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Higgins' Hunt: An Educational Game

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Higgins' Hunt

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Abstract: The goal of this project was to develop an educational game in Adobe Flash, inspired by the history of the Higgins Armory Museum. In order to further development of the game and support future works a database and system for educational game evaluation were created. All aspects have significant implications for future works.

Introduction

The Higgins Armory Museum, based in Worcester, MA is the largest arms and armor museum outside of Europe. John Woodman Higgins, a metalsmith and enthusiast of medieval arms and armor, constructed the museum in the late 1920s. Throughout the 30s he traveled the world, collecting medieval artifacts that were put into the museum. It is because of his efforts that it achieved the distinction of being of largest collection of medieval arms and armor outside of Europe. Now the 21st Century brings other ways to present the myriad exhibits of the museum.

The purpose of the project was to create an interactive exhibit of some kind that will be hosted on the museum's website. The team's main point of contact with the museum is Professor Jeffrey L. Forgeng who, in addition to being a history professor at WPI, is also a curator at the museum.

After much research, the team decided to create a flash-based adventure game that would take the historical background of John Higgins and create a somewhat historical account of his journey to collect arms and armor all over the world. The game is played with the mouse and keyboard and the user solves puzzles in order to obtain artifacts.

As part of the construction of the game, a database was created. The database was made accessible online through a website. The game uses choice selections from the Higgins' collection, and links to the relevant page in the database for each artifact. When a player acquires one of these artifacts in game, they can click it in-game and be taken to the database entry to learn more. The database is capable of being updated relatively quickly and easily. This will make further updates possible well after the project's end.

The final aspect of the project was the creation of an evaluation system with which to

judge the game after it was created. The evaluation system is a simple form that was refined over the course of several iterations, originating from theoretical material on the subject. The evaluation system stresses the important aspects of educational games with a basic weighting system. Current iterations maintain accuracy and ease of use.

Overall, the system that has been created makes for a well established base for future works.

Part One: The Game

●About the Game

The game is a web-based application created in Adobe Flash. It is a point and click adventure game that focuses on puzzle solving and not on brute force searching.

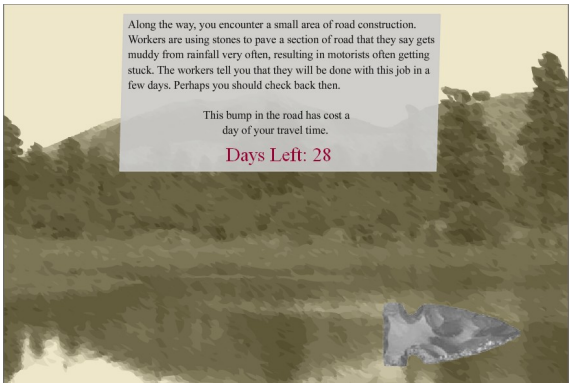
Story and Gameplay Basics

The game is set in the 1930s, the time period in which John Higgins was collecting pieces for his museum. However, the story is not completely historically accurate. Various artistic licenses were taken in order to make sense of why Higgins would be searching in San Francisco for artifacts, for example. Each location has a small introduction to the location as it was during the 1930s. Only two locations are used in each continent, therefore we were unable to represent all regions. Asia, because of its size, suffers from this issue most of all.

The game puts the player in the role of John Woodman Higgins himself, albeit a slightly larger than life version. The player has one month to visit as many locations as possible to gain as many artifacts as they can for the museum. The game is played using a combination of the mouse and keyboard. Using the mouse, the player clicks on various world locations of their choice. Every click takes travel time. Once a player reaches one of the locations they are presented with a puzzle. The puzzle can be a riddle, cryptogram, magnifying glass puzzle, or simply multiple choice. On some of the puzzles, such as the cryptogram, the player can ask for hints. Any wrong answers or hints will cost the player time while they continue to work on that puzzle.

Once the player finishes the puzzle, they are presented with an artifact. The artifacts are taken directly from the Higgins Armory collection, and the game shows the player a picture of the artifact they just found. The user can then go back to the map screen and travel to a new location, or click on the crate to view the artifacts they have collected so far. When looking at the artifacts they have found, the player can click on the name of any artifact to be taken to the database entry about it.

Some locations have hazards there. These places cost you travel time and do not present you with a puzzle. However after a condition is met the hazard will be cleared up. For example, one such hazard is that a road is washed out. A few days later the road is no longer washed out and the player instead is presented with a puzzle. In cases like this, the player does not need to visit the location to trigger the road building to start. This allows players repeating the game to save time and avoid locations that they know they cannot reach yet.



At the end of the 30 days or when the player manages to get all the artifacts, they are presented with the end of the story, as well as a congratulatory messages that depends on how many artifacts they found. For example, even if you only get one artifact the game still says you'll have the best museum in Worcester. By comparison, if the player gets almost all the artifacts, the game declares he or she will have the best armor museum in the entire Western Hemisphere.

Ideal Plan of Work

First term
Spend the first 3 weeks planning the game and learning Flash
By week 7, have a continent done, and a puzzle designed
Have the artwork for the first continent, and some for the rest.

Second term
Week 2: Finish artwork collecting. Make sure the artwork fits together well. have a second puzzle finished
Week 4: Have the third puzzle finished, and at least one more continent complete, artists begin creating buttons using the artwork. Buttons need to be created in Flash, and have at least an up and over keyframe.
Week 6: Have a 4th puzzle, all buttons should be created. Evaluate, and decide on any required changes.
Week 7: Have all of the continents, with full buttons.

Third Term
Week 1: Begin testing and getting feedback
Week 2: Take feedback, evaluate, and implement appropriate changes.
Week 3: Do more testing and getting feedback
Week 4: Take feedback and make adjustments
Week 5-7: Do final changes and submit final report.

●Development of the Game

The game was first envisioned in storyboard format in B-Term. After deciding we wanted to make an adventure game in Flash we started writing out the flow chart for the game, as well as puzzle ideas. Eventually all this was culminated into a storyboard that was presented towards the end of B-Term, and mostly integrated into Flash as a template by the time winter break rolled around.

In C-Term actual game development began, with Ed doing the majority of the artwork and Shelli and Amanda working on the technical aspects. The objective at this time was to get each type of puzzle proposed in B-Term working one at a time, and then adding variants to some of the puzzles in order to create the ability to have random puzzles each time someone plays through the game.

An important part of the puzzle creation was coming up with some sort of randomization function. In order to preserve replayability, we needed to ensure that the game was not predictable. Flash did not present any tools for this kind of randomization. However, Amanda was able to create something that mixed up the order of the puzzles. Although it is not a true random, it should be enough to prevent anyone from predicting the specifics of the game.

The game was designed in pieces. We first got it to work one puzzle at a time. By starting with a single continent functional, we were able to see what types of artwork we would need, and how big the game would end up being. When we expanded the game to have all of the continents, we had a template for how to set them up.

Progress was occasionally slow going due to many problems manifesting in the use of Flash itself. Sometimes things that were working perfectly fine when being built suddenly decided to stop working when the game was uploaded to the site. Often just exiting Flash and recompiling the game after opening Flash again would solve the problem. This caused no end of trouble as Shelli and Amanda had to repeatedly go back into the game to try and fix problems that might not even be there. Fortunately the one area where production was not slowed was the art area, although towards the end of the term it became clear some things needed to be revamped, namely the temporary buttons for all the locales needed to be replaced by permanent ones. Due to these problems, we were unable to meet the goal of having the game ready for beta testing by the end of C-Term.

