Mission HydroSci: Tech Demo

Extended Abstract

Joe Griffin
University of Missouri
111 London Hall
Columbia, MO 65211
GriffinJG@Missouri.edu

James M. Laffey
University of Missouri
111 London Hall
Columbia, MO 65211
LaffeyJ@Missouri.edu

Justin Sigoloff
University of Missouri
111 London Hall
Columbia, MO 65211
SigoloffJ@Missouri.edu

Sean Lander
University of Missouri
111 London Hall
Columbia, MO 65211
LanderS@Missouri.edu

Troy Sadler
University of Missouri
111 London Hall
Columbia, MO 65211
SadlerT@Missouri.edu

Sean Goggins
University of Missouri
111 London Hall
Columbia, MO 65211
GogginsS@Missouri.edu

So Mi Kim
University of Missouri
111 London Hall
Columbia, MO 65211
kimsomi@missouri.edu

Eric Wulff
University of Missouri
111 London Hall
Columbia, MO 65211
epwr38@mail.missouri.edu

Andrew J. Womack
University of Missouri
111 London Hall
Columbia, MO 65211
ajwfg4@mail.missouri.edu

ABSTRACT

Mission HydroSci is a Unity3D developed serious game designed for teaching middle school students, earth science and scientific argumentation. Players will be engaged in a mission requiring them to investigate water resources to establish bases for the various factions colonizing this alien planet. Our demo represents our progress in years 1 and 2 of a funded project. The project has completed the development of 4 of ab expected 6 units, and is preparing for a usage test with 32 students in a traditional classroom setting.

Demo Link: https://drive.google.com/drive/folders/0B5r8YW45yGG-MDdMdVpiaUhqVzQ

KEYWORDS

Serious games, Unity3D, scientific argumentation

ACM Reference format:

To be determined.

1 INTRODUCTION

Mission HydroSci (MHS), a serious game with $4.3M in federal funding from the US Department of Education, is aimed at teaching kids water science and scientific argumentation through narrative driven exploration of an alien planet. The water science curriculum is aligned with the NGSS objectives in the earth science middle school track (1). We cover topography, watersheds, currents, surface water pollutants, infiltration, water tables, aquifers, evaporation, condensation, and humidity. The scientific argumentation track is based on Osborne's progression (2) through Toulmin's model (3). We cover identifying claims, selecting evidence, selecting reasoning, making a complete argument, and making a counter argument.

In order to accomplish this large-scale endeavor, we have assembled an equally large team. Our 4 PI's each spearhead a portion of the team: Production, Curriculum, Assessment, and Analytics. The production team actually consists of 3 sub teams each with a full time staff lead: Design, Art, and Development. Of the 23 active people working on the project 21 are spread across 3 different buildings on campus, and the other 2 are spread across the country. This makes weekly meetings of sub teams and biweekly all team meetings mandatory to communicate the status and issues each team is facing as well as plan collaborations for the next two weeks.

2 Mission Structure

The game takes place some hundreds of years in the future. Humanity has overpopulated the earth, and water is becoming a limited resource. In order to solve this problem humanity has decided to colonize space. To conduct an initial survey of the planet and to prepare for the first colony, a diverse team has been sent made up of scientists, military, corporate, and environmentalists. The player is an investigator on this team whose job is to help the other factions collect information about the planet through exploration.

Figure 1: The player begins Unit 1 aboard a space station, and completes a tutorial before using the escape pod.

The player begins the first unit in their quarters on a space station orbiting a new planet. This first Unit is entirely a tutorial, and walks new players through the controls of orientation, navigation, dialogue, and the first steps of the argumentation system they will be using. The unit also serves to set up the narrative for the rest of the game. After the player has been introduced to some of the key characters, and the tutorials have all been completed; the space station is severely damaged. The player rushes to the escape pods with a fellow cadet, and narrowly makes it inside before the station explodes. Unit 1 ends with the player crash landing onto the alien planet.

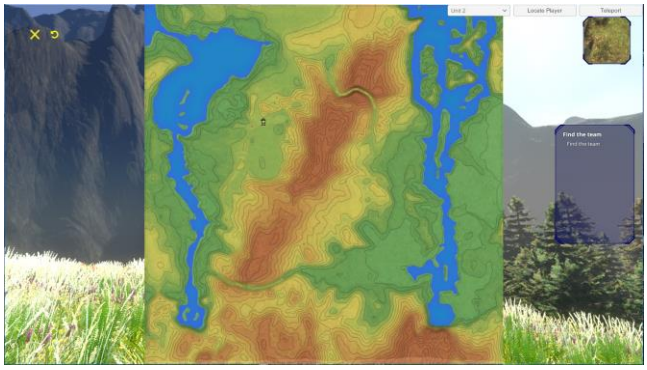

Figure 2: After crashing on an alien planet, the player must rely on navigating topography in order to reunite with the group.

The next three units each continue to advance the students understanding of scientific argumentation progressively introducing them to claims, evidence, and reasoning and then requiring students to use all three components to create a scientific argument. The units also each cover a different water systems content area within earth science: topography, surface water, and underground water. As the student learns all of this, they are exploring the alien planet, reconnecting with other cadets who crashed on the planet, and establishing bases to prepare for the first colony. These units have all been implemented and tested in a classroom setting with 32 students.

