Bird's Eye View

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Abstract

How can we use data visualization to build empathy with people around the world? Our project, Bird's Eye View, is in the form of a website with scrollytelling elements to convey the stories of the world's development. Users are able to learn about each country's access to different resources through a guessing game. Finally, they are prompted to reflect on what they just learned from the game to build empathy with other users of the visualization. Through our project, we leverage gamification and personalized reflection to help users learn about international development. Users found the experience engaging, educational, and helpful to developing global empathy.

Keywords: Interactive visualization, choropleth, empathy-building, gamification, international development, global perspective.

1 Introduction

The world contains over 7.8 billion people, each living a unique lifestyle. This leads to differences in access to services and infrastructure throughout the world; consequently, one may find it difficult to imagine the extent to which this is the case, let alone empathize with those living thousands of miles away. This lack of knowledge and empathy leads to an incomplete understanding of the world, leaving humanity fragmented and lacking in global awareness.

While international articles are accessible upon a basic web search, they must compete with local news for viewers' attention. Additionally, without the use of additional visualizations, textual articles cannot effectively express numeric data to audiences, which is crucial when discussing metrics related to international development. On the other hand, visualizations serve as an alternative vehicle for expressing quantitative information effectively and to a variety of audiences.

In this work, we present Bird's Eye View, which leverages interactive visualizations, gamification, and personalized reflection to build global awareness and empathy among viewers. Birds' Eye View begins with an interface asking users to select one of three variables that reflect various forms of global development, including access to infrastructure, healthcare, and urban density. Afterwards, users will choose a desired timeframe, be given initial exposure to their selected topic, and participate in a game guessing the state of various countries according to the selected metric. After guessing several regions, users will be presented with a map of their performance and participate in a written reflection activity that aims to build empathy. When the user finishes, they can see previous viewers' responses, incorporating them into their own self-reflection.

We believe Bird's Eye View helps build global empathy and awareness among users. The remainder of this paper introduces our methods (Section 2), discusses results and effectiveness (Sections 3-4), and explains related and future work (Sections 5-6).

2 Methods

The main idea of Bird's Eye View is leveraging gamification and empathy building through scrollytelling and personalized reflection to help users learn about international development. To achieve that, we utilize several techniques and algorithms that we will explain in this section.

2.1 Data cleaning

There are 3 datasets that we choose to visualize: the percentage of world population that has access to electricity, has access to skilled birthcare staff, and is living in urban agglomerations of over 1 million. To make the visualization stable across different datasets, we did some data cleaning and formatting.

The first step is by converting the yearly data into decade data. The datasets provide columns from 1960 or 1980 to 2020; however, only data from 1990 - 2018 is highly populated. Also, not all countries have annual data from 1990 - 2018. So, to accommodate the sparse data, we decided to visualize them as averages by decades. Therefore, there are 3 decades that the users can choose, which is the 1990s, 2000s, and 2010s.

Then, we append geographical data to the dataset. The latitude and longitude data is acquired using Google country dataset, while the regional data is referenced from Internet World Stats. We also removed rows that don't have latitude/longitude data.

2.2 Using map as the visualization

To visualize the datasets, we chose to display it in the form of a choropleth map. An alternative visualization we considered is a flower-based data visualization in which each country is a flower and the statistics of each statistics as the petals. However, there are some interesting patterns across the datasets that show up in our exploratory data analysis, such as countries that are close to each other tend to have similar resources. These interesting trends will not show up in the flower-based visualization. That's why we decided to choose a choropleth map so that readers can learn about these regional relationships.

2.3 Guessing Game

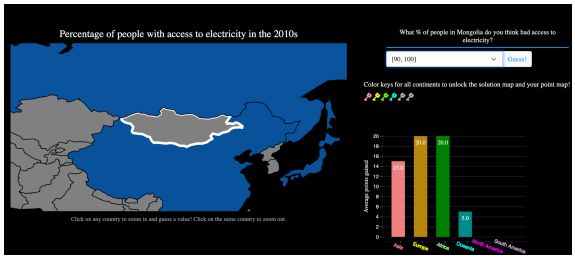

Figure 1: A screenshot of the guessing game.