In D-Term we began to really focus on all the problem areas of the game. The temporary buttons in the game were replaced, and the story arc was finally written into the game. On the technical side of things, the technical problems were with flash were largely addressed whether due to Amanda's growing experience or luck the disappearing problems were largely fixed. Placeholder data was replaced with relevant artifacts and puzzle data, finally achieving the major selling point of the game itself, which was to involve the museum and its exhibits. While we may not get a chance to have a large number of people test the completed version, the game has really come together and at this point all it really needs is some polish.

Technical Notes

Creation of Backgrounds

The backgrounds for the game were created in Adobe Photoshop. First, Ed perused the Internet for images that represented a diverse set of locations around the entire world. Of course, not just any image will do, since this game takes place in the 1930s. Pictures needed to reflect the atmosphere and look of each place as it was in the 1930s. Pictures of ruins were not hard to find, but special care needed to be taken to find pictures of the cities.

Figure 1: The original Image

After finding a suitable image, Ed imported it into Photoshop. After resizing or cropping the image to fit the resolution of the game (800x600), he then selected one significant part of the picture to remain in color.

Figure 2: Image made black and white with a color overlay

The rest of the picture was then made black and white, and then given a filtering layer of sepia, to make the background look like an old photograph. Then it was run through the smudge-stick filter on low intensity settings for artistic effect and to bring out the foreground information more. Then it was sent off to Amanda who puts it into the proper place in the game.

Figure 3: The finished background

Making the Magnifying glass puzzle

The magnifying glass puzzles are unique within the game as a visual puzzle. The background picture of the weapon at a normal size that the player sees is placed first, then the

same image is put onto a different layer and rescaled to be much larger. The dimensions used in the larger photograph in all three puzzles are 1375 by 1000 pixels. The "magnifying glass" itself is on another layer, and is a circle graphic. This graphic is made into a mask that covers the large picture layer. As a result, when a user looks at the scene, they can only see the large picture that is covered currently by the small circle graphic; they will see the smaller picture everywhere else. Another layer is used to create the graphic of the magnifying glass handle, and both handle and glass are coded to be attached to the user's cursor (and also are coded to hide the cursor itself unless over an input box). Some difficulty came in coding the cursor's appearance and disappearance. Getting the cursor to show required coding Actionscript, and text boxes did not allow for scripts to be placed on the directly. Hidden behind the text box is a box graphic that is coded to show the cursor upon mouse-over; the background is coded to do the opposite. Sometimes it can be difficult to get the cursor to appear or disappear still, but most of the time this method works, especially if the mousing-over is slow and not too fast to register.

Game Evaluation

Evaluation Form Version II *Game: Higgin's Hunt*

Determine the importance of each section. The total should add up to 100%. When evaluating ask yourself how well the game follows certain aspects mentioned below. Not all will always be used, but most usually will (or should be).

12/20
Gameplay: Always 20% value. Gameplay is the overall quality of playing the game. It represents how enjoyable the game can be and on what levels. A game that is fundamentally enjoyable if it has good gameplay.
Questions to ask yourself are:
Is the game enjoyable to play?
Is this only overall, or also at any given time during play (is it always enjoyable)?
Is game-playing engaging (does it remove you from your surroundings or make you wish to continue)?
Does the game media (visual and audio) draw your attention and further the game experience.

9/10 (Max 5-15)
Story: Between 5-15% depending upon game size and ability to implement. Story at its highest levels is the quality of the writing and the interactions between characters, but on a simpler level it is the players grounding in the game. It answers the question of why they are doing what they are doing, and provides interest to the player to find out what happens next.
Questions to ask yourself are:
Is the game long enough to warrant any involved story?
If so, what is the quality of this story, how engaging is it as a whole?
Does the game have at least a basic plot that can be followed by the player?
Are the game's characters believable? Is there significant interaction with them? If not, was there any way for this to occur given the type of game? Would it have been meaningful?

8/10 (Max 10-15)
Challenge: Between 10-15% depending upon design of game. Games that act as a medium for conveying information (games that have low integration of knowledge) should have a lower score than games that have good integration. This area does not focus as much on the difficulty as the quality of the challenges presented. A good challenge is one that is clearly present and solvable by the player. This area represents how much effort a player will put into the game.
Questions to ask yourself are:
Does the game have clearly designated goals?
Are the individual problems that make up these goals clear and challenging?
Are the goals themselves complex enough to retain interest?
If goals or problems are not clear, is it in such a way that promotes interest (puzzling, etc)
Does the game promote competition in any way?

8/15 (Max 5-15)
Flow: Between 5-15% depending upon size of game. The larger the game (at least the larger the expected play time in a session) is the more important Flow is for the game. It represents how fundamentally engrossing the game is. It reflects both the challenge of the game and the rate in which it teaches. A game that has good Flow is a game that will always be challenging its player with harder and harder problems but the perceived difficulty from the player will be the same. This cannot be observed, though, when the player is restricted in a situation because they do not know what needs to be done or cannot correct themselves easily.

Questions to ask yourself are:

How hard is the interface with the game to use? Does this detract from or add to improvement.
Does difficulty increase with skill level? Is this at the same rate or does it jump too high often times?
Is the player always aware of their current goal?
Does the play receive quick and useful feedback? Do they know what they did wrong?

15/35 (Max 30-40)
Knowledge: 30-40% depending upon the goals of the game. Knowledge reflects what is taught and how easily the player can learn it. A game should always be judged against its own goals.

Questions to ask yourself are:

Can the player search for the information themselves to learn it? Is this even possible?
Does the game provide time for the player to reflect on the game?
Does the game relay information through events such as dialog between characters?
Does the game teach through both passive and active means?
Does the game focus on abstract concepts?
If so, does it help a player to develop a mental model of the issue?
Does it focus on changing already existent ideas related to the concept?
Does develop tacit understanding of the concept from playing the game?
Does it provide opportunities for critical thinking on the subject?
If not, does it cover much information given the length of the game?

3/10
Integration of Knowledge: 10%. This reflects how well integrated knowledge is into the game. A game that is made of minigames about driving a boat and was attempting to teach about poverty would likely not have very good integration. Basically, integration is the relation of the problems of the game to the material being taught. A test, for example, is a terrible game but has perfect integration of problems and desired lessons to be taught.

Total 55/100

Evaluation Summary

Overall the game covers everything it realistically needs to, but covers no aspect very well. Examples of this can be seen everywhere. For example, the game gives the player the ability to find a great deal of information related to the artifacts, and builds up a system where it encourages the player to do so, but it is poor at teaching the information that is presented. Likewise the questions often relate to history, but not actually to the material which intends to be taught. The game gives feedback immediately, but it is only somewhat helpful. It will help someone who needs it, though, which is its main purpose. This however makes the challenge generally much lower as the player can just tap a button to get the correct answer and at little cost. Later developments of a scoring system helped to rectify this problem, but the overall lack of attachment to the material being presented is still a significant failing.

The game receives a 55/100, a passable amount for something that would be used in the museum, but a work neither stands out in teaching ability nor entertainment value. The game would require certain other additions to become truly good, such as a score system to promote competition, and a more important use of the artifacts involved.

Conclusions

"Retrospectives and Hindsight"

What was learned

Ed

I learned the importance of not procrastinating and sticking to schedules. I also expanded upon the knowledge I had of Adobe Photoshop, as well as knowledge about Creative Commons, Fair Use, and other legalese that up until now was only a passing familiarity to me. I've also increased my skills in doing video editing as I had to do some clip trimming so we could have our traveling interlude video. What I really take away from this, apart from my technical knowledge, is the knowledge that when I do my MQP, I'll know what scheduling pitfalls to avoid.