Figure 3: After finding a crate in unit 3 the player tosses the crate into the river and watches it float back toward camp.

Unit 5 is currently being developed, and is scheduled for testing in the fall with Unit 6. In this unit players learn about counter arguments and atmospheric water. The player will be caught in an erupting volcano, leaving them stranded with access only to seawater. The player is forced to distill water to drink until it is safe to return to their base exposing students to concepts of atmospheric water.

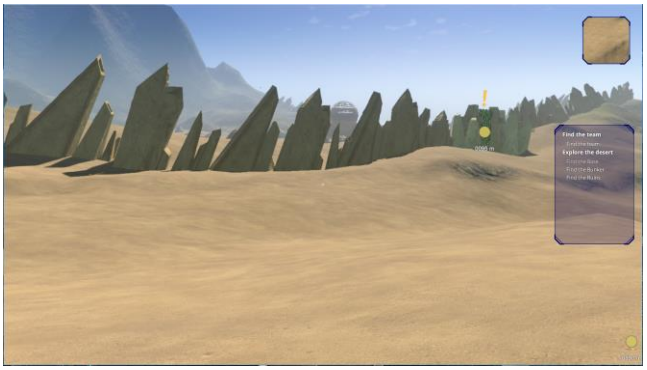

Figure 4: Unit 4 takes the player into alien ruins where they must discover the secrets of underground water in the desert.

The conclusion of the game in unit 6 requires the player to use their full knowledge of water systems to rescue the remaining crewmembers. Once all of the crew from the space station has been reunited, they can finish preparations for the arriving colony ship. Depending on the player's performance and choices the different bases will each be struggling, sustaining, or thriving. Any mission can also be replayed; so that a player can get a better ending.

3 Noteworthy Systems

Although the game itself is a large system and each task requires certain features, we have developed three rather large systems for

this project. The first large system is ARF, which serves as both our pedagogical agent and an anthropomorphized menu system. It is given to players in the beginning of Unit 1 as a fully aware A.I. meant to help keep track of all the new information the player will be collecting along their exploration. Because the player is often exploring the planet alone, ARF also delivers a fair amount of the narrative. The menu portion of ARF consists of all of our UI features such as the maps, evidence collection, and chat log. After we conduct the first field test, we plan to implement an ask system, populated with context-sensitive frequently asked questions.

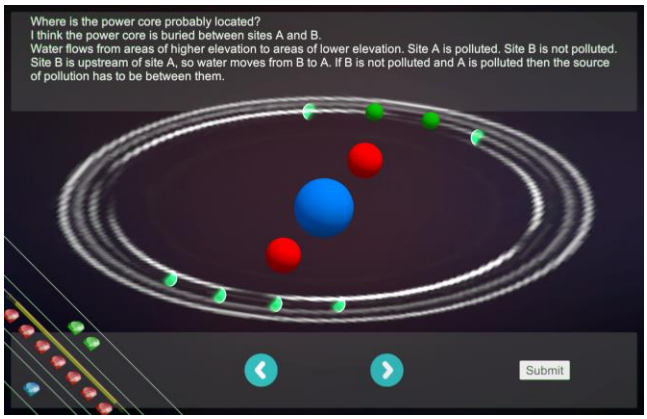

Figure 4: MHS uses a solar system analog to progressively construct an argument of claims, reasoning and evidence as the student builds competencies with scientific argumentation.

The second system we developed is our Claimer System, which students use to create their own scientific arguments. This system has gone through four major iterations (4). In its current form the system has separate components claims, evidence, reasoning, and backing info. The first three all consist of sentences, while the fourth is an image. Players are able to combine one claim statement with one or two reasoning statements and up to eight pieces of evidence. The backing info images are provided to support the players' arguments and are not included in the actual construction. Evidence and backing info are both collected by players while doing prior tasks during their exploration of the alien planet. The claims and reasoning statements are provided during the argumentation scenario. As we begin testing with larger numbers of players, we will start to evaluate whether the options provided accurately match up to what players expect. When the player has constructed their argument, they can submit it to receive custom feedback from ARF. To deliver this feedback the system checks for relevant, sufficient evidence to advance the chosen claim, and a reasoning statement that links the two.

The final large system we are developing for this project is our Teacher Dashboard. This allows teachers to track their class's progress while playing MHS. In order to accomplish this, logs are sent from the game every second with location updates, as well as specific logs for every gameplay interaction. These logs also contain progress markers for gameplay as well as curriculum, which we use as potential embedded assessments. We are currently estimating these will add up to around 35,000 logs per player. All of these logs are sent to and stored in a MongoDB database. Analyzing those logs once collected and delivering results in a useful amount of time is a nontrivial task. We are currently working on algorithms and visualizations for the players' performance and organizing them to be efficient for a classroom setting.

4 CONCLUSIONS

We are two and a half years into the four-year process of developing a game-based 3D learning environment to support middle school student's understanding of earth science and scientific argumentation. We currently have 4 of 6 units implemented and tested in a traditional classroom. Our process includes methods for curriculum design, gameplay design, narrative writing, custom artwork, unity development, user experience testing, and game log analysis. We are currently aiming for another usage test in the fall of 2017 with units 5 & 6 implemented, followed by a field test in the spring of 2018.

ACKNOWLEDGMENTS

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