To make learning different states of the world more engaging, we are leveraging gamification in the process. In the game, readers can click on the countries, then guess the percentage of the population that has access to certain resources. The closer the answer to the solution, the higher the points that the users will get. Through this game, readers can learn how different countries have different access to resources or infrastructure, and find if there are any interesting patterns across the different countries.

2.4 Empathy Building through Scrollytelling and Personalized Reflection

Before diving into the game, we want to give more context for people who may not be familiar with the subject. Moreover, not only do we want the readers to enjoy the game, but we also want them to reflect back on what they learned while playing the game. Because we don't want to reduce entire countries to single values and oversimplify the state of the world, we fit the gamification within a larger scrolly-telling interface.

Before the game, we provide a video and a short description on what the category is about. Then, after the game, we included a qualitative reflection at the end for users to think about issues that our map-based guessing game alone cannot capture. If the readers are curious on what other people learn from the visualization, we also provide the answers. Through the stories and reflection, we are hoping that the readers of our visualizations can escape their own life bubbles and be empathetic on the state of the resources around the world.

3 Results

Bird's Eye View is in the form of an interactive website. In this section, we will show how the platform can be used through a walkthrough of a user learning about the world's access to electricity in the 2010s.

3.1 Walkthrough: learning the world's access to electricity in the 2010s

When the user first goes to the webpage, they will be prompted to choose the categories: access to electricity, access to skilled birth staff, and urban agglomerations. Then, they will choose the decade they want to learn the map of: the 1990s, 2000s, or 2010s. After that, there will be some videos and brief descriptions of the category they chose. It is then followed by the game instructions, and the game will be shown when they scroll down.

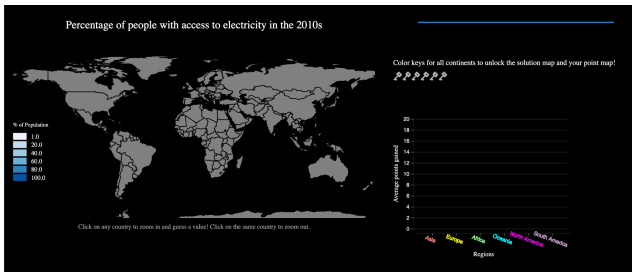

Figure 2: The starting state of the guessing game.

In the game section, they will be shown a blank map and an empty point bar chart (Figure 2). Above the empty bar chart, there are also 6 grey keys, each representing a region.

When the user clicks on a country, it will zoom in, and a drop-down menu will show up. In the drop-down menu, the user can choose a range of percentages of the country. For example, when the user clicks on Japan, they have to guess what percentage of Japan's population has access to electricity in the 2010s. Then the user will click the Guess button. The country on the map will be colored based on the solution regardless of what the users' answer was. This is because we want the user to use the solution as a hint for guessing the neighboring countries.

The point bar chart will also be updated if the user's guess is close enough to the solution. If the user's guess is in the same range of the actual answer, they will get 20 points. If they're off by 1 range, they will get 10, and when they're off by 2 ranges, they will get 5 points. Otherwise, they will get 0 points.

Figure 3: The 6 region keys need to be acquired by the user.

When the user guesses an answer of a country, they will get a "key" of the region that country is at (Figure 3). For example, when the user guesses the answer for Japan, they will get the key for Asia. The user has to collect all 6 keys, 1 for each region, to get the "End Guessing" button that lets them reveal the answer for all countries in the map (Figure 4 - top). This is done so that the user can explore countries in different regions.

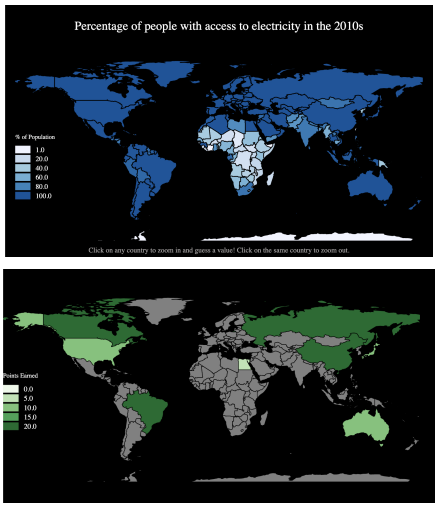

Figure 4: (top) The completed map shown to the user when the "End Guessing" button is clicked. (bottom) The map that represents the points the user gets for each country.