Shelli

Flash is easy to use until you get past the basics of buttons and simple animations. The actual coding can get difficult! Even the magnifying glass puzzle, which was simple at first to implement, proved a menacing task to improve bit of code later on. In that sense it's hard to gauge how much time should be spent on one task as opposed to another. I ended up spending more time fixing problems I encountered in trying to improve my puzzle than I did trying to implement new things altogether.

Amanda

During this project, I have learned Flash, some Perl, and how to do some work in mySQL. I have put a database online, for anyone to see, of the artifacts at Higgins Armory Museum. I have

learned the limitations of Flash, and the advantages Flash provides. Flash is easy to do user interactions and animation with, but is not designed to create non-linear games. Flash also makes it possible for a non-artist to create a visual game. I've also learned to use Photoshop and the GIMP to edit images. I was able to create a semi-random function when Flash's library of functions did not provide what I needed.

What went well

Ed

I really think that the database is an excellent element of the game, and Amanda did a great job doing the coding for it. I also think that we managed to find a way to capture both the theme of being educational in regards to history as well as adding a sense of adventure and discovery.

Shelli

The idea of making the virtual exhibit into a Flash game was a large step forward. I remember our other idea involving the Quicktime VR was going to hit some snags in the long run. Flash is supported by all browsers (to the best of my knowledge), and does not require domain host support to be run (just a plug-in download on the user end which is easy to acquire).

Amanda

Flash worked well for how the group was giving me materials. It was simple to import images, and it was also simple to make images into buttons. Keeping the files on the website worked well

for keeping track of progress and keeping track of what still needed to be done.

What could've been improved/What didn't go quite to plan

Ed

-I think we definitely had some communication problems, also during the PQP and First Term of the IQP we had trouble getting meetings as soon as the term started, which caused serious issues later on down the line. Another problem was the slowdown we hit in C-Term when Flash started behaving finicky and thus limiting our time to make a full-featured game.

Shelli

-I did a lot of computer hopping during the C Term development period due to laptop breaking emergencies, which was really taxing on my workload. Amanda had been having laptop issues at the time too, so she might have had similar experience. I got a new laptop again after Spring Break, which really let me feel that I could sit down and get things done without the worry of sharing a laptop, or running around campus for a workstation. It's a shame it happened so late in development though. I wish my laptop had decided to break down after we got everything done, but, ah, Murphy's Law. Also I had hoped to throw in some more finished vector work, but to get anything really detailed would have required a tablet peripheral, which I have yet to obtain.

-Our scavenger hunt idea has evolved over time, but we had to leave many brainstormed ideas out. Our hint-system via telegrams or library locales was never put forth, for instance.

Amanda

-Ironically, I think our main mistake was using Flash, although it was also a great benefit. Both the program and time ended up limiting our final project. Given another chance, we would need to start learning Flash and Action Script at the beginning of the first term, or during the PQP, rather than halfway through the first term. It is also important that everyone does their work for the week, and if they fall behind, they still get more work to do the next week. Otherwise, the work distribution will become uneven. The work should be divided such that the person creating the puzzles can concentrate on that, and someone else makes the game's framework. We also needed to choose a final art style far earlier. By the end of the 2nd term, artwork should be done and getting finishing touches, as should most of the game.

Attached Works

As noted elsewhere in the report the following sections are attached works covering those portions of the project that were not a part of, but were related to, the game itself. These works are the creation of a database of artifacts of the Higgins Armory, and the creation of a system for the evaluation of educational games. Both sections are meant to be used separately from the main document, but are of significant importance in their own right.

Part Two: The Database

Database Overview

Creation and Functionality

As a stepping stone in our project, we created a mySQL database that made the Higgins collection available for on-line perusal. This allows people to view artifacts even if they are unable to physically arrive at the museum. We were also able to reference it from our game. Within the game, the player collects various artifacts. At any point when they are viewing the artifacts, they can click on one and they will be taken in a new window, to preserve the game, and allowed to view the page specific to that artifact. Each page links to the Search form, the Higgins Museum web site, and other related IQPs.

The database also contains images of many of the artifacts. Some artifacts contain ten or more pictures, allowing for a viewer to get a good idea of what the artifact would look like seen in person. Pictures can be added easily when placed in the webspace with a filename in the form [assn#]-[number].jpg where [number] is any number and differentiates the photo from other photos of the same artifact, and [assn#] is the Accession number unique to each artifact.

The database allows anyone viewing the website to look up artifacts based on their Accession number, assigned by the museum; their type, such as sword or shield; their origin; and the date they were created. The searches are general and will return any artifact with the search terms in the specified fields. Once someone has searched, they may then choose to sort the resulting artifacts by accession number, type, creation date, and the place of origin. The results are displayed 50 per page.

These searches are done using Perl code that was originally written by Stacy Haponik to

provide access to the swords in the Higgins collection, and was edited to handle the larger number of artifacts and variety.

The database can be updated easily using the database that Higgins Armory keeps of its artifacts. This can be done from anywhere, as long as one can connect to the CCC machines. As well, the downtime from a complete update is quite short, under 2 minutes.

Updating the Database

The process for this is relatively simple to follow, however it also takes a number of steps.

1.) Take the access database, and export the list of artifacts to an Excel spreadsheet. how to do this will vary depending on the version of Microsoft Access you are using.

2.) Open the Excel file. Select the Accession column, and change the cell formatting to "Text Field". This prevents trailing zeros from being left out.

3.) Save the Excel file in comma separated values format, or .csv in the My_Documents folder on your toaster drive.

4.) Connect to the CCC machines via command line. You may use PuTTy, TeraTerm, or a number of other options.

5.) Type in "cd ~\My_Documents" and hit enter. This brings you to the directory with the list of artifacts.

6.) Type in "mysql -hmysql.wpi.edu -uUSERNAME -pPASSWORD harmory --local-infile=1" to open mysql.

7.) Type in "truncate artifacts2;" to clear the list of artifacts.

8.) Type in "LOAD DATA LOCAL INFILE 'filename.csv' INTO TABLE artifacts2 FIELDS TERMINATED BY ',' OPTIONALLY ENCLOSED BY '"' LINES TERMINATED BY '\n';" where filename.csv is the filename used to save the list of artifacts. This will load the data into the table.

9.) Type "exit" to quit mysql.

A description of the database. This shows the information stored, and corresponds to similar information the museum keeps in its own database.

anum	varchar(64)	NO		PRI		
style	varchar(127)	YES		NULL		
sortstyle	varchar(63)	YES		NULL		
date	varchar(63)	YES		NULL		
earlydate	smallint(6)	YES		NULL		
latedate	smallint(6)	YES		NULL		
artist	mediumtext	YES		NULL		
location	longtext	YES		NULL		
sortloc	mediumtext	YES		NULL		

materials	mediumtext	YES		NULL		
measure	tinytext	YES		NULL		
weight	mediumtext	YES		NULL		
exihist	longtext	YES		NULL		
comments	mediumtext	YES		NULL		
bibliography	mediumtext	YES		NULL		
label	mediumtext	YES		NULL		
description	longtext	YES		NULL		
marks	mediumtext	YES		NULL		
publicloc	longtext	YES		NULL		
+-------------- +-------------- +------ +----- +---------+-------+

Image Updating

An important part of the online database was the pictures. We also needed to make sure that the images could be identified as pictures from Higgins Armory. We also needed to include the filename so that, should the pictures end up elsewhere on the Internet, they could be traced back to the correct artifact.

