

1 Introduction

In this PROCESS BOOK we will explain how we devised our project, explaining all the design and technical decisions made by the group. We will dive into how the project evolved from its first sketches, commenting on all the major changes made in Section 2.

Additionally, we will revisit all of the major challenges faced by the group and how they were overcome in Section 3.

We also provide some comments and thoughts on the design chosen for the website in Section 5.

To finalize, we provide the work distribution per peer in Section 6 and a small conclusion in Section 7.

2 Path to the Final Result

The project idea came up when the professor showed in the first class an example which included an interactive map. Drawn by the idea, the group tried to find a theme where an interactive map could be used and made sense. While looking into the most prominent features and debates around Switzerland, the group thought it could make sense to compare Switzerland in terms of guns (and what it involves) to other countries. The idea was born.

After that, using *Kaggle* and other websites as data sources, we looked into datasets that could be used for this end and quickly found them.

We then started to wonder how we could use the interactive map in this situation. The first idea we had was to just have the map display a *popup* with information on mouse hover. We quickly understood that we all wanted something more interactive and therefore came up with the idea of having just some information on the mouse hover *popup* and more when the user clicks on the country. This approach also allowed for more information to be displayed in the clickable *popup* than solely in the mouse hover *popup* as there would be more space, avoiding visual clutter.

By watching the classes, we understood that color plays a huge role in visualization. As so, we wanted to include it in the map. We then came up with the idea of using a danger level indicator for each country, calculated from the data number of deaths by gun per 100k people in the datasets. This danger is shown using color: from light green for the safest country to dark red and black for the most dangerous one. The colors are scaled from one color to another using a linear scale to show the evolution of danger in the different countries.

The Quiz started as an idea for a bonus feature but it quickly became clear that it would be part of our project. We understand that the Quiz makes our project more interactive and, although technically not a visualization, it fosters users to be more interactive with the website and then more interested and active on the topic, leading to learning more about the topic. The ultimate goal of any visualization is to expose data in a human-understandable way. Interactivity such as a quiz is an interesting and powerful technique to expose a subject and keep the user interested. Hence, we implemented the quiz as a 3rd part of our project.

We chose a multiple-choice quiz, which is easier to answer, allowing us to keep the user interested. A quiz must be short and easy to play even if the questions are hard or else the user loses interest. This format allows us to easily calculate a score and display it at the end of the questions. The score is an interesting feature as it allows for competitiveness between users, which can be useful to increase the website's popularity.

The questions are rather complicated at the moment, which makes the quiz section a little less interesting, but if we had more time, we could have created more questions with levels (beginner, intermediate, expert). Due to lack of time, we didn't have time to link an interactive map with the questions, for example: click on a country or which country is the most dangerous... But the main thing was to make sure that everyone understood the usefulness of the website and its possibilities, and we feel we've succeeded.

3 Challenges

Some challenges apply to all project parts, mitigated through reading the slides and online searching. Two of those challenges were that the team was not accustomed to working with *JavaScript* and *CSS*. Hence, it took some time to get used to working with these technologies and how to take advantage of them. In particular, *CSS* posed some problems regarding positioning elements in the *Web page*, since some attributes (**z-index**) were interfering with the buttons, making them not clickable.

3.1 Interactive World Map Development

The development of the interactive world map involved overcoming complex challenges to provide a dynamic user experience:

- **Integration of Interactive Elements:** The initial challenge was adding interactive capabilities to the Esri-based map. We utilized .geojson files to create distinct polygons for each country, which allowed us to detect and respond to user interactions such as mouse entries and exits within specific geographic boundaries.
- **Visual Representation of Danger Levels:** Our main goal was to visually depict the danger levels of various countries. This was accomplished through a "Show Danger" button, which employed a color scale from green (indicating the lowest danger) to black (indicating the highest danger), segmented into six zones. These colors provided an intuitive representation of safety, enhanced by a detailed scale that included numerical and descriptive danger levels based on the Gun Deaths Violent Rate per 100,000 people. For visual and discovery purposes we also have the case when not clicking on the show danger button, where the countries are not colored, and when you hoover inside of the polygons of the country the danger color of the hovered country is shown. Both cases allow us to have a global and discovery visualization of the danger.
- **Data Integration and Consistency:** Gathering comprehensive and consistent data for all countries was challenging. Missing data and name discrepancies were significant hurdles, which we addressed by standardizing country identifiers through alpha-2 codes

(Ex: France → FR), ensuring accurate and consistent data integration across various datasets.

