Università della Svizzera italiana | Faculty of Informatics

Bachelor Thesis

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How do children search?

A tool to support researchers in understanding how children search for information online

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Abstract

Abstract goes here ...

Things to write: Context, Problem, Limitations in SOA, Contribution and Findings

Keywords:

Advisor:
Monica Landoni
Co-advisor:
Diletta Micol Tobia

Approved by the advisor on Date:

Contents

1 Introduction

Things to write in the introduction: Acknowledge seminal work in the area (very similar tool or research). In the last paragraph list all your contributions. Add a subsection titled “Report structure” where you briefly discuss the content of each following section (e.g., In section 2, we review previous studies in the context of ....).

Context, Problem, Limitations in SOA, Contribution and Findings

2 Background and Related Work

The study of how children search for information online is a growing area that connects education, information retrieval (IR), and human-computer interaction (HCI). The goal of this project was to develop a research tool that could collect interaction data from children using both traditional search engines and their results page (SERP), and large language models (LLMs). Unlike other projects focused mainly on improving user experience or visual design, this project was designed as a flexible platform to support various research questions on children's search behaviors. At the same time, the tool had to be fully functional and ready to use in real research scenarios, so an engaging and appropriate User Interface (UI) and User Experience (UX) for younger users was still a key requirement.

2.1 Foundation

The starting point for this project was the bachelor thesis by Savoia [8]. In her work, she proposed an interactive game designed to observe how children search for information. The interface was structured around a group of six islands, where each island represented a question framed with a specific emotional tone (positive, neutral, or negative). The children were allowed to choose how they wanted to answer the question, using a familiar web search interface (Google) or a chatbot-style LLM. Her work demonstrated that this narrative approach could encourage natural interactions and meaningful behavior from children.

Although her prototype successfully demonstrated the idea, it was not built with the core feature of data extrapolation nor with reuse or extensibility in mind but as a proof of concept. This project rebuilt the system from scratch to make it modular, maintainable, and suitable for future research experiments. Still, it kept the core idea of gameplay, the use of emotionally charged questions, and flexibility in tool choice to support various search strategies.

2.2 Motivation

A review of the literature highlighted the need for a research tool tailored to children's needs. Children are frequent users of search engines, especially in school settings, but often struggle to find relevant information efficiently [1]. Most commercial tools like Google or Bing are designed for adults [1, 4], and there is no single search interface that fits all users, especially young people with different cognitive and emotional needs [4].

In the IR research community, there is a clear call for child-friendly systems that are more suitable in educational contexts [7]. However, building such systems is challenging. Designing for children means taking into account their specific abilities: cognitive, technical and emotional [3]. In many cases, children say they want one thing, but their actual behavior shows something else. This is why relying only on interviews or post-task questionnaires can be misleading [1].

Besides, children are often left out of mainstream IR research and there is a lack of reliable data on how they really use search tools [8]. Researchers have highlighted the need for dedicated datasets, experimental tools, and evaluation methods designed for children [5].

Observing how children search and interact with systems, we can gather important insights that help improve the design of future tools [8]. These insights can also guide the development of features that help children, for example, by offering visual cues to highlight relevance or reduce confusion [4]. Data from child search behavior can also support many different research directions, including how emotions impact search performance, how children respond to positive or negative task formulation, or how task complexity affects engagement [7, 5]. In particular, it is also interesting to consider how negative emotions are handled. Some research suggests that tracking negative user emotions could support better filtering, while others warn that hiding negative content could limit learning opportunities [7].

A game-based tool, like the one built in this project, can collect structured data such as query logs, number of queries, time spent, and user clicks [1]. It can also capture richer information about how children switch between tools or how many queries / prompts they need before answering. This kind of data would be difficult to gather with traditional observational methods or surveys.

3 Requirements

This project did not begin with a fixed list of specifications. Instead, requirements emerged iteratively through exploration of the research domain, analysis of related literature, and discussions with advisors. The system was designed to be general enough to support a wide variety of research questions in information retrieval (IR) and human-computer interaction (HCI), while also being engaging and usable for children.

