Mapping Global Child Well-Being:

An Interactive Visualization for Social Good

Project Mock Design

Group 2L: Harrison Park, Hongbo Zhang, Charlie Zhang, Jialiang Liu, Yaxuan Bai

Primary Data Sources (Planned for Use):

- UNICEF (2024) *State of the World's Children*
- OECD (2024) *Child Well-Being Dashboard*
- WHO (2023) *Stunted Growth and Development*
- World Bank Open Data

Figure 1: Introductory instructions for the user upon entering the webpage

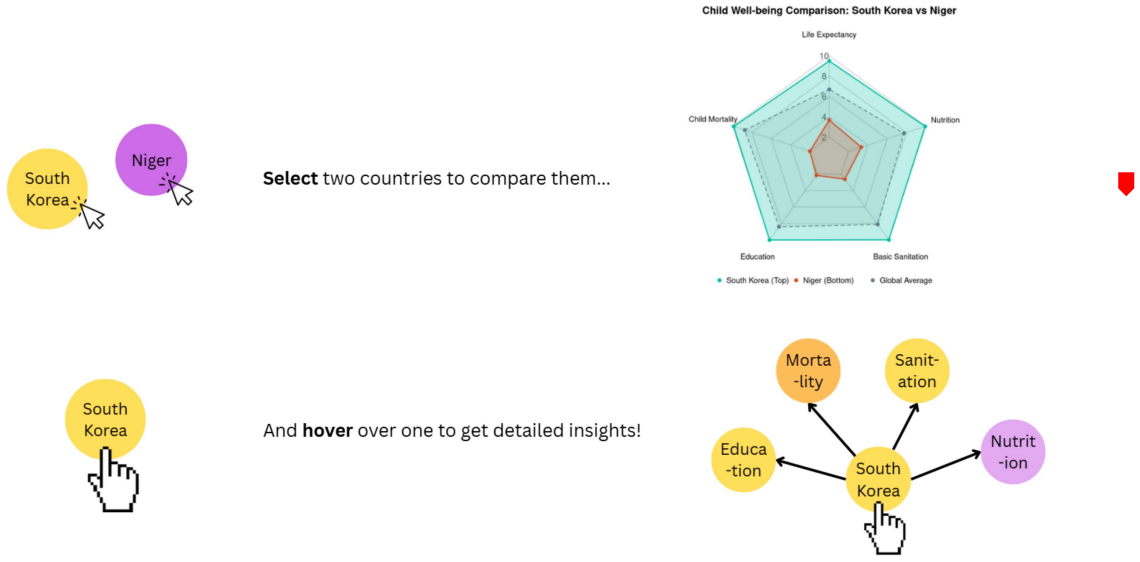


Figure 2: Baseline bubble map with option to select preset filters for aggregate child wellbeing index (mapped to color hue)

