OceanQuest: A University-Based Serious Game Project

J. R. Parker
Digital Media Laboratory
University of Calgary
403 220 6784
jparker@ucalgary.ca

Sonny Chan
Digital Media Laboratory
University of Calgary
403 220 4315
chanso@cpsc.ucalgary.com

ABSTRACT
A case study of a game design project is presented, in which both traditional game goals and educational goals exist. One way to create a design that respects both sets of goals is illustrated.

Keywords
serious games, education, interactive media, computer games.

INTRODUCTION
For many generations people have used games to teach their children. Indeed, many toys are patterned after actual artifacts and tools used by adults in their daily work. It has been only relatively recently that it has been possible to use computer games and video games for this[2]. In spite of that, there has been sufficient interest in the use of video games for teaching and training that a category of game has been defined to encompass them - *serious games*[1]. Of course NASA has been using something much like video games for many years, as has the military. Simulations and games are tightly connected.

From the outset we knew that this project would be very closely funded and on a very tight schedule. The game was to be delivered on the Web, and the basic web site was to be complete by the end of February 2004. This gave us four months in all for design, implementation, art, audio, and testing.

In October of 2003, the Digital Media Laboratory at the University of Calgary was approached with the idea of building a video game that could be effectively used in the teaching of science. The subject was ocean floor ecology, particularly that of the volcanic vents of the Endeavour field west of Vancouver Island.

Proceedings of DiGRA 2005 Conference: Changing Views – Worlds in Play.

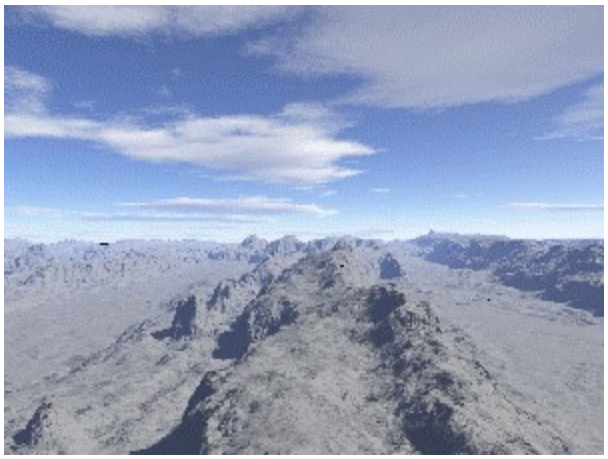

Figure 1: Terrain model using the actual data from the Endeavor field. We did not render water, and drew in a sky.

OCEANQUEST DESIGN

The game was originally intended as a supplementary tool for teaching concepts in Grade 8 science. The overarching goals involved the hydrothermal vents and their ecology, but after scan of the entire curriculum, we found that there were a number if related topics that would also be re-enforced. These included the following [6]:

- The biological ecosystem and habitat created by the presences and temperatures found at the ocean floor hydrothermal vents.
- A sample of the ocean life at a depth of ~2000m, near the ocean vents.
- The relationship between depth and water pressure.
- The force of buoyancy and the function of ballast tanks.
- Water temperatures at the ocean bottom, and outside hydrothermal vents.
- Using infrared vision as a tool to visualize temperature.
- The properties of sonar.

The game design proceeded from this list. It seemed clear from the beginning that the game should involve viewing the vents and the life forms, and perhaps measuring environmental factors such as temperature. We wanted the game to be as realistic as possible, so we used actual topographic data from the ocean floor area under examination and used that as a terrain model for the game (Figure 1).

The obvious way to visit the vents was in a submarine. The players could pilot this craft from the surface to each of the vents, and see the flora and fauna out of the window (we provided lights on the sub) and could make measurements. The question remained: what was the motivating factor for this game? What was the player visiting the vent?

First generation educational games were a necessary beginning, and showed some of the potential, but largely failed to enthuse students and teachers and so largely failed. One possible reason for this is that they were thinly disguised drill and practice schemes, for the most part. All games teach something, but a close examination shows that they teach by implication. The rules, the game map, the properties of the monsters and other characters, where to find items - all of these things are simply present in a game, and are useful to know. Learning about the game makes it more fun to play, and makes the player more skilled.

Our goal was to do the same thing with OceanQuest. The player would need to be able to pilot the submarine, located and move to the vents, identify plants and animals, and sample them. A host of information would be absorbed by osmosis, at it were, rather than as a blatant lecture. Given this, how does the game design proceed?

A story was needed as a backbone, one that connected the vents and their properties to a problem that could be solved. Visiting the vents had to be necessary in order to solve some interesting problem within the game. Most games other than puzzles have such a narrative, and it must be logical, interesting, and sufficiently complex.