- **The Pop-Up Page:** We integrated a pop-up page activated upon clicking on a country. This feature provides extensive information beyond the basic name and danger level available via hover text. Designing this was complex, requiring careful consideration of various parameters such as size, color, and appearance of the page and its content. Notably, we chose to display the flag of the selected country. However, this introduced a unique challenge. The Swiss flag, distinct in its square shape compared to the typically rectangular flags of other nations, necessitated additional space within the pop-up to accommodate its format. This issue highlights one of the many nuances you can find when working on the visualization.

3.2 Quiz Development Challenges

During the development of the quiz, we faced several challenges:

- Generating dynamic questions involved distinguishing between pre-answered and template-based questions. For pre-answered questions, the correct options were pre-calculated using the `quiz_answers_calc.py` script and involved the random selection of country options from the dataset.
- For template questions, where the country is chosen randomly, the correct answers and other plausible options were generated using a random number generator based on a variability parameter, ensuring a diverse set of options.
- Ensuring uniqueness and accuracy among the options, especially in managing *null* values and preventing duplicate choices in the dataset, presented technical difficulties.

4 Final Sketches

In this section, we compare the versions of our previous sketches with the final version. Generally speaking, we had to adapt the sketches from portrait to landscape format, which meant making some modifications.

The final version of the cover page is visually more engaging and professional. The use of the world map as a background adds a relevant and attractive visual context. Embossed buttons enhance the interactivity of the interface. Text framed in a light blue box enhances the legibility and organization of content.

We have modified the discovery page so that the use of a detailed satellite map offers better visualization and richer context, making the site more informative and engaging. Modernized buttons, alongside the addition of the "Show Danger" button, enhance the interactivity and aesthetics of the interface, making navigation more intuitive for the user. Zoom controls on the map enhance interactivity, allowing users to navigate easily and focus on specific areas of interest.