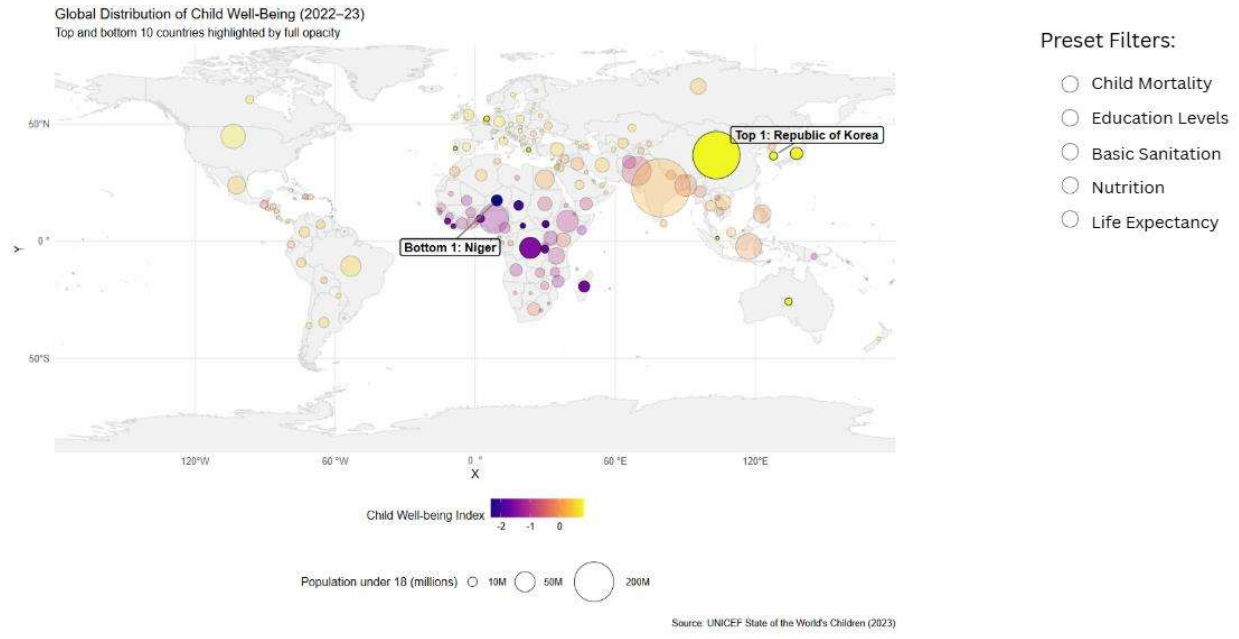


Figure 3: Upon clicking two countries, a radar chart slides out into view to compare the two countries selected along each data dimension and a bar chart to compare across the selected filter's data dimension.

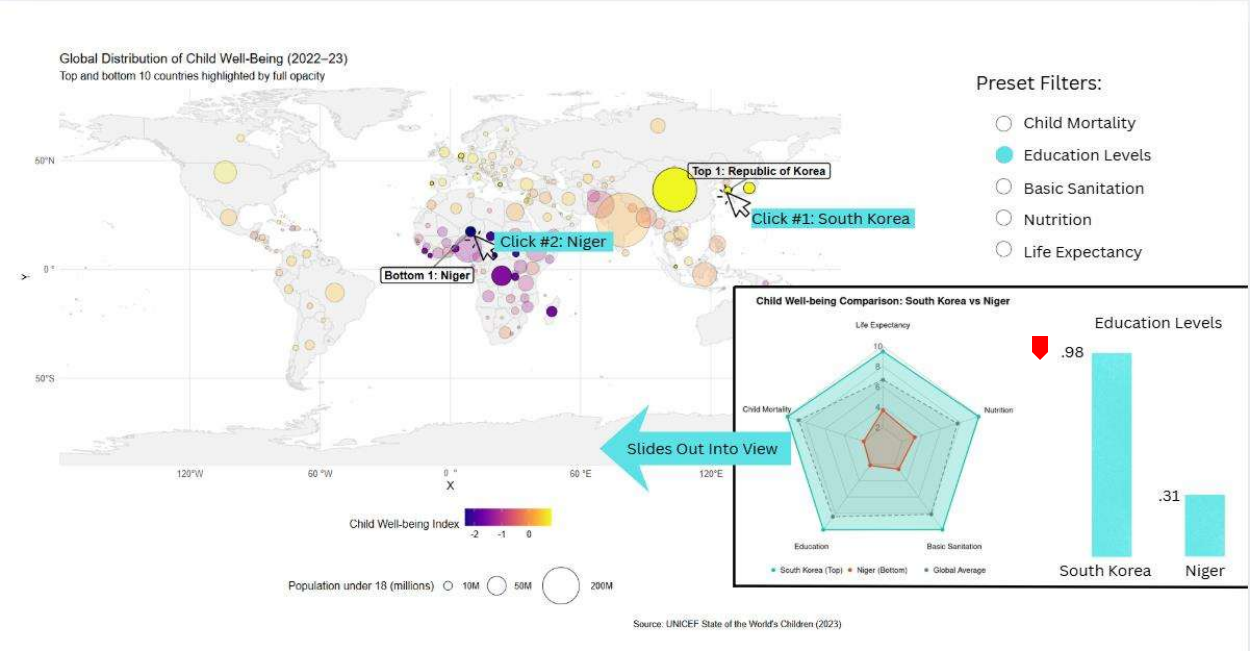
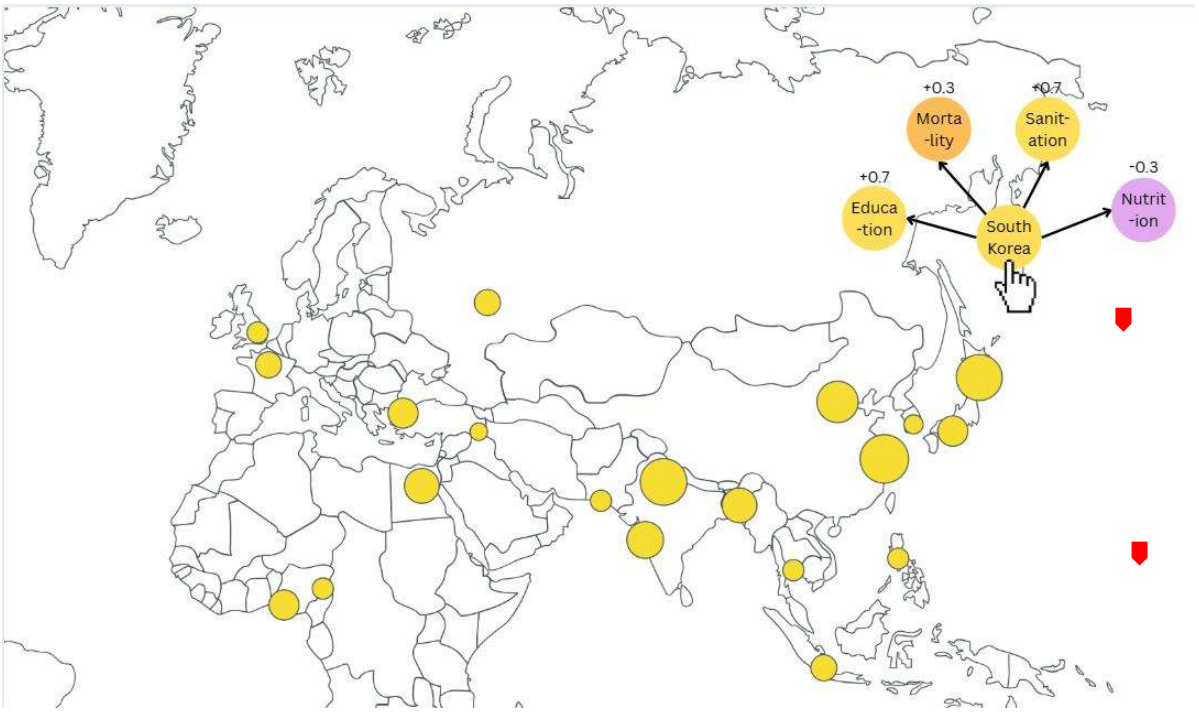