In this endeavour, Photoshop failed us. Although Photoshop had many tutorials for adding a watermark, it did not allow for adding the filename. To do this, I located a program called FastStone Resizer, which was free for personal and educational use. This program allowed us to resize the images to 800x600 maximum resolution. This helped to make sure that the images would fit on almost everyone's screen when viewed. The program also allowed for creating a watermark with text. The watermark was set up to be semi-transparent. This allowed it to be seen on all images, but also allowed details underneath the watermark to still be seen.

Once the settings were chosen, the program could be run on all images in a folder. This simplified the process as there are a large number of photos.

Part Three: The Evaluation

Educational Game Evaluation: Developing a better system

Introduction

The general process for the creation of the evaluation system was a long and tedious path. The core concepts behind the system itself are those etched in the basics of both educational system evaluation and general game design theory. In this way the project seeks to produce results as accurate as possible for as wide a range of uses as possible (in the area of interactive educational media evaluation), with a format that is usable by layman in the area, such as museum staff.

The evaluation process was done in several steps. The first step was the creation of the background theories that would become the basis for the project. It was this process that judged what would become fundamentally important in the future and decide the structure of the form itself. Likewise, it would be a point to fall back on for support and validity. This part consisted almost entirely of researching established theory in the area of educational game evaluation, whether the areas were those of established education, game design principles, or both. The next step was the creation of an initial evaluation form and the testing of that form in order to create a practical version. This phase was mostly field work on the evaluation of games and the refinement of the form already created for practical use. The form was tested by a single person (myself) for practical consistency and ease of use. The most final phase was the basic testing of a final version of the form for layman use (through experimental sampling) and further refinement and analysis of the system. Each period would be analyzed separately. These analyses are found

further in this document.

History/Background

In understanding the underlying concepts behind the evaluation process it is important to understand many of the underlying concepts of game design, evaluation, and of theories of educational process that were used to generate the evaluation.

Interactive media has become exceedingly important in many areas in recent history. On a recreational level, video games have become a defining aspect of society as a multi-billion dollar industry in America. These same principles have gradually come to be recognized as important in other areas, including education. Currently, a large number of museums and other institutions have recognized the use of such interactive media for the purpose of drawing attention and helping to teach a wide variety of topics. It is for this purpose that an evaluation system is increasingly useful for a museum such as the Higgins Armory. With a quality system they will be able to quickly and effectively evaluate the acceptability of a given game or interactive exhibit.

Historically educational games saw a rise in the early 1990s as they were seen to have a great deal of potential, however there has been relatively little conclusive research done on their effectiveness as teaching aids and on means of evaluating them effectively. Because of this it is important to ensure that the games are genuinely helpful for teaching or at the very least help to draw attention to the subject. Otherwise they are nothing but a waste of time and space.

Educational games as a genre generally fall into the category of Question/Answer style games with a fairly straight-forward approach to teaching the material. The design of the game is usually fairly simple, information is supplied to to the player and they must remember,

extrapolate, or guess the correct answer. This design has many shortcomings including generally poor game play, poor ability to teach, and an inability teach more abstract concepts. This, however, is not the only means of designing an educational game, it is merely the easiest. Many other games, such as Food Force, Democracy 2, and The Typing of the Dead are completely different within the same category of educational games. They have a wide variety of teaching styles, game-play styles, and goals that differentiate them from more conventional Question/Answer games.

There are many disadvantages and benefits to this, however, they can be described by the requirements of an educational game to be good. The game must be entertaining to play, it must retain the interest of the player, and it must teach the player the desired material. A game that fails in any one of this areas is generally a poor game.

The elements that make up most of this are those of good game design. These are generally summarized by how engaging a game is. Engagement of the game comes from how fundamentally fun the game is to play, the challenge of the game, and the story of the game. Described as interfaces with the game these are fun (how much one enjoys the elements of the game), story (how much one is drawn by the story of the game), goal formation and completion (how much one is challenged by the game), and by 'flow'. Flow is the concept of how drawn into the game a player becomes, it incorporates the clarity of goals, the challenge level relative to skill, and the ease of play for a given player. In an ideal situation the player will become entirely focused upon the game itself. By following these concepts (through means that will not be discussed in detail here) the designer is able to make a 'good' game, at least for the purposes of teaching the player.

Testing of the evaluation format remains promising. All initial tests seem to indicate a reasonably high level of consistency achieved between individuals given even very limited constraints. Additionally, there is significant insight gained by the users into 'what defines a good educational game' when they use the form. This alone makes the current work a success.

Phase I: Educational Game Theory and Research

Overview

On the subject of video-games there are many methodologies for the evaluation and understanding of games. These methodologies rely largely upon two elements, the flow of the game and the overall ability for the game to relate educational values. The flow represents an individual's immersion in the game due to a number of factors, most notably challenge versus player ability. Conversely, the ability to teach individuals with the game is the fundamental aspect that differentiates educational games from more normal recreational games. The ability to teach players is largely dependent upon the size of the information being taught and it's level of integration into the game. The models of evaluation mostly differentiate between how these two aspects are measured. Three most well defined models that exist to this end are the GOM(Game Object Model), POM(Persona Outlining Model), GAM(Game Achievement Model). The GOM relates game elements to the promotion of educational objectives. The POM uses expected player interaction to build a 'persona' concept to better define the best design. Finally, the GAM relates to the overall structure of the educational game and how to best relate objectives. All of the models involved are designed with the primary focus of being taken into account during the design of the

game, however, they are able to be used to evaluate a game after it's creation by comparing them to the model.

Introduction

Educational games for a very long period of time have been a sort of 'holy grail' of educational groups. There has been a number of sources that contend that video games in most forms will form a negative impact upon students. These views have been argued by many to have only superficial benefits as players are removed from the real world (Billen, 93), but the vast majority of researchers agree upon their educational benefits(Amory, 2006). Today very few forms of systematic model for the creation or evaluation of these games exist beyond those methods that directly measure the progress of users.

The GOM: Versions 1 and 2

The GOM is based largely upon the programming concepts found in object-oriented programming. The model, originally created in 1999, creates the concept of a game-design where the game components are objects explained through concrete or abstract interfaces. Pedagogical(educational) and theoretical concepts are expressed through the abstract interfaces and design elements are expressed through the concrete. In the model as seen below (taken from Amory, 2006) the black circles represents the abstract interfaces while the white circles represent the concrete. Each object is one of the rounded squares as seen in the image. Objects convey all

of their interfaces to those objects contained within them. The larger concepts of the game contain mostly abstract interfaces while the most specific and elemental objects consistent of concrete interfaces. The elements space then includes Fun and Critical thinking interface.

Fundamentally, interfaces are the means of interaction between the game and the player. They can be somewhat one-sided as can be seen in the case of the sound or graphics interfaces, but are invaluable for the player and the defining points for the mechanics of the game. If an interface is concrete then it is something that is easily defined. Usually this is a standard game mechanic such as 'push left to make the tribesmen walk to the left', but can be far more complicated. Abstract interfaces reflect pedagogical concepts and intangibles. One cannot easily define the concept of how 'fun' or 'engaging' a game is, but these are extremely important principles that cannot be ignored. Other abstract ideas include the critical thinking required of players and other aspects of the experience(Amory, 2007).

Objects are best seen as the individual aspects of a game. For example, walking could be an object on the Elements Space or Problem Space level. It inherits all interfaces from those above it, therefore walking can be fun, challenging, an aspect of discovery, and a means of interaction all at once. These attributes outside it's level are always present, or at least can be, though they are often negligible. One rarely finds walking important to critical thinking or the story-line, but it is possible. When evaluating these objects it is best to bring them together as a group for the purpose of the overall evaluation. About the actor space one might ask, how fun is it to do these things? Are the actions I can take important, fun? Do they develop the story-line or the game at all? Most certainly, certain interfaces are more important for certain objects, but it should be remembered that the game is a sum of it's parts. Walking does not need to be fun, but

if the overall means of interaction is seen as tedious then it is quite likely there will be problems in the overall concept.