The main objective was to implement a fully functional and reusable prototype capable of collecting detailed data on how children use traditional search engines and large language models (LLMs). The project builds on and extends Savoia's prototype [8], which demonstrated the potential of a game-based framework to study children's search behavior, but did not actually integrate the data collection aspect of it.

To structure the design, the following questions guided the requirements definition process:

- What kind of data do researchers want to collect?
- Can a game-based interface be used to collect these data effectively?
- What kind of game design is both engaging and suitable for structured data collection?
- How can the tool be both usable for researchers and appealing to children?
- How can the system be modular, extensible, and maintainable for future research?
- How can it adapt to different experimental setups or research contexts?

These reflections acted as a guide to explore the literature, which then led to a concrete list of functional and non-functional requirements, discussed below.

3.1 Data for Research Use

Exploring the literature revealed that researchers need a wide range of data to understand children's search behaviors. This includes both quantitative metrics and qualitative observations, but this project resides in the quantitative metrics domain. The following types of data were identified as relevant for this project:

- **Query Logs:** Query text, number of queries, and query term counts [1, 8].
- **Performance Indicators:** Session length, click counts, and rank depth [5].
- **Task Outcome Data:** Final user responses, with the idea that scoring based on teacher rubrics or predefined relevance criteria could be done later when analyzing the gathered data [5].
- **Tool Preference:** Children's selection patterns between search engine and LLM [8].
- **Timing Data:** Time spent on each question, delays before interaction, and time spent on web pages [8].

3.2 UI Insights from Literature

Key research informed the UI requirements:

- There is no one-size-fits-all SERP interface suitable for children [4].
- Children prefer playful and engaging tools, and emotional design improves product recognition and user satisfaction [3, 2].
- Humanized design elements such as avatars, animations, and storytelling are particularly effective for younger users [2, 3].
- Participatory design methods show that children prefer familiar, usable UI elements but appreciate fun, cartoonish visuals [9, 6].
- Children prefer to interact with a tool they perceieve to be as the real thing, instead of a simplified version [1].
- Based on their age and cognitive abilities, children require different levels of scaffolding and support in search tasks [3, 9, 2]. In particular:

  - **Ages 6 to 8:** Interfaces should use simple, familiar words, and reward systems are effective in maintaining engagement. Bright colors are still encouraged.
  - **Ages 9 to 12:** These users value autonomy and prefer interfaces that offer control rather than instructions. Feedback should be informative rather than directive. Colors can be more subdued, such as green, gray, and navy tones. They are generally more skilled at navigating websites and handling smaller UI elements.

3.3 Functional Requirements

Based on the insights from the literature and discussions with the advisors, the following functional requirements were defined for the system:

Language and Initialization

- The language of the game should be modular and easily changeable.
- A landing page must appear before the game starts to allow teachers or researchers to explain the rules.
- The game must be reset when a new language is selected.

Session Management

- Each session must be identified by a unique user code provided by the teacher.
- The game must start only after the user inputs a valid code.
- The game must persist its state on page refresh using local storage.
- Researchers must be able to download session data at any time, even if the game is incomplete.
- When downloading data, the system must request a password to protect the export and prevent children from tampering with it.

Gameplay Logic

- The game must include six clickable islands, presented in a randomized order per session.
- Islands can be clicked in any order.
- Each island represents a question with a specific emotional framing: positive, neutral, or negative.
- Once answered, an island becomes inactive and cannot be clicked again.
- Inactive islands must show a different cursor, remove hover effects, and a message should appear when trying to click on them.
- Each completed island increases the score by 10 points (maximum 60).
- The current score must be shown to motivate the user.

Search Tool Interfaces

- Clicking on an island must open a question page where the user chooses between Google or Gemini (LLM).
- Users must be allowed to switch between the two tools freely before submitting an answer.
- The Google interface must visually mimic a real search engine and display the top 10 results.
- The Gemini interface must mimic a realistic chatbot interface.
- Clicking on a Google result must open the link in a new browser tab.