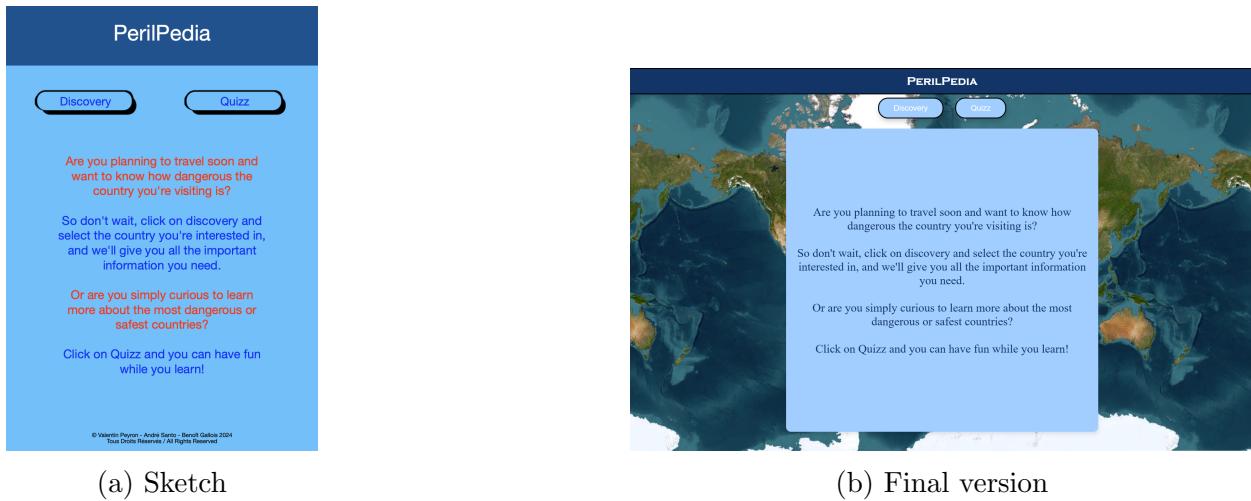


Figure 1: Introduction page



Figure 2: Discovery page

When a country is selected, the result is much better in the final version. The map automatically zooms in on the selected country, giving it a color gradually linked to its level of danger. The pop-up that appears when you hover over the country is relatively handy, as it gives the most important information directly to the user.

The new version of the discovery page is much more user-friendly.

The Quiz page has undergone fewer changes than the previous one, as there are fewer functionalities. However, the final version is improved because the outline appears in red on the start button when the cursor hovers over the button. This makes it easier to visualize.

The question display is much smoother and more pleasing to the eye in the new version. What's more, the 'Questions' title is easier to understand. The map next to it should have been used to make the questions interactive (due to lack of time, we were unable to implement this), which is why we've added it.

Additionally, the page that pops up when a quiz is finished is improved, as the score is



(a) Sketch

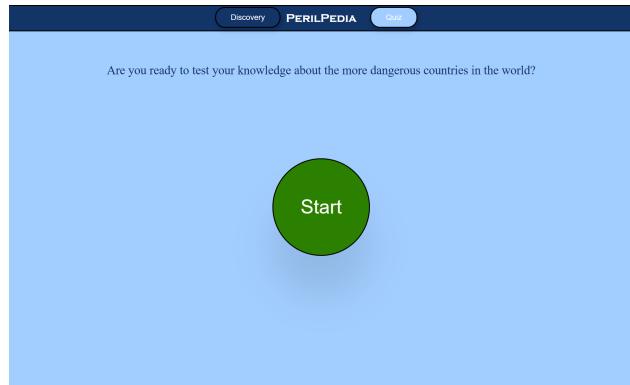


(b) Final version

Figure 3: Discovery page with zoom on Swiss pop-up page and pop-up name of the country.



(a) Sketch



(b) Final version

Figure 4: Quiz start page

displayed, and another important feature has been added: the 'Restart' function.

In conclusion, the final version of the website is much more developed and user-friendly than the sketches. However, the sketches were very useful in helping us understand what we wanted to present and how we would do it.

5 Comments on the Design

We built a website with a solid foundation that includes several attractive, interactive elements designed to provide a positive user experience. The introductory page is clear and simple, with a clear purpose that invites users to begin their journey by choosing between "Discovery" and "Quiz" using prominent buttons. The welcome message effectively communicates the site's purpose and encourages users to continue their exploration.