Example 1a GOM

The Game Space consists of the interfaces of play, exploration, challenges, and engagement. On a functional level these represent the abstract concepts of interaction, expansion, difficulty, and immersion come in. Play represents the fundamental concept of interaction within the game. Every component has the way it reacts to play and on a Game-Space level this reflects the overall game-play. Exploration is how much the game can expand to a player over time. It adds to effects such as replayability and the ability to enjoy the game for longer periods. It is largely how much there is to the game or any given component and how this changes over time. Challenge represent the difficulty of the game. On a game-space level this is the overall difficulty, though it can be applied to each and every component before it. Engagement is quite simply how well the game engages a player. It represents immersion and is an important factor in the development of the game. It is highly related to flow theory, which will be discussed later. All concepts on this level are abstract and while applicable to all aspects can be hard to quantify(Amory, 2007).

The Visualization Space consists of more thought related interfaces- critical thinking, discovery, goal formation, practice, and goal completion. Almost all of these interfaces are also abstract. Likewise, the interfaces are also largely self-explanatory. The roles of critical thinking, goal discovery and the like do not change meaning in this situation and therefore will not be

covered. Story-line remains a concrete interface in this stage as unlike all of the other concepts one can directly quantify what consists of it. All interfaces below might represent pieces of the story-line but as a whole it is represented on this level.

The Elements Space has the interfaces of fun, graphics, sound, and technology. It's interior object of drama, interaction, and gestures are found within the Actor space. Fun and drama are the only abstract interfaces of this space. The Problem Space utilizes many of the concepts of the Visualization space in it's use of manipulation, memory, logic, mathematics, and reflexes interfaces, all of which are concrete. It is on this level that most all concrete interfaces exist and that factual information would be taught. The element space provides all means of immediate interaction within the situation whether it is social or that maneuvering of pieces. The problem space represents not the critical thinking of the Visualization Space, but rather the means of each question that would be asked. These concrete questions or requirements are what would best be used to convey the most basic and factual information. For example, in the memory area of the Problem Space, one might find the object question of 'what tribe has the best agricultural production' or 'what tribe is found within the Horn of Africa'. These questions might be relevant on other levels as well, but they are inherently related to this category. The problem space is the composite of all problems demonstrated in the game, whether skill, knowledge, or thought based(Amory, 2007).

On a functional level the model allows for the easy break down of the various concepts involved in the design of the game. Each individual component, however, needs to be rated by

means outside the bounds of the model itself. This can prove challenging in some ways especially for abstract interfaces in the game.

Functionally the game design is either of a model using or a model building variety. Model using systems rely upon a set group of guidelines meant to teach students generally basic facts about things while the model building variety of game teaches the student about a deeper level of understanding, or at least attempt to do so. Applied information derived from mere simulations has a marginal effect and needs to be combined with a more immerse mental experience in order to teach the individual anything significant (Amory, 2007). For a more specific example of how the model might be used, see example 1c.

The GOM:II offers a substantially extended model. The most significant addition caused by this model the addition of the Social Space.

The social space is an Object-Space that overlaps with the Problem Space. This reflects the ability for individuals to solve problems more easily thanks to their peers. The Problem space itself gains several aspects including Flow, Conflict, and Conversation. About every object-space, though, gains at least one new interface in the newer model, representing a more complete view of the objects involved.

New to the GMOII is a series of subsections that cover a broad range of areas. These include definition, authentic learning, narrative, gender, social collaboration, and challenges-puzzles-quests (Amory, 2007).

The elements of definition are exploration, challenges, engagement, relevance, emotive, complex, and dialog. Each of these interfaces works to define the game experience and type of

game. Exploration, challenge, and engagement have already been covered in their purpose. The emotive follows it's namesake and reflects the emotions created by the game. Complex reflects the complexity/simplicity of the game on the large scale, or of individual tasks when brought down to their level. The complexity of the game should be scaled based upon it's size(Amory, 2007).

The elements of authentic learning are Authentic, Multiple Views, Transformation, Reflection, Relevance, and model-building. Each of these interfaces works to help impart genuine and useful knowledge upon the player through various mean. Authenticity is quite simply how 'true-to-live' the information is, especially within the context it is given. Multiple ideological views can help to include more people in the lessons the game teaches. Transformation reflects the social transformation evoked from the game and is largely irrelevant for a more simple educational goal. Reflection and Relevance are relevant almost entirely on the Problem-Space for the analysis of what is currently occurring. Finally, model-building reflects the use of the game system in regards to model building vs model using(Amory, 2007).

The elements of the narrative are narrative spaces, plot, and story. The role of the narrative interfaces are to engage the player. All aspects involved are functionally literary elements more than game-design elements in the conventional sense. They function as their namesake would imply.

The elements of the gender section are Gender-Inclusive, Game Rhythm, Role-Models, and Activity-Base. "In order for educational games to be gender-inclusive, more use should be made of activity-based (inquiry or experiential) interactions that are not ‘hidden’ but support the rhythm of the game, design conflict to include both ‘I win/you lose’ and indirect non-

confrontational outcomes, and include appropriate role models" This proves difficult in more simple games therefore would not be a point of focus for a more basic game design.

The elements of the social section are Democracy, Social Capital, Network, Tools, Visualization, Relationships and Dialogue. Social capital refer to the collective value associated with a social network and is fundamental to the building and maintenance of democracy working through information flows, norms of reciprocity, collective action, and broader identities and solidarity (Putman, 1995). Democracy itself is the simply the function of a group of people playing together deciding based on consensus. The rest follow as their name would suggest. Overall, the social elements of games are very important though difficult to achieve. In a simple game this is best achieved by creating a situation where outside input would be practical. Proper application of social systems provides a case that the GATE theory can function normally within(Amory, 2007).

Finally, the elements of the challenge-puzzle-quest subsection are Tactit Knowledge, Explicit Knowledge, Puzzlement, Accommodation, and reflection. Tacit Knowledge and Explicit Knowledge are what people learn through their experience in the game and what is told to them in the game respectively. In order for explicit knowledge to be practical it must be incorporated into the game as a memory-object. Puzzlement is retaining constant stimulus for the learner during a puzzle or challenge situation in order to retain focus. Functionally the ideal situation follows either Flow theory or the Zone of Proximal Development(Amory, 2003).

Example 1b GOMII

The Game Object Model version two is significantly more complicated and inclusive that the initial version. It manages to cover most-all aspects of game design both educational and

mechanical, but this is also part of it's weakness. Because the model itself covers so many things it will become necessary to create a fairly complicated evaluation system to match it. The capacity for sub-objects to have so many potential interfaces means that if anything practical is to be done, it will need to be done through a well structured system without focusing too much upon game details. Let us take for example a the conceptual tribal game concept. The game would need to be evaluated on a Game Space, Visualization Space, Elements Space, Problem Space, and Social Space level. Each space would be rated differently in it's overall value to the total design based upon the concepts that were to be emphasized and the nature of the game. Then, each interface would be rated for it's inclusiveness within any given object. The evaluation of the game would likely work based upon the total point evaluation given, but would be most useful in determining weak-points in the game design.

The GMO has a few disadvantages outside of implementation. It is a highly theoretical model and incapable of taking into account the experience of an individual as a whole. It instead takes the aspects as individual interface elements which are considered. In addition, there has only been minimal research done on the validity of the model itself. While the model might be useful for the purposes at least organizing the thoughts about the game regardless, it is not so highly rated that we could trust it entirely. So far, though, all research seems to support it as an acceptable and usable model.

