly
	Learning	Spreading and communicating information
User interface	Visual elements	The visual components, e.g. map, toolbar, table
	Interactions	The interactions for users, e.g. clicking, dragging, filtering, ordering
	Layout	The arrangement of the visual elements, e.g. map-centered, multi-page
Content	Data	The source, scale, spatial coverage, format and privacy of data
	Data processing methods	Data cleaning, projection, interpolation, aggregation, modeling, mining and etc.
Evaluation	Expert feedbacks	The interviews with the domain experts, normally including the quality, efficiency and effectiveness assessment
	User test	The task-solving effectiveness and user satisfaction

4 Preliminary results

To analyze the design space (visual elements and interactions) of map-based dashboard and storytelling map, we applied the parallel set chart. Figure 2 presents the percentage and correlation of purposes, elements, interactions from the 35 map-based dashboards and storytelling maps.

To be more specific, most of the map-based dashboards serve for data analysis. Filtering, selecting, highlighting and zooming are common and useful interactions for dashboard. Some innovative elements are included in the design, such as glyph, parallel coordinates, calendar view, cartogram, sankey diagram. Moreover, dashboards for analytical purposes are with more engaging interactions than other purposes. Highlighting, ranking, and ordering are helpful for decision-making and monitoring, but not often implemented.

In contrast to dashboard, storytelling map serves mainly for learning purposes. The overview maps are applied to give the rough spatial information. Also, a lot of static visualizations, e.g., text and images, are included in the storytelling maps. The storytelling maps with decision making and monitoring purposes have more interactions. Besides, 3D scene is especially used in storytelling maps, not in map-based dashboards.

In most of the map-based dashboards and storytelling maps, maps are used as supportive tools to present the spatial information. The interactions with

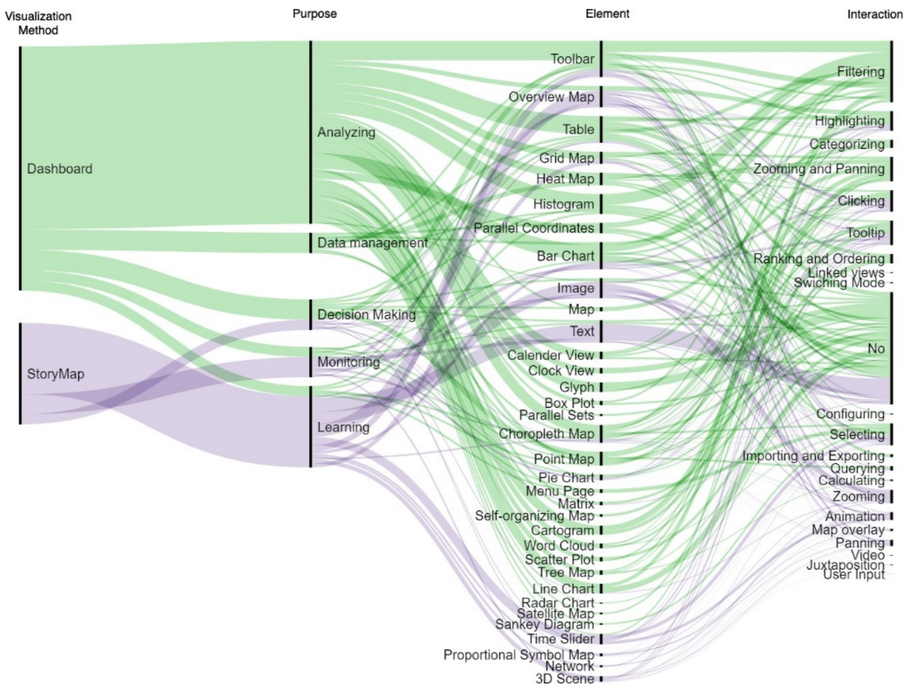

Figure 2: The parallel set chart illustrates the design space and the correlations among features using the collected samples of map-based dashboards.

low engagement interaction, i.e., clicking, zooming, panning, and hovering, are integrated with the maps. Moreover, if maps are linked with other elements, more knowledge will be revealed. For instance, a map with a time slider can convey both spatial and temporal patterns more intuitively.

5 Conclusions and Outlook

The proposed searching scheme and the framework helped us to collect and categorize the samples. The preliminary results provide some insights into the map-based dashboard and storytelling map features and characteristics. However, more work needs to be done in the future: 1) refine the framework for the comparative study and analyze in-depth of each characteristic, 2) search for more samples of both visualization methods, 3) identify the advantages and disadvantages of the two methods in various application scenarios, 4) propose design guidelines for these two visualization methods.

Acknowledgements

This work is funded by the project “A Visual Computing Platform for the Industrial Innovation Environment in Yangtze River Delta” supported by the Jiangsu Industrial Technology Research Institute (JITRI).

References

Cao, N., Lin, C., Zhu, Q., Lin, Y.-R., Teng, X., and Wen, X. (2017). Voila: Visual anomaly detection and monitoring with streaming spatiotemporal data. *IEEE transactions on visualization and computer graphics*, 24(1):23–33.

Chen, S., Li, J., Andrienko, G., Andrienko, N., Wang, Y., Nguyen, P. H., and Turkay, C. (2018). Supporting story synthesis: Bridging the gap between visual analytics and storytelling. *IEEE Transactions on Visualization and Computer Graphics*, pages 1–1.

Few, S. (2006). Information dashboard design.

Keim, D. (2010). Mastering the information age: solving problems with visual analytics.

Kosara, R. and Mackinlay, J. (2013). Storytelling: The next step for visualization. *Computer*, 46(5):44–50.

Lundblad, P. and Jern, M. (2012). Visual storytelling in education applied to spatial-temporal multivariate statistics data.

Schell, C. O., Reilly, M., Rosling, H., Peterson, S., and Mia Ekström, A. (2007). Socioeconomic determinants of infant mortality: a worldwide study of 152 low-, middle-, and high-income countries. *Scandinavian journal of public health*, 35(3):288–297.

Tong, C., Roberts, R., Borgo, R., Walton, S., Laramee, R. S., Wegba, K., Lu, A., Wang, Y., Qu, H., Luo, Q., and Ma, X. (2018). Storytelling and visualization: An extended survey. *Information*, 9(65).