
Habi Hero: An Online Math Resource for 1st Grade Students

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Abstract

For first graders who struggle staying motivated to learn, the concept of math is incredibly tough. Habi Hero is a conservation-themed, math-based learning game with the goal of making math fun, customizable, and socially impactful. Habi Hero uses gamification with a focus on saving endangered animals and their habitats. Each animal represents a topic in the math curricula that is based on the Common Core Standard. As students solve problems, they earn habi-badges and habi-coins that can be redeemed to customize your hero. Parents and teachers can also track progress and create lessons with game parameters for their little heroes to face. In all, Habi Hero attempts to explore gamification and the critical connection between online learning and student motivation.

Introduction

In the first grade, students are stepping into math education and are introduced to fundamental math concepts, such as addition and subtraction. With approximately 80,000 first grade students enrolled in Washington state in 2019, most schools have developed their math curriculum around the Common Core Standard (ElementarySchools.org, 2019). It is understandable that some first graders struggle with the abstract theories of math (Bernander et al., 2020). However, first grade educators often allow the student to continue onto the next grade, despite the student's

inability to meet the standard. As the student progresses onwards, they will continue to face difficulties to grasp the increasingly challenging math concepts (Kiss et al., 2019). With math being a general requirement for education, it is important for students to have a strong foundation of math concepts at an early age, so that they can succeed in their future schoolwork (Kiss & Christ, 2020).

We wanted to create a solution that addresses how public school first graders with numeracy challenges could gain greater motivation to practice math skills in order to achieve WA state 1st grade Common Core math standards. Therefore, we created Habi Hero, a math-based learning game helping 1st graders overcome these numeracy challenges.

Design Process

We decided to implement a value-oriented design process as we determined how to approach this sociotechnical space.

Approaching the Problem

In the initial stage of our process, we ideated how our design might tackle the problems that first grade students face in achieving proficiency in the Common Core math standards. We first needed to establish who the stakeholders of our design might be and the potential values that they may hold. This information was then utilized to generate the principles of our design and the primary functionalities that our game would provide to our stakeholders. Upon this investigation we came to the conclusion that our game would be centered on the core principle of gamification. We chose to utilize gamification within our design in order to support the first-grade students' values of

engagement and motivation. By using gamification in our design, we would be able to achieve greater interest in practicing Common Core math skills in a fun and unique way for first grade students.

Furthermore, we concluded that our game would need a central story and theme in order to further maintain engagement for first grade students practicing math. We decided that the game would be focused on saving endangered animals. We chose this as our theme in order to increase first graders connection to the game, as well as instilling conservational values at an early age, so future generations can challenge the environmental issues that affect our beloved animals. This theme would serve to promote the user values of engagement, transferability, and motivation.

Paper Wireframe

In our initial wireframe, users are first taken to a level selection screen where they can choose the Common Core math standard they wish to practice and the endangered animal they will help save. Upon selecting the level, the user is taken to the endangered animal's environment where they will see various real-world threats to endangered animals. When the user clicks on a threat within the environment a modal will appear with a math problem that they must solve in order to eliminate the threat from the game's environment. After correctly answering the problem the environmental threat will then disappear from the level's environment and the user may select and solve other threats until they all are completed.



Figure 1: Our initial paper wireframe for the main game.



Figure 2: Our low fidelity prototype of the problem modal. There is the habi-coin counter in the top right corner and the habi-badge progress meter in the middle of the footer. Additionally, we have included a basic input box for writing the answers.



Figure 3: Our high-fidelity prototype of the game environment. We introduced different kinds of threats in the tiger's environment.

Low Fidelity Prototype

Building from our paper wireframe we designed a low fidelity prototype of our game. The main additions that we made to our design in this stage was the addition of a leveling progression and a coin reward system. A leveling system was added to the design to help promote the values of motivation and engagement for first grade users; incentivizing them to continue playing the game in order to level up. Finally, we decided to incorporate a coin reward system in our design to further engage students and maintain their motivation in practicing math. This coin system acts to positively reinforce students to complete math problems so that they may gain in game rewards. Lastly, we decided to opt for a writing-to-text input to reinforce the practice of transcribing numbers. As for the graphic design, we used temporary stock images for our characters.