The story created for OceanQuest was all of those things.

OceanQuest Narrative

It is the dawn of the 21st century, and a new plague is ravaging the Earth. Millions have died, and no cure has yet been found. Scientists believe that this 'new' bacteria is actually very old - it was trapped in the polar ice caps, and has now been released with their recent melting. Since it evolved in a primordial Earth, some believe that the cure may lie in organisms living at the bottom of the ocean, near some of the oldest places on Earth - volcanic hydrothermal ocean vents. Some believe that life on Earth was originally formed in these locations.

As the only veteran pilot of one of the newest deep water submersible vehicles, your assignment is to collect a set of biological specimens which may hold the key to curing the plague. You must race against time and face the dangers of the dark ocean bottom to collect these rare life forms. Their DNA holds the key to our survival as a race.

Game Play

From a ship on the ocean surface, the player will board the submarine and descend to the ocean bottom (~2000m deep). This stage will be presented as a full-motion, pre-rendered video. In reality, the descent could take several hours of time, so the video will compress the time it takes.

The player gains full control of the submersible vehicle once it is within a small distance of the ocean bottom. From here, the player's job is the collect as many assigned quest items as possible, given the constraints on the amount of air and power available. The player will be able to use the different technological tools the submersible is equipped with (infrared vision, sonar) to aid in finding the quest item. This "scavenger hunt" is the key element of game-play in Ocean Quest.

At the ocean bottom, the player will encounter a variety of different game elements. The ocean floor terrain features and hot, smoking ocean vents provide navigational hazards that can potentially damage or destroy the player's submersible. Water pressure will also be a game-play factor in that if the player goes too deep in the ocean, the extreme pressure will damage the

submersible. Temperature and pressure and all other features as a accurate as we can make them.

The player will be able to see a variety of life forms at the ocean bottom. Some of these life forms will be the quest items that the player must collect. The majority of the gameplay will take place at the ocean bottom, where the objective is to pilot the submersible to search for these quest items, while avoiding the aforementioned hazards.

The game is won if the player manages to collect all of the assigned quest items and return to the surface before running out of power or air. A score can be awarded based on the amount of time it took for the player to complete the mission, with a faster time being a higher score. A partial win may be awarded if the player manages to collect some portion of the quest objects before returning.

IMPLEMENTATION

The original version of Ocean Quest was designed to run on Microsoft Windows 98/2000/XP as a real-time 3D interactive video game. When it became clear that a web deployment was required, we started on an ActiveX control over the World Wide Web, in addition to the full stand-alone application on compact disc. A final constraint was added by the contractors: that the system be multi-platform.

At this point we abandoned the ActiveX version and decided to build two games at the same time: the full 3D version for the PC, and a Flash version that could be played interactively across the internet. These two versions use the same narrative, but needed quite distinct development methods, and look quite a bit different from each other.

Immersive Version

The full version of Ocean Quest will is able to run in full-screen mode and have high quality video content. The player sees the world from a first-person perspective, as if looking through a front-facing window of the submersible. The camera model for the game will be a fixed first-person, “bumper mounted” camera. (Figure 2). Above the window are simulated video screens showing infrared, topographic, and other views of the local undersea scene.

Beneath the HUD is a sonar display, in which the player will be able to see a rough sketch of the nearby terrain, as well as large, nearby objects. Various instruments are located in the bottom-left and bottom-right corners of the HUD. These tell the player important information such as depth, speed, heading, pressure, remaining power, and remaining oxygen.

The player can navigate the submarine in three dimensions in a fairly realistic way. There are ballast tanks, and rudder and engine controls. The player will be required to visit more than one vent to accomplish their task.

Flash - Web version

The Flash version can be played through a browser by visiting the OceanQuest web page. Game play is very similar, although the graphical quality is lower because of Flash limitations, and Flash does not provide support for 3D. Thus we have a 2D version that shows a top view of the ocean floor with the sub, vents, and other objects in their relative positions.

Figure 2: A view from the cockpit of the OceanQuest submersible vehicle. Note the video screens above and the instruments below the window.

The fact that the two games are really the same in narrative and general design is unusual. It was important to provide a simple, inexpensive way to access the game for schools with rules forbidding teachers to install games; indeed, it is often true that teachers are not allowed to install anything! Access to Oceanquest on the Internet, and on multiple platforms, seemed a reasonable solution.

USABILITY STUDY

A usability study of OceanQuest was recently preformed here at the University of Calgary by a student in Educational Technology, Mr. Phuoc Lam. A usability study does not evaluate an object from the perspective of an educational tool. This would be a complex task undertaken at some expense over a long term. Instead, the idea was to examine the interaction in general, and the game aspects in particular.