User Interaction Tracking

The system must record **per-island data**:

- Question
- Sentiment of the question
- Time of the first click on the island
- Time of the answer submission for the island
- A list of objects containing information about each query or prompt performed by the user, in particular:
  - If the query was made using Google or Gemini
  - The text of the query or prompt
  - The number of query terms
  - The answer provided by the tool of choice - either a list of SERP results for Google or the response from Gemini.
  - When saving SERP results, the system must record:
    - The title of the result
    - The snippet of the result
    - The position of the result in the SERP
    - The order in which the result was clicked
    - The time spent on the page corresponding to the result
- The user's final submitted answer

The system must also record **per-session data**:

- Language of the game
- A code to identify the session, provided by the teacher
- Start time and finish time of the session
- Session length
- The order in which islands were completed
- The order in which islands were clicked
- Total number of clicks in the session
- The time before the first click in the session
- The final score of the session

User Experience and Engagement

- The game must allow revisiting of islands prior to submission.
- The emotional tone must be visually represented with colors or icons.
- The User Interface must balance playful and realistic design to reflect real-world behavior.
- Upon completion, a thank you page must show the user's final score.
- The background must include animations to enhance engagement.

4 System Design

5 Conclusions

5.1 Usage Scenarios

This section illustrates how researchers or teachers can set up the game and download the data and how a child interacts with it during a typical session.

Step 1: Language Selection

The game begins with the language choice screen (Fig. 1). The researcher or teacher selects their preferred language before continuing, setting up the game for the child. A hover effect provides visual feedback (Fig. 2).

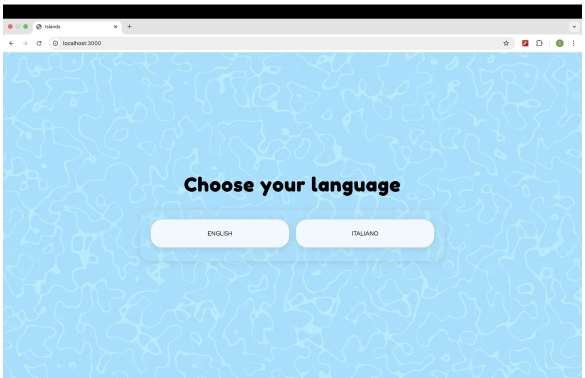

Figure 1. Language choice screen.

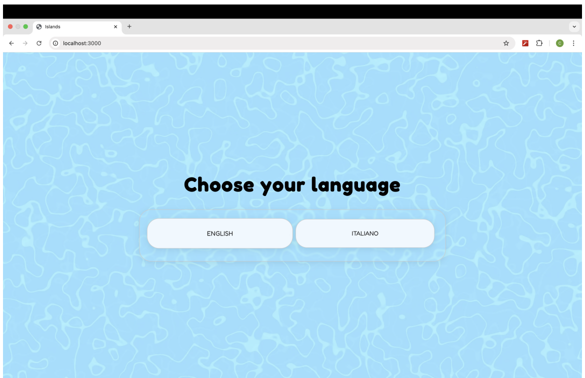

Figure 2. Hover effect on language choice.

Step 2: Session Start

After an adult has chosen the language, the child sees the start screen of the game (Fig. 3). A hover animation was implemented, guiding them to start (Fig. 4).

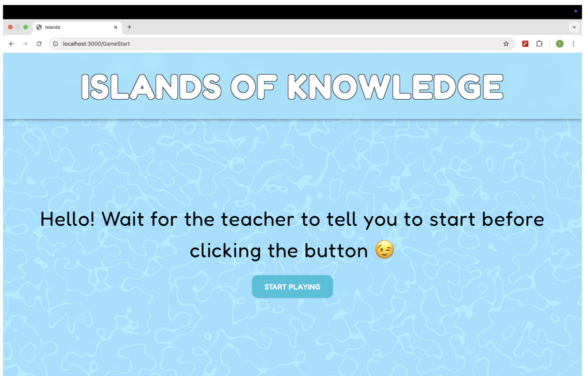

Figure 3. Game start screen.