Designing Visual Elements

For the visual direction of our game artwork we determined that a bright and colorful color palette would be used because it maintains engagement for younger children. The visual assets would be simple with solid fill, as overly realistic, complex linework in designs can be difficult for younger children to interpret and connect with.

High Fidelity Prototype

Upon review of our investigations of the stakeholders, values, value tensions, and value scenario we made several additions and changes to our design. We decided that our design should also incorporate a way for teachers to use our design in order to better promote the values of effectiveness, accessibility, and customization in practicing common core standards. The design will enable teachers to utilize this game as a

tool for teaching Common Core math standards promoting a wider accessibility to this game as a resource for students. Teachers can create and customize lessons, as well as, viewing students' progress and results from the lesson. In this final prototype, we also give students ways to customize their hero avatar to further promote engagement with the game. By redeeming their coins through additional customizations for their hero avatar, our game gives them greater motivation to continue playing.

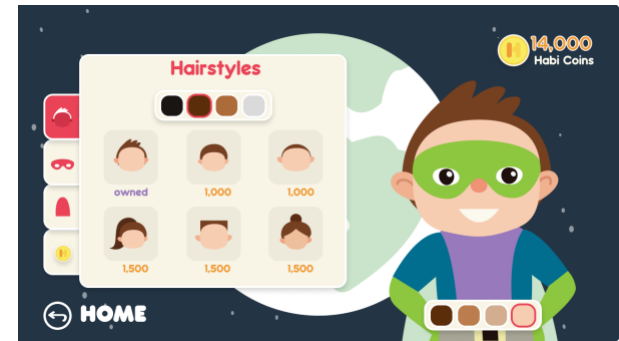


Figure 4: Our habi-shop.

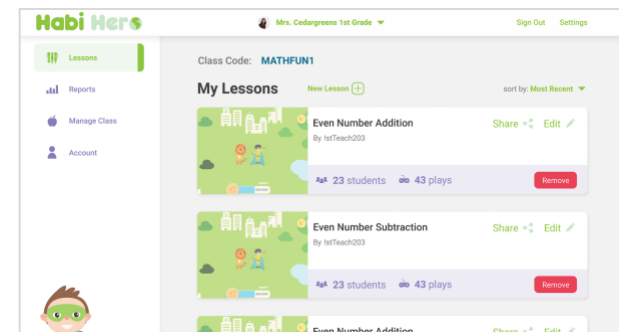


Figure 5: Our lesson view for the teachers.

Stakeholder Analysis

As the first group of direct stakeholders, public school 1st grade students want a learning experience that is “fun” and new. Our summary of the 5 student interviewees when asked to elaborate on what “fun” means to them is that the learning platform should be engaging, keep them motivated, and promote excitement. Similarly, the parents of these students desire a learning experience that is engaging for their kids, effective in teaching math content, and easy to navigate through. Lastly, public school 1st teachers want a learning tool that is customizable, simple to use, and accessible on multiple devices. In all, the values of the direct stakeholders revolve around engagement, motivation, productivity, personalization, and accessibility.

Regarding indirect stakeholders, other online math platforms may modify their content to align with our own in hopes to attract more users. Additionally, 1st grade content of Habi Hero might be extended to other grades, as the CCS applies to students up until the 10th grade. Finally, the Washington public education system may further incorporate online platforms, such as Habi Hero, as online resources become more readily accessible and effective. In all, the values of the indirect stakeholders consist of engagement, transferability, effectiveness, and accessibility.