(a) Sketch

(b) Final version

Figure 5: Quiz Question page

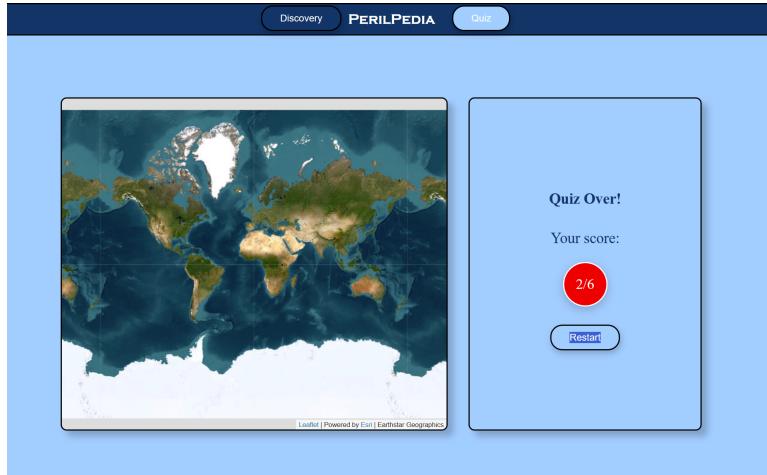


Figure 6: Score page

The "Discovery" page features an interactive map that uses color coding to show the different levels of danger in different countries, making it both intuitive and visually appealing. When users select a country, they receive detailed information such as population, danger level and firearms statistics, presented in a consistent, professional layout. When we selected the colors we ensured that color distinctions were clear for color-blind users. We also enabled a zoom option for better navigation. The button "Show Danger" is a very good add-on because it shows all the information in a very friendly way. To improve the design, we could add a color scale to indicate the degree of danger.

The "Quiz" page offers a simple interface with clear answer options and a geographical context provided by a world map. To improve this page, we would suggest adding a progress bar to indicate quiz completion status.

6 Work Distribution

We will refer to the group members as André(376762), Benoît(296867) and Valentin(301340).

Milestone 1: Concept Development

- **Group Effort:** The team worked together to find a suitable project idea.
- **Valentin:** Performed dataset analysis.
- **André and Benoît:** Tasked with documentation:
 - Authored the `README.md` file.
 - Defined the project problem statement.
 - Conducted a search for related works.

Milestone 2: Website Framework

- **Benoît:** Created the initial sketches of the website design and made initial aesthetic choices, particularly the design of the main map.
- **André:** Wrote the comprehensive project report.
- **Valentin:** Developed the core structure of the website:
 - Built page structure of the website for home, world map, and quiz sections.
 - Added a `.geojson` overlay for interactive mapping.

Milestone 3: Implementation and Finalization

- **Valentin:** Enhanced the functionality and aesthetics of the world map and other website pages. Key contributions include:
 - Implemented zoom functionality on the map, focusing on a country upon clicking and displaying an aesthetically coherent pop-up with crucial details and a clear information layout.
 - Developed dynamic color changes for countries on hover, indicating their danger levels instantly.
 - Refined visual design across various website pages to ensure a consistent and engaging user experience. such as font, colors, positioning, button formats, hover appearance.
 - Structured and designed the quiz section, including aesthetics for the start page, question interfaces, scoring, and restart functionalities.
- **André:** Developed the interactive quiz feature, incorporating questions and interactive elements to engage users in learning about global safety. In particular:

- Developed a method to generate questions and options, alongside the correct answer automatically.
 - Developed the initial HTML and initial CSS of that site, integrating it with the *Javascript* functionality.
- **Benoit:** Developed features for the world map page, authored the project report, and scripted and edited the video presentation. Specific contributions include:
 - Implemented a pop-up feature that displays a country's name and danger level when hovered over.
 - Added a “Show Danger” button to color-code countries on the map according to their safety levels, enhancing visual representation.
 - Sourced a comprehensive dataset of national flags to incorporate into each country's popup, enriching the visual data representation.

7 Conclusion

Summing up, we developed a visualization that lets users learn more about gun-related statistics (homicides using a gun, gun ownership, and others) in the world, which can be valuable information for some users such as travelers, or just a curiosity for others.

Our Website consists of 2 main parts: the Interactive World Map (IWM) and the Quiz (and the Main Page, not considered here). The IWM lets users learn the statistics about each country interactively and the Quiz enhances interactivity, allowing users to compete against each other and learn through trial-and-error.

We strongly believe that these 2 elements are complementary, as the Quiz may also push the user to use the IWM and learn more about the specified country. Questions that ask for the country with the maximum/minimum value for a certain statistic might push users to look through more than one country.

We argue that our project provides a new insight into this topic, as we stated in Milestone 1, since there are no available visualizations, to the extent of our knowledge, that cover the same topics with the same interactivity. As so, we hope that our project provides a new tool for users who want to be informed about gun-related statistics in other countries, or their own.