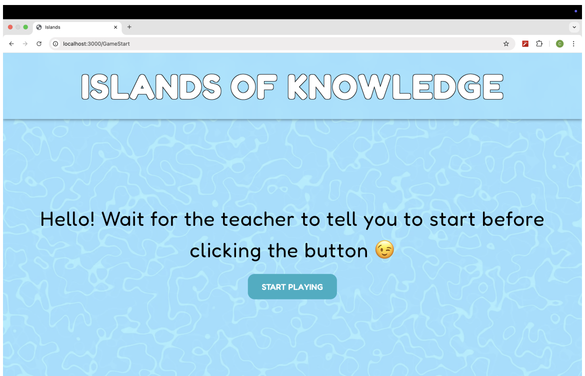

Figure 4. Hover effect on start button.

Step 3: Entering a Code

The system requires the child to enter the session code they received prior to the start of the session (Fig. 5), which is validated (Fig. 6). This ensures that all recorded data is associated with a specific session.

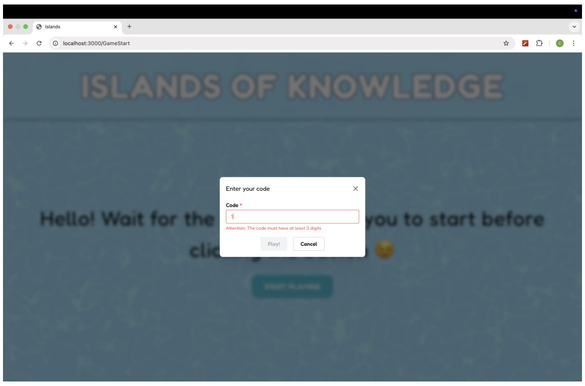

Figure 5. Session code entry screen.

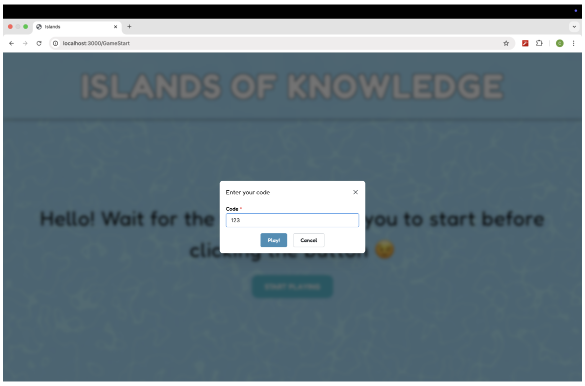

Figure 6. Successful code validation.

Step 4: The Island Map

The core component of the game corresponds to the map page (Fig. 7). Each of the six clickable islands represents a unique search task. The hover feedback (Fig. 8) helps guide the attention of the children.

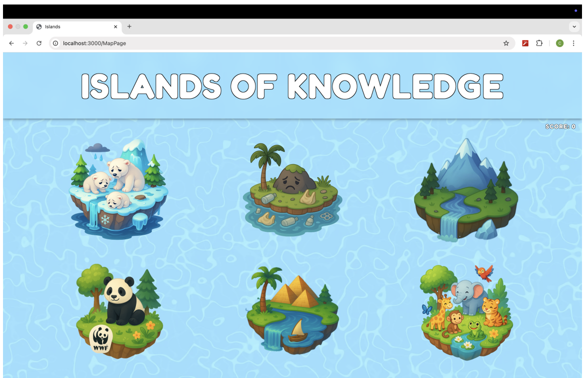

Figure 7. Island map with clickable islands.