Value Definitions

This paper will focus on the following values: *Engagement, Motivation, Productivity, Effectiveness, Customizability, Accessibility, and Transferability.*

- *Engagement:* To keep 1st graders focused and interested in both the narrative and math content

- *Motivation:* To reinforce positive feedback and support for 1st graders to learn math content
- *Productivity:* To generate lasting habits of math achievements for 1st graders
- *Effectiveness:* To teach CCS curricula and have 1st graders internalize abstract math content
- *Customizability:* To personalize an online math tool for parents and teachers to keep track of progress
- *Accessibility:* To be available across multiple technologies that is intuitive for a wide range of users with differing technological knowledge
- *Transferability:* To develop features and game structure that can be a template for math content beyond the 1st grade

Value Tensions

This paper will focus on the following value tensions: *Engagement vs. Effectiveness, Customizability vs. Accessibility, and Effectiveness vs. Transferability.*

- *Engagement vs. Effectiveness*
Certain features may act as distractions and hinder the effectiveness of our lessons. For example, visual components that were meant to sustain eye contact may overwhelm the student’s sensory input (Buchheister, 2017). Also, when establishing a thematic approach for our game, it is imperative to choose an age-appropriate explanation for such a heavy topic like conservationism.
- *Customizability vs. Accessibility*
When developing personalization features for our teachers and parents, the amount of game parameters and the complexity of the dashboard may prove to be difficult to navigate across.

- *Effectiveness vs. Transferability*

The specificity of our lessons for 1st graders may affect the transferability. Alternatively, devising a general template of features and game structure may decrease the effectiveness of having distinct 1st grade content.

Design Insights

Through our design process we developed a couple key insights. One insight that we found was that students strongly respond to rewards and incentives when learning. We incorporated this into our final design by including an in-game currency that users would be given to them when they complete a math problem. This currency could be used by the user to unlock various rewards for their in-game hero avatar. Another insight that was developed from this process was that teachers could find value in utilizing this game within their own curriculum. In our final prototype, teachers have a dashboard to create customized lessons in our game and provide them with the ability to analyze student progress within each lesson.

Implications for Design

The implications of our design seek to address the problem of first grade students struggling to learn the CCS. Our design enables these students to learn math concepts in a fun and engaging way through a web-based learning game. The design of our game serves to engage, motivate, and effectively teach math by using a thematic approach centered around saving endangered animals. Further implications of our design seek to give a tool for teachers that could potentially be used in first grade math curriculums across the country.

Future Work

In future work we will look to further develop the teacher dashboard for this game in order to give teachers additional features, improve user interfaces, and greater customization of lessons so that they may better utilize our platform as a learning tool and apply it towards a wider range of math concepts. Additionally, we will further develop our design to provide parents with a resource for helping their child practice and learn math. We also plan to develop additional levels for student users, giving them more content to keep them engaged. Furthermore, future work needs to be conducted on the usability and overall attitudes towards our game for children and teachers. This will be achieved through rigorous user testing in the future.

Conclusion

As online learning platforms steadily become incorporated into our education system, our stakeholders' values should be embedded in these new systems to fulfill the multifaceted approach of learning. For Habi Hero, the exploration of motivation and engagement has been at the forefront of discussion. We found great benefits for a thematic approach of animals and conservation, along with user incentives. For teachers and parents, developing a dashboard to keep track of student progress and game parameters to customize lesson plans proved to be advantageous features. Lastly, the connections between abstract concepts (i.e. addition) to concrete skills (i.e. counting) revealed that our platform can be transferable, as we acquire different methods to solving a variety of math problems. In all, we will continue to research motivation within gamification and the complexity of human values for an online learning experience.

Appendix A: Reflections on Design Process

Overall the project went fairly well for our design team. However, the implications of COVID-19 and the current racial injustices happening in society today made it difficult to complete this project. These issues affected the robustness of our project's design process, as our communication and focus were negatively impacted by the current circumstances in which we find ourselves in.

One thing that went well in the design process of this project was creating the visual assets of our game. We were able to complete almost all of the visual assets that were core to the functionality and use of our design. Another thing that went well in this process was using the values we established to guide the direction of our design. As we progressed through the different stages of designing the game, we were able to uncover additional features that would be included in our design in order to account for the values and value tensions that we investigated upon. One final thing that went well in the process was creating the game interface that users would interact with when solving problems.

In the future we would have done a couple of things differently. The first thing we would do differently is spending more time analyzing the features that should be included in our design at the initial stages of ideating. We could have better established how certain features should be removed or included in order to better promote our stakeholders' values. Lastly, in the future we will conduct value oriented semi-structured interviews in order to gain a greater understanding of stakeholder views and values surrounding technology surrounding the scope of our design and problem.

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