The POM: Persona Outlining Model

The POM works under the concept of four fundamental questions. Who will be

exploiting the system. What will they be doing. How will they do it. With what technology will the system be developed. The who and what aspects of these four questions form the "persona" of the system. This persona has certain aspects that are derived generally from statistical tools. These aspects are, of course, those of the expected user. Fundamentally this model is a variation of the GOM where the aspects of the various interfaces are weighted in importance depending upon the individuals who would use it and their importance in use.

Use of the POM would be a modification of the use of the GOM. Functionally, each interface would be rated for it's importance based upon some variety of outside survey. The importance is based on the relevance for the theoretical persona that the game will interface with. By taking into account the persona it is easier to judge where the flaws in the game lie. For example, if it was indicated to us that story-line was unusually important to the attention of a certain group then it would become rated more highly on the evaluation. Likewise with other interfaces in the GOM. The model itself has no use outside the GOM itself. (Amory, 2003)

The GAM: Game Achievement Model

While the previous concepts of the GOM and POM worked upon the principle of linking individual game components into a functional and educational interface, the GAM works on a larger scale of interaction. The GAM works on the principle of linking educational and in-game objectives in order to create a continuous experience and maintain interest in the game. It is important in the GAM that all objectives are clearly defined and linked together directly.This forms the outline of the game and the basic 'story'.

Each 'act' of the GAM has it's own set of objectives and tells a certain portion of the story. These acts form the larger structure of the GAM model and the overall flow of the story. Acts are composed of scenes which implement the interior models of the Visualization Space. It is here that the POM's influences are fully realized in order to better adapt the game to the player. While the learning objectives might be established on a larger level they are accomplished in the scenes. The story-line of a game created under the GAM is designed to include all learning objectives or goals for the game. For example, if it was judged that the people the game was teaching to had a deficiency in the knowing the difference between tribal groups, one or more aspects of the story-line would be based around the differences of the groups in order to better related the lesson. (Amory, 2003)

Example 3a GAM

Example 3b GAM part 2

GATE(Games for Activating Thematic Engagement) Theory

The GATE theory is a theory of educational game design driven around the principles of engaging the learner in a topic in order to encourage further exploration. The theory is based around the concept that by generating the interest in the topic the self-driven player will then be motivated to learn the material on their own and thusly retain information more effectively. The underlying premise behind GATE is to make the player autonomous and self-motivated. The concepts behind GATE do not lend themselves as readily to the process of evaluation of already made games, however the theory will be covered briefly.

The theory of GATE is heavily based upon the works of Bruner, who focused largely on self-motivated discovery and the creation of an atmosphere for people to learn. Vygotsky is another important theoretical basis for the model. Vygotsky theorizes that the expansion of intelligence is based upon the addition of new 'tools' or techniques available to the learner. By internalizing these 'tools' they gain access to new skills and function. Internalization refers to the creation of higher mental function based upon social constructs or interactions. Having concepts internalized leads to a more complete or effective view of the world. Likewise Vygotsky proposed the Zone of Proximal Development, which is also heavily used in GATE. The Zone of Proximal Development represents the most effective challenge level for an individual to progress effectively without becoming frustrated or bored. By the initial design of the theory, the zone is based upon the ability for an individual to solve problems with the aid of a group of their peers. The zone itself is the area in which they are able to work comfortably with the help of the group. Both of these fundamental theories fall into the Constructionist school of educational theory.

The summary of the functionally important aspects of the GATE theory are quite simple. Develop a context for the game that immerses the player. Provide players with an educational benefit for playing the game as implemented. This means the game must be self-contained for the purposes of providing education to the player and must do so within the context of the game. Provide feedback to the player such that they are aware of their progress in the goals of the game. These goals should also be educational goals by the previous integration of educational values. Overall, the game should provide understanding of the material, an engaging experience, and have some practical value.

It is important for one to understand how the GATE theory would be used in order to

appreciate its potential importance in an evaluation. Functionally, the GATE theory looks at the means in which the game engages the player and encourages them to learn the material. This can mean many things, but generally would refer to how the game entertains and how this relates to the material being covered. It is very difficult to create a direct empirical rating of such abstract concepts, but they can be related qualitatively then approximately quantitatively. Looking at a common game, lets say the old Oregon Trail game. The game itself has many 'hooks' drawing in attention regardless of how the player enjoys the game. They are committed to it through things like the lives of the characters they control. Overall this would receive a fairly good rating. The game, however, does not attach these points directly to educational benefit. One does not need to appreciate a map of the United States in order to progress in the game or have a knowledge of disease in order to avoid them. Instead these concepts are entirely different and unrelated. One could then rate these qualities together in order to determine a rating for the game, likely by multiplying them as neither one together means anything on it's own for the quality of the game. As can be seen, the GATE theory does not lend itself to easy evaluation of other models, though it has its uses. Ideally, it would be best to take it into account when designing the evaluation, but not to use it as the basis of design.

The Kiili Model and Flow Theory

Yet another model is that devised by Kiili. The Kiili Model works not upon the creating a unique framework for the creation of educational games, but instead works to related already existent game theory with already existent educational theory in order to create a functional

model based off of already well accepted concepts. Foremost important in the Killi Model is the concept of Flow Theory found in game design.

'Flow' is a common concept found within many school of game theory. The basic concept is as follows. An individual playing a game will gradually increase in skill while playing a game. The individual's immersion and enjoyment of the game is related to the challenge the game presents to the individual.(Zhang, 2005) In order to maintain ideal experience, the game developer must then increase the difficulty level of the game along with the progression of the individual maintaining a constant challenge level in relation to skill. This leads to a state of complete absorption into the game known as 'Flow'.

Killi argues that flow needs to be broken down into both the aspects created due to the main task and the 'artifacts' being used by the player. Both of these present challenges and rewards that must be accommodated for. If the artifact being used to achieve these goals is sufficiently challenging or helpful it can harm the process for achieving best results.

The aspects of the game itself are known as activities or tasks. They are inherently basic things such as reading a book or writing a story. The medium used by them in most cases can be ignored, such as the book that is being read or the paper and pencil that are being used. This is because the medium has been expected to be perfected it provides minimal resistance. Tasks specifically refer to those portions of the activity that are isolated from the tool, though they require them. The activity as a whole is what uses all parts. In the case of playing a game, the game itself is the means to any of it's subsequent tasks and therefore needs to be included when attempting flow. (Zhang, 2005)

Artifacts are a means of determining progress and gaining insight or progress into the

task. Their key traits are most often defined as Vividness and Interactivity. Vividness being the power or impact of their responses while interactivity is defined as how well they respond to the user, whether it is the range of the responses or easy of communication. Overall it is best to treat them as separate entities for the purposes of establishing flow. Regardless of this, the simpler the interface the less the artifact aspect needs to be taken into account. In an idealized setting the artifact is neglected in it's entity. (Zhang, 2005)

The most basic model of Flow that is useful can be seen below. Basically, there are four clear requirements for the initiation of flow-experience. These are besides the obvious key mixture of challenge and skill. There must be Clear Goals and immediate feedback upon those goals. Likewise, there must be a high level of potential control, leading to a merger of action and awareness. These are known as the antecedents of Flow. During flow there is an increase in concentration. This leads to a loss of self-consciousness and a distortion of time perceived. This all leads to a large number of benefits including increased educational retention and an idealized experience.(Zhang)

Example 4a Standard Model of Flow

The Game itself by Kilii's model can best be viewed as one large problem linked by a series of smaller problems. Players should naturally progress in the difficulty of the problems by Flow theory with am emphasis on discovery of new concepts rather than repetition. Kilii's complete model can be seen below. This key aspect of game-play is probably the most important aspect of the completed model. Each step of the game on a fundamental level should intuitively lead to the next step creating the basic concepts of game-play.(Kilii)

Killi's main model works upon the basis of Experiential learning combined with flow-

theory. The basic design of something created for experiential learning "begins with a concrete experience followed by collection of data and reflective observations about that experience". By constantly updating the series of circumstances involved with the situation, a learner can learn a great deal more and learn to apply the information more effectively. For example, a player could create a series of fundamental beliefs or theories about the game, such as that assaegi are always the best weapons to be used in combat. His theory is supported in the first combat when he defeats his enemy, but over time through a series of other circumstances he reflects and alters this personal model to adjust for the new experiences. In the end he has a more complete view of the purposes of the weapons involved and their advantages in the field.