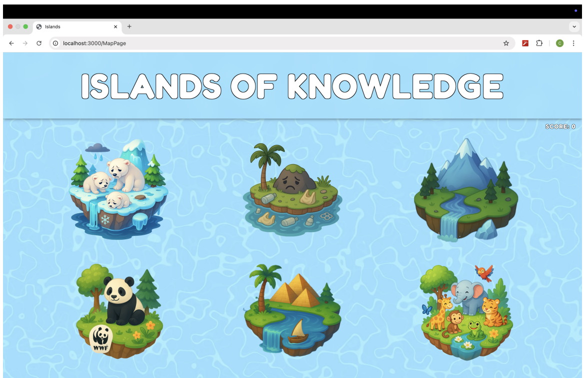

Figure 8. Hover effect on islands.

Step 5: Tool Choice

After selecting an island, the child reaches a tool selection page (Fig. 9) where they choose between a traditional search engine (Google) and a large language model (Gemini).

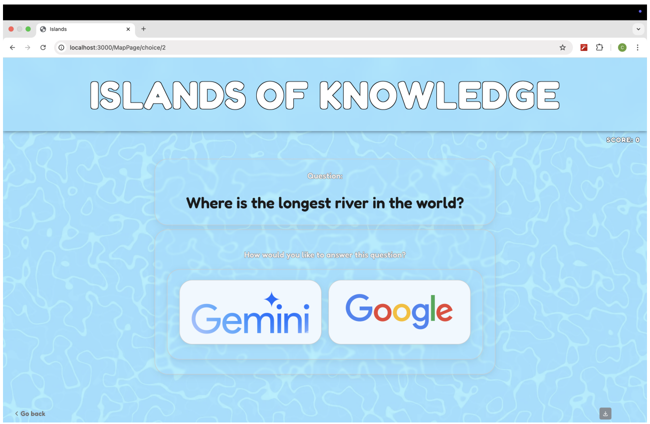

Figure 9. Tool choice screen.

Step 6: Using Google

If the child selects Google, they are presented with a simulated Search Engine landing page (Fig. 10). The interface and behavior mimic real-life scenarios (Fig. 11). Clicking on links opens them in a new tab.

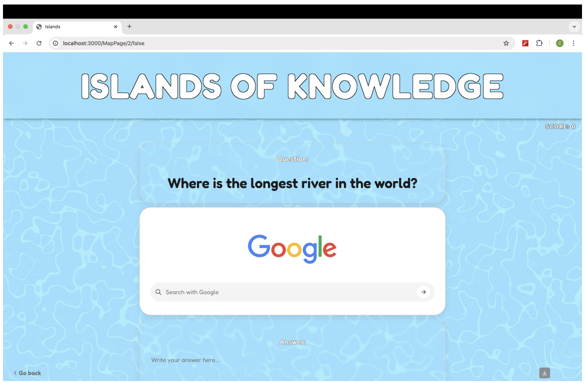

Figure 10. Simulated Google landing.

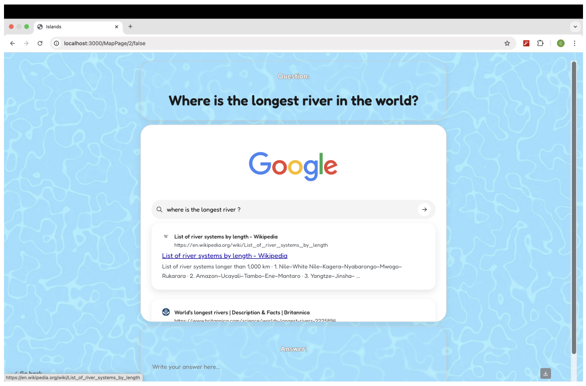

Figure 11. Google search results with clickable links.

Step 7: Using Gemini

Alternatively, children can choose Gemini, where a chat-like interface appears (Fig. 12). A waiting screen mimics the LLM response delay after sending a prompt (Fig. 13), followed by the result output (Fig. 14).