After the user clicks the "End Guessing" button, another map will appear. This map reveals the amount of points the user gets for each country they guessed (Figure 4 - bottom). Through this map, the user can learn how well they do in the game and whether they have trouble guessing countries in certain regions.

After the game, when the user scrolls down, they will see embedded Google forms containing personal reflection questions. There are 3 questions per category available. Once they finish answering the questions, they can scroll down and look at other people's anonymous answers for each question.

4 Discussion

Bird's Eye View creates an experience that pushes viewers to more directly interact with the datasets we selected and the true stories behind them. By interacting with our system, users learn about various levels of development and access across the world in a particular time frame. Beyond just showing the hard numbers, our system highlights the significance of electricity, skilled health staff, and urban areas. This pushes users to empathize with others across the world, serving as a successful solution to our original goal of using visualization techniques to build global empathy and awareness.

We conducted a handful of informal user testing sessions that verified the effectiveness of the immersion, gamification, and reflection we incorporated into Bird's Eye View. Specifically, the gamified approach pushed one user to try to increase their average across various continents, as their initial guesses were wrong. Subsequent guesses were much more correct, which highlights an increase in context and awareness among this user. Additionally, a different user noted that they "liked knowing how bad I messed up; it grabbed my interest and it's making me think about things more deeply." These two testimonials demonstrate the level of engagement gained by the gamification and interactivity we wove into Bird's Eye View. Finally, at the end of one user's experience, they even told us, "The visualization helped me build empathy because I felt bad for people who didn't have access to these different services." This hits at our original goal of building global empathy and awareness among users.

5 Related Work

The primary techniques we suggest for building empathy and improving international development awareness using visualizations are gamification and personalized reflection, both of which are inspired by visualization design literature.

We were influenced by two affordances of the medium discussed in the Narrative Visualization lecture of 6.859 (Satyanarayan, 2021) -- making systems playful and promoting self-reflection. Bostock's New York Times visualization (2014) on playfully interacting with Senate forecasts and Aisch's New York Times visualization (2015) using drawing for guessing the impact of family income on college chances are two visualizations that influenced our coloring guessing game.

For our scrolly-telling design, we followed the Martini Glass style of visualization (Segel et. al, 2010) by implementing a balanced mix of author-driven and reader-driven visualization. As described for the Martini Glass style, we begin with an author-driven approach, using videos and written stories to introduce the visualization. Once our intended narrative for one of three international development categories is complete, the visualization opens up to a reader-driven stage where the user is free to interactively explore the data using the guessing game coloring visualization and by exploring the reflections of other users. Segel et. al. note that this is the most common interactive visualization structure among the narrative visualizations they examined.

In his work on the ethical dimensions of visualizations, Michael Correll (2019) encourages us to question the neutrality of data and to visualize invisible components of the data visualization pipeline. We implement this suggestion in our visualization by fitting the gamification within a larger scrolly-telling interface with stories about international development. We include a qualitative reflection at the end for users to think about issues that our map-based guessing game alone cannot capture. By engaging with other users' reflections on our guessing game interface, we hope that users can ponder upon the "hidden" components of our guessing game.

6 Conclusion and Future Work

Bird's Eye View is a platform that allows users to build their empathy and learn about international development. Through reading the stories, playing the guessing game, and writing personal reflections, users are able to learn about other countries' access to electricity, skilled birthcare staff, and infrastructure.
There are several improvements that can be useful for the system in future iterations. Improvements that involve map visualizations include adding a search bar for the country so that smaller countries are more easily accessible and coloring different regions in the map based on the color of the game keys. Other than that, adding a multiplayer element to the game will make the visualization more engaging as people can learn and play the game together. Last but not least, adding an actual database for the personal reflection will make the website more aesthetic and cohesive, as currently the reflection questions are using embedded Google Forms, and other people's answers are shown in embedded Google Spreadsheets. Adding a database will also allow developers to do further data analysis on other users' answers of the personal reflections.

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