Of significant importance is that Kilii's model is an experiential model as opposed to a mechanical model. It covers very loosely the means of achieving the goals presented and instead presents what the player of the game should be experiencing when the game is played. The model itself is based highly upon the behavior of the player rather than the mechanics of the game. It is believed that through both behavior and thought combined that one is able to achieve true learning.

As can be seen when viewing the model itself, there are several distinct steps towards learning. There is the simple cycle that individuals carry on themselves of Idea Generation and completion of learning objectives. The learning techniques can differ but on a basic level the player thinks of solutions, solves problems, then goes on to look at more problems. On a intra-game level, one must look at the behavior very differently. On this level there are about four to seven steps depending upon your perspective that make up the pattern. Players are first presented with challenges. In order to complete the goal they experiment with various means, such as trying

a new structure for base building in a real time strategy game or taking a new path in a maze. They receive feedback in the game based on their various techniques or solutions. The individuals then reflect upon what this means for them in the context of the game(Kiili, 2005). Based upon what this means for them functionally, they alter their view of the world. This viewpoint is what is used to determine the decisions that will be made in the future and functionally determines what has been learned up until this point. As the players learn more about the game and improve their viewpoint or 'schema' the game becomes easier and skill develops. In an educational game the 'skill' required in the game is ideally the end as well as the means. By developing the skill in order to progress in the game the player also learns valuable lessons that apply to the real world (or trivial facts as the case may be) thusly achieving the real objective of the game, to teach. Both the loops in Kilii's Model occur simultaneously in and outside the game world.(Kiili, 2005) The core piece of the model, the 'challenge' section, works to both motivate the player and provide additional problems which are to be solved. It is here that the loop becomes refreshed, and without reaching this place often enough it is easy for the player to become dejected and give up. It is important that the game also provide places for each of these steps to exist either by creation of a game mechanic to facilitate them them or by giving time for them to occur naturally. A good example of this is in shorter games where segments can be repeated quickly. The time that exists between game sessions can be used to reflect what occurred during the game and to develop new schema. While the player develops more skill in this way the challenges should be constantly increasing such as to provide an ideal flow experience as described previously. (Kiili, 2005)

Kilii also describes three other aspects of educational game design that exist outside the

core of the model but should be expressed somewhere. The first one of these, storytelling, has been addressed elsewhere, but the importance of maintaining game balance and optimizing cognitive load will be addressed here.

The purpose of game balance is two-fold. There is first, the goal of preventing dominant strategies from occurring, where a dominant strategy is defined as one strategy being clearly better when others should still exist within the situation. Likewise, the point of game balance is to ensure that there are now game flaws that can be exploited so that the player gains an advantage. This ensures that the better player, at least in general, has an advantage when playing the game. The concept is especially important in educational games designed under this model as skill correlates to knowledge learned in most situations. If you provide players with a means of undermining this, then the behavioral model becomes void as the process is unnecessary to them. Also covered in this is the steady increase of challenge level noted to be important in flow theory.

Oftentimes in an educational game there is a large flaw that is covered in little part by the other designs but can easily cripple the game. That flaw is overburdening cognitive load. The designers of the game aspire to highly and attempt to fit far to much media into too small a place. The result is simply too much information for the player to process or retain. In order accommodate for this, a number of theories have been created for determining the most effective load in visual and auditory channels in multimedia. There are two varieties of cognitive load. There is that which is intrinsic to the material being taught. The level of this varies depending upon the complexity of the material in question. Teaching basic facts, for example, will have a very low intrinsic load, while teaching advanced calculus will have a very high load. There is also the germane cognitive load, or that which is used to develop the schema with regards to the

game. It is impossible to change the inherent cognitive load, therefore the game design should take into account that it cannot exceed certain limits depending upon the complexity of the material. A game that teaches advanced calculus cannot do so functionally unless the design of the game itself is simple. Conversely, a game that teaches simple facts can have a great deal of depth in it's own right without becoming too burdensome. In fact, it likely will need to use the additional resources it will have available. If the game is educational in nature then it will likely want to use what is available to make the player connect with the game more deeply. The key concept that should be emphasized, though, is to not exceed what the player is capable of. This will damage their learning more than any other influence.

Example 4b Kilii's Model

The use of the experiential and behavioral model designed by Kilii is self-evident. It provides a very basic pattern for the game to intrinsically follow that can be expanded upon to any degree. Likewise, the model provides a means of ensuring that the game draws players in, looking from the experience side rather than the mechanical side. Because of this, its flaws are completely unrelated to those we find in the GOM or GOMII.

Summary

Ideally it would seem that a compound model would be used for the evaluation of educational games and exhibits for the museum. One would need to take into account the mechanical and experiential aspects of the game in order to achieve the best result. The GMOII model covers an easy and step by step analysis of the mechanical components of the game. It

determines of a fairly simple level whether or not the game can be good or educational. The Killi model and the Flow models seem to be ideal for rating the experience of the game. One cannot determine with certainty the experiences of the player, but it would work significantly better to look at the problem from all viewpoints. Below is a proposed model for evaluation linking all models mentioned above.

Fundamentally in the model there are 6 core aspects that must be individually rated. Each one of these concepts is equally important individually and a failure in any one of them can make the difference between a good game and a bad game. These fundamentals are game-play, story, challenge, flow, knowledge, and integration. Each of these concepts blends into the others. The blending of the concepts is also evaluated in this sense, an important concept for the integration of knowledge and flow of the game play.

The first of these fundamentals, game-play, covers a wide range of aspects of the game and can be called the most general aspect. It covers how entertaining the game is and how simple and intuitive it is to play. This is an evaluation of the mechanics of the game as a whole. In short, it is the skeleton of the game. The linked interfaces with gameplay are Fun, Graphics, Sounds, Technology, Game Rhythm, Activity Based, Play, and Engagement. These interfaces represent the basic immersion of the game. The more complex or large the game is the more immersion can be left to the story, but both aspects are always important. A game with little Game-play value will be seen as enjoyable or tedious.

The next fundamental is story. Story is necessary for even the most simple of games in order to provide a context for the game to be presented. Without a story the game will have little contextual purpose and it will be seen as awkward or pointless. Of all of the six aspects, this is

probably the least visibly necessary. Regardless of this, the storyline is what keeps the interest of the player beyond a single session and is necessary for any lasting appeal. However, because it's importance lies mostly in the long-term, the story does not need as much focus in simpler or less complex games. Regardless, the story creates both the immediate and the long-term draw of a game and cannot be ignored entirely.