Since the game was intended for grade 8 student, the study involved Junior High students, four boys and four girls, having a range of computer expertise and gaming skills. As might be expected the students described many shortcomings. The most serious flaws were labeled as very severe, and included the following:

Trouble collecting items, Too few items, Items hard to collect

This is a leftover problem from the original implementation. Items were to be collected by using a ‘robot arm’, but our budget did not permit us to implement that feature.

No statistics/radar in sub view

We fixed the game so that all controls a visible in all views.

No description of vital statistics, Game goals unclear

Accompanying educational material was to be provided and placed on the web site. The game was intended partly to motivate students to go through that material.

Radar display at bottom unclear; Power level is unnoticed; Not enough indication of depth

The display has been redesigned and re-implemented.

There is no feedback as to why a Game Over occurs

This was actually a bug in the program. I hope we fixed it.

IMPROVEMENTS

The new version of the game also fixes a lot of lesser priority problems. For example, there are now enemy subs that will try to steal collected samples from the player, and they show up on the sonar. The player is in fact competing against these 'evil BioCorp submarines' on her mission to sample the quest objects. The robot-controlled BioCorp submarines will attempt to collect all the elements to manufacture the cure for the plague first, to destroy the habitat that remains (hence destroying quest items), and otherwise impede the player from completing her mission successfully.

To make player-AI interaction more interesting, when the BioCorp submarines come within close proximity to the player's submersible, they will attempt to do everything in their power to impede the player's progress. This includes occluding, moving, or destroying objects the player may be trying to collect or even attempting to collide with the player's vehicle.

Once the player has collected all the assigned quest items, run low on air, run low on energy, or for some other reason decides to, he or she may return to the ocean surface. The player can do this by ascending to a certain depth above the ocean floor, at which point the game will ask to confirm the player's desire to ascent to the surface. If the player confirms the ascent, a time compressed or time lapsed full-motion video will be played to communicate the ascent. At this point, the game is over.

CONCLUSIONS

The game suffered from a lack of connection to the educational content right from the beginning. Having spent many months on the design and implementation of a game of this sort, it has become quite clear that the game design must coincide with the instructional design. The mechanism for this is not plain at this time, but the educational material must be clearly defined at the outset, the goals must be defined by both the game and instructional designers, and the game must explicitly incorporate the material before the program is written[3].

It is also clear that a usability study is a very valuable tool for locating flaws and highlights in a game. Traditional game development teams use professional testers, and this does work very well. Finding members of the target group was, in our case, just as useful, and can also serve as a check on the educational aspects.

The project required a multidisciplinary group[4,5]. We worked closely with a 3D artist, employed two C++ programmers and a Flash programmer. We built a small sound studio and recorded music and voice in addition to sound effects. Music was composed for the trailer.

Unless a workable team can be assembled having the required skills, the result will be much less than the players will find acceptable. Students have been exposed to some very exciting games with state of the art graphics and sound. I they are presented with a game that suffers too much from lack of currency, they will simply not be attentive.

ACKNOWLEDGMENTS

This project was funded through Sci-Q. Thanks to Mike Magee and Trevor Doerksen for funding and organizational help, to Sonny Chan and Jeff Howell for their work on the C++ version of Oceanquest, and to Eric Yeung for the Flash version. Thanks to Phuoc Lam for giving us a summary of his usability study.

REFERENCES

1. K. Becker, **Serious Games Pathfinder**, 2005. http:// pages.cpsc.ucalgary.ca/~becker/Main/PhD/Pathfinder.html
2. Johannes Fromme, **Computer Games as a Part of Children's Culture**, volume 3, issue 1, may 2003
3. S. Papert, **Does Easy Do It? Children, Games, and Learning**, Game Developer, June, 1998.
4. Parker, J.R. Becker, K., and McCullough, D. **Computer Science and the Arts: Some Multi-Disciplinary Teaching Collaborations**, iTiCSE 2003, Thessaloniki, Macedonia, July, 2003.
5. Parker, J.R., **Games and Animation: Collaborations Between the Arts and Computer Science**, 5th International Conference on Information Technology: Coding and Computing, IT Education, Curriculum & Assessment Track, Las Vegas, USA. April 5-7, 2004
6. Alberta Learning, Science Grades 7-8-9 Curriculum, Province of Alberta, 2004. http://www.learning.gov.ab.ca/k_12/curriculum/bySubject/science/default.asp

Figure 3: A screen from an early Flash version of OceanQuest. The submarines are seen from above. The terrain is still real data, also viewed from above. Instruments and sonar are still an important feature of this simplified game.