Figure 4: Upon hovering over one country, branching bubbles extend out, showing Z-scores for various data-dimensions related to child wellbeing, relative to the global mean.



3.1 Overview of the Main Interaction Flow

The landing view (Figure 1) uses a small set of highly salient, pre-attentive cues: two colored country dots and a hand-cursor prompt to communicate the core interaction without text-heavy instruction. The contrast between the dots and the neutral background creates color popout, helping first-time users immediately perceive that these elements are clickable on the main visualization. A brief hover demonstration reinforces the interaction model by showing that bubble elements reveal information on demand. By limiting the amount of on-screen information, the design minimizes extraneous cognitive load, making the main interaction of selecting and comparing visually and perceptually obvious for new users.

3.2 Baseline Bubble Map and Visual Encodings

The central bubble map shown in Figure 2 leverages pre-attentive attributes such as hue, size, and position to create a fast, perceptually efficient overview of global child well-being. Hue encodes the composite index using the "magma" colour-pallete selected for perceptual saliency and strong "high–low" separation, enabling users to detect outliers through simple color popout. Bubble size conveys under-18 population; this separation of variables into different channels prevents users from misinterpreting population as an indicator of well-being. Every bubble is also outlined in a thin, black stroke to ensure legibility on both light and dark backgrounds; this avoids the "merging" effect that occurs when circles and map backgrounds share similar luminance. Choosing a bubble map instead of a choropleth is a deliberate choice: bubbles avoid geographic bias, ensuring small but important countries achieve equal perceptual weight. However, the tradeoff is that spatial precision is sacrificed, but exact geographic borders are not central to our analytic task; relative performance and child population size are, thus motivating the usage of a bubble map over a choropleth. Labels appear only on hover to avoid visual crowding and reduce attentional competition. The Preset Filter panel on the right is placed deliberately apart from the map to maintain a response mapping: when a filter changes, the color scale updates instantaneously, producing a highly salient feedback loop.