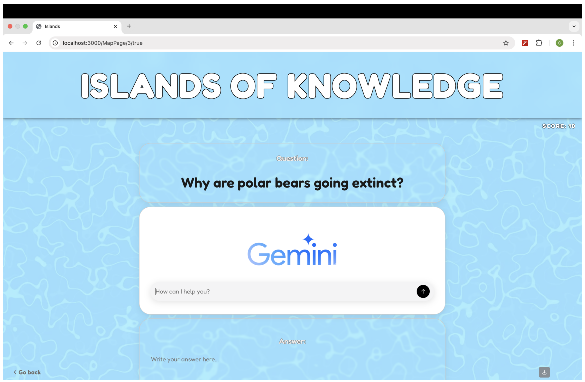

Figure 12. Gemini chat interface.

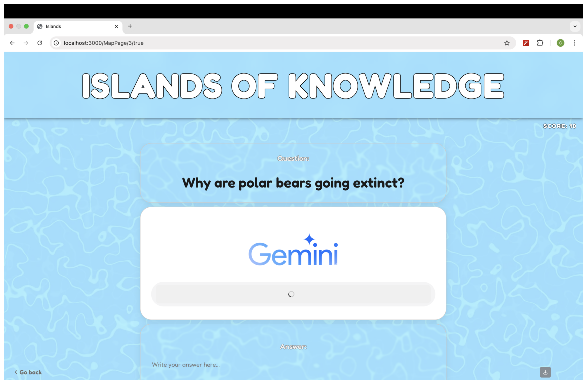

Figure 13. Waiting screen for Gemini response.

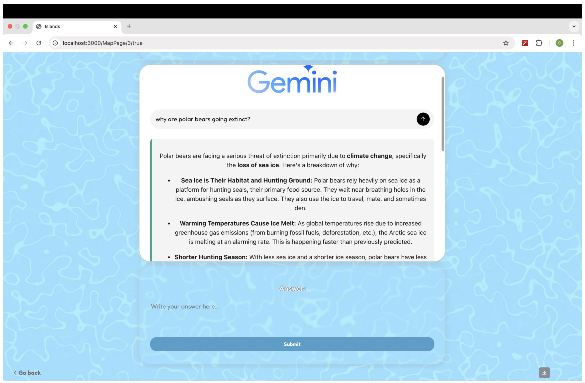

Figure 14. Gemini response output.

Step 8: Submitting an Answer

After exploring the results, the child can type the final answer (Fig. 15). Once submitted, the user is redirected to the map page, and the island becomes inactive. If the child attempts to revisit a completed island, a warning is shown (Fig. 16).

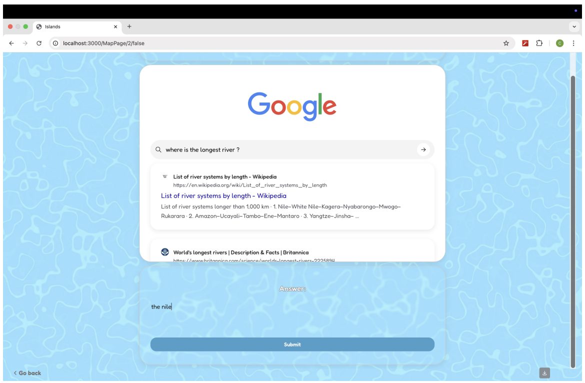

Figure 15. Final answer submission screen.

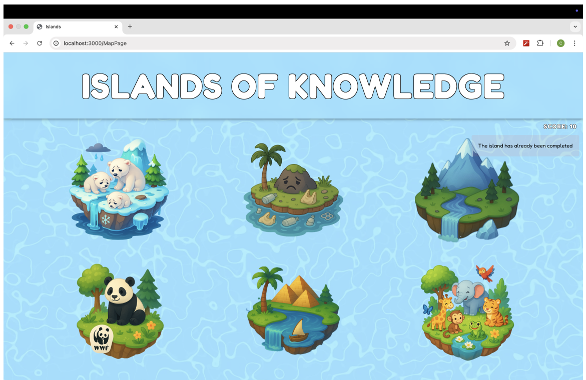

Figure 16. Can't click on a completed island.

