Animal Adventure: Explore Wildlife with Colorful Data Visualization Enhancing Kids' Visual Literacy

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1 Abstract / Introduction

The importance of raising awareness about the environment among children, from elementary school to university, has long been a goal in the United States. As early as the 1800s, U.S. President Thomas Jefferson envisioned this need.

In many cases, readers, regardless of age, choose optical presentation over words. (Evans, Watson & Willows, 1984; Woodward, 1989). The combination of pictures and words is more powerful than each one separately Heifer (1995); however, Watkins et al. (2016) have noticed that elementary school students use their imaginations to interpret visual representations instead of relying on the associated text.

Fontichiaro et al.(2017), noted that data visualizations are widely popular as they enable developers to represent data in formats as simple as pie charts and as complex as infographics.

In addition, data visualizations enable developers to summarize and classify data efficiently, thereby facilitating easy data searching. Interactive techniques such as data graphics allow users to experience data in an open-ended manner.

The success of a good data visualization depends on identifying the user of the data, the type of data, the simplicity of the presented data, and the ability to revise existing graphs (limited to data for the X and Y axes) (Myatt, 2019). The team has identified the users as elementary school kids, the data to be used as wild animals, and simplicity has been classified by location as well as animal family just to mention a few.

2 One-sentence description

This vibrant educational website for children employs colorful and visually captivating data visualizations to impart knowledge about animals, including an interactive USA map for exploring regional wildlife, a network graph illustrating familial relationships, and a density graph highlighting animal distribution across habitats, all aimed at nurturing curiosity and facilitating learning.

3 Project type

The project is a web-based learning application for kids, aptly categorized as such due to its combination of educational content with interactive features tailored to engage children in learning. Its features, including an interactive USA map, a network graph displaying familial relationships among animals, and a density graph showing animal distribution across habitats, provide dynamic ways for children to explore and interact with the dataset. The incorporation of visually appealing elements and a playful design enhances the user experience and fosters engagement with the educational.

4 Audience

This project targets elementary school children as the audience who are intended to learn about animals in a way that is interactive, fun and engaging.

This project meets the audience needs in many ways:

- It caters to an educational audience by providing comprehensive information about animals, including scientific names, enriching their learning experience from elementary through high school levels.
- The incorporation of interactive features such as the USA map and graphs enables children to independently explore and discover data through engaging colors and animations, enhancing their attraction to the learning experience.

When the needs are not met, the following are likely to happen:

- Without fulfilling the desire to learn, the system will fail to meet its intended purpose, leading to a decline in engagement and effectiveness.
- If the need to engage children in learning about their environment through the app is not met, the resources invested in its development will become wasted
- Failing to meet the need for children to learn about their environment and surroundings would impact their overall understanding and appreciation of the world around them.

5 Approach

Our approach is to make the visualizations very colorful and interactive, with an aim to attract children's curiosity about natural resources and wildlife. We believe this approach is effective and will be successful because of the following aspects:

1. The application's capacity to engage children is poised to revolutionize their perception and interaction with it, fostering continuous excitement and sustained involvement.

2. The ability for the application to allow the children to explore at their own pace and based on their curiosity. We think this is cool because kids love to explore new things and this will keep them invested in the app.

3. As the web app progresses, it will gradually introduce increasingly complex visualizations, accommodating children of varying skill levels by starting with simpler graphics and advancing to ones that are more intricate.

6 Best-case Impact Statement

In the best-case scenario, children effectively learn about their environment through the website, leading to widespread recommendations from schools to utilize the app as an invaluable resource for education.

7 Major milestones

1. Collecting/Generating the dataset that contains suitable information
2. Design UI/UX
3. Creating and conducting experiments based on goals and objects
4. Testing the developed app
5. Implementing the app and monitor that is working as designed

8 Obstacles

8.1 Major obstacles

Challenge 1: Potential failure to meet deadlines due to various factors such as conflicting schedules, technical glitches, and miscommunication.

Mitigation:

- Implement Agile methodology to adapt to changes and prioritize tasks efficiently.
- Foster proactive communication through regular vertical weekly meetings, group chats, and other communication channels.
- Encourage transparency by openly sharing progress updates and workload distribution.
- Delegate tasks appropriately to ensure timely completion.

Challenge 2: Ensuring the accuracy and reliability of project data poses a significant challenge.

Mitigation:

- Source data from reliable and reputable sources to maintain accuracy.
- Conduct exploratory data analysis to identify potential issues and enhance data quality.
- Implement measures to continually improve data integrity throughout the project lifecycle.

Challenge 3: Technical hurdles may arise during any phase of the project, from development to deployment. Mitigation:

- Promptly address technical issues as they arise to prevent delays.
- Seek assistance from teaching assistants (TAs) or team members when spending significant time on a specific problem.

8.2 Minor obstacles

Challenge 1: Inadequate domain knowledge or coding skills among team members can hinder project progress.

Mitigation:

- Invest in improving necessary skills through self-learning resources and peer support.
- Foster a culture of knowledge sharing and mutual assistance within the team.

Challenge 2: Incomplete or unclear communication can lead to misunderstandings and inefficiencies.

Mitigation:

- Encourage team members to seek clarification when necessary to ensure mutual understanding.
- Establish clear communication protocols and channels to facilitate effective information exchange

Challenge 3: Sustaining project relevance and effectiveness requires a commitment to ongoing improvement

Mitigation:

- Continuously monitor and evaluate project outcomes to identify areas for enhancement.
- Iteratively refine the platform through regular updates and enhancements based on feedback and performance analysis.