3.3 Country Selection and Comparison View

Once two countries are selected, a radar chart and bar chart appear through a short slide-in transition as seen in Figure 3. The transition is not purely ornamental: it maintains change awareness by giving users a perceptual cue that a new analytic layer has entered the view. The radar chart itself offers a holistic, pattern-level comparison across the five well-being dimensions. While radar charts sacrifice numerical precision, we use them because they excel at communicating shape differences and multi-dimension imbalance, which is central to understanding disparities in child well-being across different data dimensions. We acknowledge a trade-off: users may misjudge magnitudes due to radial distortion, but this is mitigated by pairing the radar chart with a bar chart. The bar chart, tied to the selected preset filter, provides

an exact quantitative comparison. Bars are aligned to a common baseline to maximize perceptual accuracy according to the hierarchy of graphical channels. By placing the bar chart beside the radar, we allow users to fluidly shift between macro-level shape interpretation and micro-level numeric reading on the data dimension filtered for, enabling our target audience of policymakers interested in child wellbeing to deep-dive into the specific dimension of interest for targeted policies.

3.4 Expanded Detail View via Hover-Based Breakdown

Hovering over a bubble activates an expandable breakdown of underlying metrics (e.g., Education, Mortality, Nutrition). This alternative to a simple tooltip is chosen to provide meaningful structure to the decomposition: branching nodes make the relationships between sub-indicators and the composite score visually explicit. Thin connector lines establish hierarchy through Gestalt principles of connectedness, while consistent color scales link sub-scores back to the main well-being index. When a preset filter is selected, the corresponding sub-indicator node is also highlighted within this breakdown, using a subtle increase in saturation and stroke contrast. This creates a clear attentional anchor that ties the user's filter choice to the sub-dimension driving the recolored map, strengthening the stimulus–response mapping and reducing the cognitive burden of locating the relevant metric. We considered a pop-up table but rejected it because it interrupts spatial context and increases interaction cost. By keeping the breakdown anchored to the bubble's location, users preserve map awareness while utilizing the "drill down" narrative pattern so that our target audience can obtain a wholistic view of many factors that contribute to child wellbeing across many countries.

3.5 Visual Choices, Transitions, and Design Trade-offs

Every visual channel, color, size, spatial layout, labeling, animation, supports the overarching theme of "*global child well-being disparities*." Color conveys relative well-being, size conveys population implications, and interactive transitions guide users through increasingly detailed views of inequality. The design intentionally supports reader-driven exploration, enabling users to form their own questions (e.g., "Why is Country X an outlier?", "How do large-population countries compare to small ones?") and pursue them effortlessly. However, limitations remain: bubble maps obscure precise geography; radar charts are less precise than bars, and many interactive components may confuse new users. These are acceptable trade-offs at the mock-up stage, and where possible, we augmented our design to address the limitations, such as the inclusion of the supplementary bar chart to the radial chart, or a landing view to guide new users.

Development Plan

In the next phase of the project, our team will advance from the mock-up to a functional prototype by dividing the work into two coordinated streams: data preparation in R and front-end

visualization using D3 in JavaScript. R will be used strictly for data wrangling: cleaning, merging, validating, and standardizing the global child well-being indicators. Harrison will lead this component, ensuring that composite scores, dimension-specific indices, population measures, and metadata are exported as clean, well-documented CSV files.

All interactive and visual elements will be implemented directly in JavaScript using D3, which offers the flexibility needed to reproduce and extend the behaviors specified in our mock design. Charlie and Harrison will lead this portion of the development, being the most experienced coders. However, implementation will be quite modular as constructing the bubble map, implementing hover-based metric expansion, designing the transition into the comparison view, and rendering both the radar chart and bar chart using perceptually grounded encodings are mostly disjoint operations, allowing for easy delegation of tasks to different members. D3 also allows for additional enhancements should time permit. One planned extension is replacing the static 2D bubble map with an interactable globe, enabling users to rotate and zoom the Earth while retaining the bubble overlays. Although this feature is not required for the prototype, choosing D3 now ensures that the visualization can scale toward this functionality without restructuring the codebase.

To maintain cohesion between R's data pipeline and the JavaScript front end, the group will use Git for version control with a shared repository. R guarantees data integrity and reproducibility, while D3 enables flexible interactivity vital to our design goals. The modular design of our interactive elements and different views also allows for a balanced division of labor.