

Visualizing the Quality of Life: part 1 – Technical Report

Please use this template table to describe and justify how you addressed the assignment and your application of visualization skills and techniques. Techniques that are correctly implemented, but not correctly described in the table will not receive full points. Please add any references that you use after the table; these should be cited where appropriate in the reporting. Your report (second column of the table) can be up to 1000 words, excluding references.

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Task	Description of how you addressed the task
Describe the data pre-processing steps carried out prior to visualization.	To create an effective and robust visualisation, I had to go through a meticulous data pre-processing phase using Python and Fancy Impute. I decided to use Multiple Imputation by Chained Equations (MICE) instead of a standard technique such as mean imputation. This was crucial for handling missing values in the dataset. While MICE addressed most of the missing data in the dataset, three cells still required attention, leading to the implementation of a traditional averaging method for these instances, using the data from the other countries. To ensure consistency, decimal values across different columns were also standardised post imputation.
Fit to task: Describe how the visualization support exploration and comparison of well-being in countries.	The primary aim of this visualisation is to empower users to explore and compare the quality of life in various countries across the world, and to “assist humans in solving problems” (Purchase et al. 2008). To achieve this, I designed four distinct interactive charts, each offering a unique perspective on well-being. "Environmental Factor Comparison by Country," encompasses a bar and line representation, effectively comparing water quality and air pollution. This allows the viewers to see the variance in environmental issues between countries, while outlining the obvious correlation between water and air quality. The second chart, "Socioeconomic Indicators Across Countries," adopts a bar chart format, portraying disposable income, education attainment and life satisfaction for each country. This supports exploration as the users can see the relationships between these socioeconomic factors and can draw conclusions from them. The third chart, "Comparative Country Overview - Income,

	<p>Education, Health, and Safety," is presented as a scatter plot, plotting countries based on student skills, disposable income, feeling safe walking alone at night and self-reported health. The vast amount of data in this graph specifically allows for a deep comparison of various factors. Finally, the fourth chart, "Global Quality of Communities," adopts a "geoshape" map format - inspired by the Maps and Graphs section of CSC3833 (Newcastle University, 2023) - offering a digestible visual representation of the quality of support networks in different countries.</p>
Fit to user: Describe what steps have been taken to ensure that the visualization is appropriate for the intended user.	<p>Recognising that users may lack a background in statistics or mathematics, this visualisation prioritises intuitiveness and accessibility. I made all the charts contain detailed tooltips, making it appropriate for those who would like extra on-demand information or assistance. Furthermore, all charts are designed to be interactive, accommodating features like panning and zooming, thereby enhancing the exploration experience. The careful consideration of user preferences ensures the visualisation is accessible both on-screen and on paper.</p>
Analysis: Describe how statistical patterns of relevance are presented in the visualization.	<p>The visualisation effectively presents statistical patterns of relevance through a variety of visualisations. For example, in the scatter plot, countries are plotted based on disposable income and student skills, with feeling safe alone at night and self-reported health encoded as colour and size, respectively, with a legend to explain this. This strategic encoding allows users to discern patterns related to the well-being indicators, which will assist in "amplifying cognition" (Card, Mackinlay & Schneiderman. 1999). Despite the large amount of data being displayed in both examples, the data is all relevant and helps convey the message of each chart.</p>
Describe your use of visual channels in the visualization.	<p>Visual channels have been implemented to enhance the effectiveness of the visualisation. Throughout the 4 charts, size, colour, shape, and position were utilised to display the various statistics being presented. This extensive use of visual channels ensures a clear visual hierarchy and aids in conveying nuanced information to user. They were effectively displayed using legends.</p>

Describe how you have made use of Gestalt theory and design principles.	Gestalt theory explores the concept of a whole being greater than the sum of its parts (Wertheimer, M., 1993). I implemented this ideology through ensuring that my charts were comprehensible as a group, and didn't all display similar information, for the purpose of effectively summarising the varying quality of life in different countries. On a smaller scale, I ensured that elements with similar characteristics are visually grouped together, facilitating users in quickly interpreting relationships and patterns. In the scatter plot, for instance, circles represent OECD countries, while squares denote non-OECD countries—a deliberate application of Gestalt principles to aid categorisation and understanding.
Describe your use of colour in the visualization.	Colour, a powerful visual channel, has been used to enhance comprehension and differentiate between elements. The importance of colour in visualisation was stressed in the Perception and Colour section of CSC3833 (Newcastle University, 2023). For example, the map employs a gradient from yellow to purple to signify different levels of community support quality, offering users a quick and intuitive way to understand the variation across countries.
Describe the interactive features used in your visualization, and how they facilitate exploration.	Interactive features serve as a cornerstone in the design, ensuring a dynamic and engaging exploration experience. Tooltips have been thoughtfully incorporated into all charts, providing viewers with detailed information on-demand and aligning with the principles outlined by Munzner (2014), by supporting the users in carrying out tasks based on this information. Additionally, the charts are designed to be interactive, allowing users to pan and zoom, allowing a detailed exploration experience.
Describe the design of the multiple coordinated views visualization, and how it facilitates exploration.	The comprehensive design includes four coordinated views, each offering a unique perspective on well-being. The coordinated views empower users to explore relationships and patterns across different the charts simultaneously, aligning with the principles of information visualisation. I decided to have a labelled scatterplot to display an overview containing a large amount of digestible information. The bar and line chart was designed to show the relationship between environmental factors. The bar chart

	demonstrates the socioeconomic side of wellbeing, and the map allows for an analysis of the relationship between geographical location and community quality. Concatenating all of these in a grid format allows for easy comprehension and exploration by the user.
Describe considerations made in the use of language and text in the visualization.	Language and text considerations were imperative in ensuring clarity and accessibility. Labels above the bars in the bar chart explicitly state the nature of non-OECD countries, ensuring that users are informed about the distinction. Legends are thoughtfully provided in each chart to guide users in interpreting colours, shapes, and sizes, reinforcing the user-friendly design. The language used in tooltips and labels is kept concise and straightforward, aiming to make the visualisation approachable to a general audience. Finally, the labels for the scatter plot were shortened to abbreviations to make the chart less crowded and avoid overlaps.

References:

Card, S. K., Mackinlay, J., & Shneiderman, B. (1999). *Readings in information visualization: Using vision to think*. Morgan Kaufmann.

Purchase, H. C., Andrienko, G., Jankun-Kelly, T. J., & Ward, M. O. (2008). *Theoretical foundations of information visualization*. In *Information Visualization* (pp. 46-64). Springer.

Munzner, T. (2014). *Visualization analysis and design*. CRC Press.

Wertheimer, M., 1938. *Gestalt theory*.

CSC3833. (2023). *Week 5 – Perception and Colour*. [Newcastle University].

CSC3833. (2023). *Week 6 – Maps and Graphs*. [Newcastle University].