9 Resources needed

- **Computational Resources**: Access to high-performance laptops or computers with sufficient processing power and memory is essential, especially for tasks involving large datasets or simulations. Consider utilizing cloud computing services or dedicated servers if local resources are insufficient.
- Testing the application across different platforms (e.g., web browsers, mobile devices) requires access to various testing environments. Consider using

emulators, virtual machines, or physical devices to ensure compatibility and functionality across different platforms.

- **Expertise and Skills**: Given the introduction of new technologies, acquiring expertise and skills becomes imperative. The learning curve for certain technologies may be steep, necessitating investment in training programs, workshops, or hiring individuals with relevant expertise to mitigate potential challenges.
- **Data Access Licensing**: Ensure compliance with data access requirements by acquiring the necessary licenses. Some datasets may necessitate full access permissions to utilize them effectively. Obtaining proper licenses ensures legal compliance and allows for full utilization of the dataset's capabilities, preventing any limitations associated with partial access

10 5 Related Publications

- Muthersbaugh, D., Kern, A. L., & Charvoz, R. (2014). Impact Through Images: Exploring Student Understanding of Environmental Science Through Integrated Place-Based Lessons in the Elementary Classroom. Pages 313-326. http://dx.doi.org/10.1080/02568543.2014.913217

  This publication holds historical significance as it outlines the introduction of environmental lessons in schools and delineates methods for teaching with and without computers. Its insights serve as a guide for our project development, helping us understand user needs and ensuring legal compliance.

- Bishop, F., Zagermann, J., Pfeil, U., Sanderson, G., Reiterer, H., & Hinrichs, U. (2020). Construct-A-Vis: Exploring the Free-Form Visualization Processes of Children. *IEEE Transactions on Visualization and Computer Graphics, 26*(1), 451-460. Doi: https://ieeexplore.ieee.org/document/9903547
  This paper focuses on visualization designed for children aged 6-11, which aligns closely with our target age group. Despite the slight age difference, the approach of encouraging children to engage with data on a personal level offers valuable insights that can enrich our project.

- Alper, B., Riche, N. H., Chevalier, F., Boy, J., & Sezgin, M. (2017). Visualization Literacy at Elementary School. *Journal Name*, Volume(Issue) https://doi.org/10.1145/3025453.3025877
  This publication is a research study that explores the deployment of visualizations in education and evaluates its effectiveness. Its findings offer promising insights, suggesting that successful integration of visualizations in educational settings is achievable.

- Gäbler, J., Winkler, C., Lengyel, N., Wallner, G., Aigner, W., Stoiber, C., & Kriglstein, S. (2019). Diagram Safari: A Visualization Literacy Game for Young Children. *Journal Name*, Volume(Issue), https://dl.acm.org/doi/pdf/10.1145/3341215.3356283
  This paper explores the implementation of data visualization in an educational setting using a game called "Diagram Safari." The game, designed to be interactive, has shown promising potential as an effective educational tool. Given our project's focus on animals and data visualization, examining how the classification was implemented in this context could provide valuable insights and inspiration.

- Stenliden, L., Bodén, U., & Nissen, J. (2019). Students as Producers of Interactive Data Visualizations—Digitally Skilled to Make Their Voices Heard. Journal of Research on Technology in Education, 51(2), 101–117. doi: https://doi.org/10.1080/15391523.2018.1564636
  The publication focuses on students who are 6-9 years old not only learning from visualizations but also actively engaging in producing their own visualizations based on what they observe. This active participation allows students to develop their digital skills and express their voices through data visualization. We found this is a perfect control loop in a way, and maybe it can be a future plan of an app to be developed.

11 **Define success**

- Positive user feedback is a crucial determinant of success, as it reflects user satisfaction and perceived value. Deployment marks a significant milestone, but success extends beyond the initial launch to ongoing usage and impact.

- Comparing the project's objectives with the actual system output provides a concrete way to assess success. If the app effectively meets its intended goals, such as promoting data visualization literacy for children and providing an engaging learning experience, then it can be considered successful.

- Additionally, monitoring key performance indicators (KPIs) like user engagement, retention rates, and learning outcomes can provide valuable insights into the app's effectiveness and help identify areas for improvement even after deployment.

- The rate of user engagement post-installation will serve as a key indicator of user satisfaction. If users find value in the system, they are likely to continue accessing it even after deployment.

Reference

Muthersbaugh, D., Kern, A. L., & Charvoz, R. (2014). Impact Through Images: Exploring Student Understanding of Environmental Science Through Integrated Place-Based Lessons in the Elementary Classroom. Pages 313-326. http://dx.doi.org/10.1080/02568543.2014.913217

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Literacy Game for Young Children. Journal Name, Volume(Issue), https://dl.acm.org/doi/pdf/10.1145/3341215.3356283

- Alper, B., Riche, N. H., Chevalier, F., Boy, J., & Sezgin, M. (2017). Visualization Literacy at Elementary School. Journal Name, Volume(Issue) https://doi.org/10.1145/3025453.3025877

- Bishop, F., Zagermann, J., Pfeil, U., Sanderson, G., Reiterer, H., & Hinrichs, U. (2020). Construct-A-Vis: Exploring the Free-Form Visualization Processes of Children. IEEE Transactions on Visualization and Computer Graphics, 26(1), 451-460. Doi: https://ieeexplore.ieee.org/document/9903547

- Myatt, G. J., & Johnson, W. P. (2009). Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications.

- Evans, M. A., Watson, C., & Willows, D. M. (1987). A Naturalistic Inquiry into Illustrations in Instructional Textbooks. Journal of Reading Behavior, 19(1), 5-29.

- Watkins, J. K., Miller, E., & Brubaker, D. (2004). The Role of the Visual Image: What Are Students Really Learning from Pictorial Representations? Journal of Visual Literacy, 23(1), 23-40. https://doi.org/10.1080/23796529.2004.11674601