Step 9: Final Page and Data Export

After completion of all six islands, the child sees their final score (Fig. 17). Each completed island contributes 10 points, with a maximum of 60.

To end the session, a password-protected download prompt is shown (Fig. 18), allowing the teacher or researcher to save all session data locally. It was a design choice to use the brower's prompt functionality instead of a custom modal, to discourage children from trying to tamper with the data export.

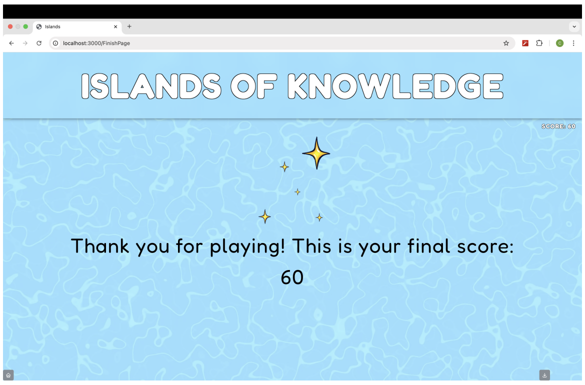

Figure 17. Final score screen after completing all islands.

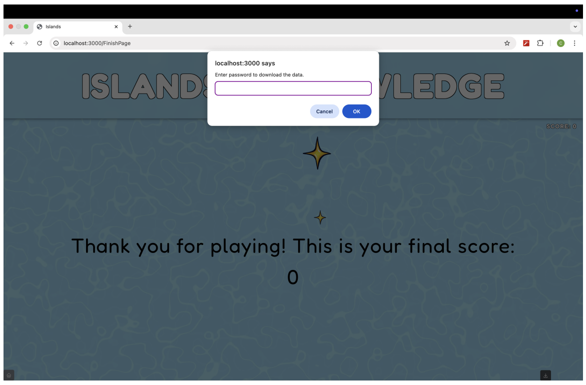

Figure 18. Password-protected data download prompt.

5.2 Future Work

Although the current prototype is functional and is already suitable for small-scale research studies, further improvements can be made in future iterations to improve usability, data collection, and scalability.

User Interface and Usability Testing

The current interface was designed based on the insights of the literature and internal feedback, but because the design interface could have been a whole project on its own, it can be improved. Furthermore, it has not yet been tested with children in real-life settings. One key area for future work is to conduct formal usability testing sessions with children of different age groups. These sessions would help identify which parts of the UI are intuitive, which are appealing, and which are confusing or too complex. For example, visual feedback (for example hover animations, tool choices, iconography) may need to be adjusted based on children's preferences and cognitive abilities. Additionally, working with experts in child-computer interaction and UX/UI could help refine the design to better suit the target audience.

Extending Data Collection

The current version of the system already collects a wide set of interaction data, including query logs, tool switches, time spent, and submitted responses. However, there is room for improvement and expansion. Future versions could include additional behavioral signals, such as

- Mouse movement and hover times to infer hesitation or curiosity.

- Scroll depth within the SERP.
- Optional feedback prompts for children to self-report satisfaction or perceived difficulty.

Improving Efficiency and Scalability

In the current version of the system, all interaction data is stored locally in the browser and must be manually exported at the end of each session. Although this solution is suitable for small-scale studies or pilot experiments, it introduces several limitations when conducting larger studies.

Managing data from multiple devices becomes time-consuming and there is a risk of losing session data if a participant closes the browser before exporting. Relying on browser-based password prompts also provides only minimal protection and may not be ideal in more formal research contexts.

A possible solution could be to integrate a back-end infrastructure that stores the data in a centralized manner, allowing researchers to:

- Monitor sessions in real time, even across multiple classrooms or devices.
- Automatically collect and aggregate data without manual intervention.
- Minimize the risk of data loss due to user error or technical problems.

Experts' Feedback

The tool was presented to two experts, teachers with experience in working with children and technology. They provided valuable feedback on the design and usability of the tool.

HERE COMMENTS FROM TEACHERS

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