The third fundamental given is challenge. Challenge represents the difficulty of the game, varying across different times in all forms. Every puzzle, every question, and every difficult leap forms a different aspect of the challenge section. It is not important for a game to have a wide-variety of challenges, but it is important for it to maintain a certain level of challenge in order to retain interest. A game without Challenge will quickly become dull while a game with too high a challenge will be seen as frustrating. The goal is to increase the challenge level of the game at the same rate in which the player learns. This creates the flow experience that keeps a player enjoying the game during each session.

The fourth fundamental, Flow, is caused by a combination of challenge and knowledge. By having a person gain skill and raise difficulty at the same time the person is kept in a constant state of focus, able to play for long periods of time without noticing it and gain the maximum benefit for doing so. Not only does Flow require a well met challenge and skill level, but it also requires a consistent progression of difficulty, a clear sense of goals, and immediate feedback. When determining the difficulty of the game one should simultaneously determine the difficulty of the artifact and adjust for it's skill/difficulty progression as well. If the progression is unnoticeable then it can be discounted.

Knowledge, the next fundamental on the list, reflects the educational value of the game

more than any other aspect. Without things being taught by the game it is merely a normal game. When establishing that which is to be taught by the game, one must make sure not to overburden the player with too much information doing so will 'overload' the player causing them to lose focus and give up. Knowledge is largely separate from the means in which it is imparted for the purposes of evaluation. The interfaces used for knowledge are exploration, authenticity, Multiple Views, Gender Inclusiveness, Transformation(of viewpoints), Tacit Knowledge, Critical Thinking, Discovery, Goal Formation, Reflection, Relevance, Explicit Knowledge, Model Building, Accommodation Assimilation, Dialogue, and Role Models. The existence of each one of these interfaces is important, for the ability to understand and retain the knowledge presented, but is not as important as the final fundamental.

The final fundamental is the integration of knowledge with the rest of the game. There are no direct interfaces involved with this, but rather the attempt to make the knowledge itself inherent to the other fundamentals. This is done through numerous means. The knowledge does not need to be part of the game play itself, but it needs to be part of both the challenges and the storyline in order for retention to occur. Like the Kilii Model, the challenges and means of getting by those challenges must be related to the material taught. Like the GAM model, the information being taught must be part of the story in order for it to have relevance to the reader. Ideally in this way it would be naturally integrated into the Flow of the game, the player naturally progressing through the information in higher and higher levels, making it ideal to the GATE model as well.

Conclusions:

All of the models in their own right are able to evaluate games effectively. Each of the models, though, has its own disadvantages when attempting to judge. Generally this is in the form of a weak-point of some sort. The GOM has a tendency to focus too much on mechanical aspects, while Kilii's model focus' only on behavioral aspects and the GATE model is too abstract. One is able to combine all of the models, however, this creates something that is unreasonable to do as a whole, especially when the models do not align well. Instead, I have broken up the agreed upon aspects of all models involved into six core fundamentals that simplify an otherwise overly complicated system. This evaluation method, like the others, is imperfect as it requires more from the evaluator and can change much from situation to situation, but I believe with proper weighting it would be just as accurate and easier to manage.

Phase II: Review Process – Conclusions and reconsiderations

Several games were reviewed in the review form created earlier (see 1a.) The review process was fairly simple, the game would be played from start to finish. The game would then be evaluated subject-by subject based on the fulfillment of the characteristic in that region. Each of these aspects was treated independent of others and was rated on a scale of 0-2 where 0 was not-implemented, 1 was partially implemented, and 2 was fully implemented. The goal of this was to represent a gradient of change instead of a pure on/off situation when determining if interfaces were used. Overall the evaluation process was found to be sub-standard due to a lack of variation from media to media and because of an awkwardness in evaluating interfaces evenly. All evaluations, however, were generally found to be consistent with the perceived quality of the game.

The process for evaluating the interfaces was fairly straight-forward. Each interface was refers to a specific aspect of interaction with the game.

Gameplay

Gameplay related sections cover the workings of the game itself.

-Play refers to the ease of game play and how readily available it is. A game with poorly implemented play would be something where you can do little to interact with the game or could not intuitively perform actions.

-Engagement is how ingrained an individual is in the overall game. An engaging game is one that will distract the player from the outside world and give them an invested reason to continue

playing.

-Game Rhythm is making the pace of the game neither tiring nor boring for the player and giving them the ability to alter this flow at least partially.
-Activity Based learning refers to each lessons relation to facts of the game, treating them as contextual problems instead of as facts.

-Fun refers to the game being simply entertaining on a small scale. An individual activity of the game would be 'fun' such as jumping from platform to platform or finding objects. This interface refers to the sum of this in the game.

-Graphics refers to the use of graphics to engage and entertain the player.

-Sound refers to the use of sound to engage and entertain.

-Technology refers to the use of technology to gather interest outside of the expected of the medium. It is the hardest interface to define easily.

Story

The story section refers to the overall story of the game. It is used to engage the player and make them wish to continue playing.

-Narrative Space is the use of individual scenes to convey concepts or story.

-Story itself merely refers to the overall game and the overarching concept of what occurs.

-Plot refers to the basic cause-effect links of the story and how engaging each subsection is.

-Conversation is simply the interaction of characters verbally.

-Backstory is what is used to establish a context for the game and give it meaning. A simple backstory can make a game far more entertaining and relevant for the player.

-Emotive is the ability for the game to convey emotions in any specific scene that occurs.

-Gestures adds to the humanity of the game.

-Interaction is the ability for the player to interact with the story and it's progression making it more meaningful.

-Drama is the smallest subset of the story and rates the quality of the overall interactions of the game and smallest portions of the story. It isn't dramatic in the conventional sense but rather reflects the quality of the actions within any given scene.

Challenge

The challenge section covers the difficulty of the game. A game that is too easy or too hard will easily lose interest and is generally less engaging to play.

-'Challenge' as an interface refers to the overall challenge level of the game in comparison to its target. It is most easily seen by the existence of specific hurdles the player must come across, specific challenges present within the game.

-Goal Completion refers to the ability for an individual to complete the desired goals for the game in a step-by-step manner. First they have the goal of, for example, finding one specific artifact at a time when their overall goal is to find all the artifacts. It keeps the game more focused which helps in learning.

-Competition is the ability for the game to have players compete against someone either real or fake. Generally this is done by adding a scoring system to the game, but can implemented far more effectively with direct competition.

-Conflict refers to the presence of problems which must be resolved or of resistance to solutions. This is generally not seen well in on-line games but can be found in more complete ones such as Democracy.

-Puzzlement refers to the ability for the game's problems to create interest by needing to be solved. Obvious examples include interesting puzzles. Fundamentally the goal for this interface is to create non-transparent solutions to problems.

-Complexity refers to how ingrained a problem is for the purposes of solving it. It is basically forcing a player to commit themselves more to the problems.

-Inherent Problem Qualities is an extremely vaguely defined category based upon the Problem Space. It covers generally the quality of the individual problems of the game whether they test reaction, skill, intelligence or memory. It is quite simply making sure the problems are genuine and well made.

Flow

The Flow section is significantly different than the other sections, it basically checks to see if the game helps flow experience. It is not necessary for it to do so often, though, as tending towards flow itself improves the overall game quality even if it never quite reaches it.

-Artifact Usability is the ease of use of the interface used to interact with the game. A simpler interface generally makes the rest of the game design easier while a hard one must be accounted

for in game difficulty.

- Progression of Challenge and Skill is an extremely important aspect, the goal is to have the required skill level be just below the players own at all times so that they are always challenged even though they are constantly improving. A poor progression will often either frustrate or bore a player.

-Smoothness of Progression refers to have even a progression this is. Wild fluctuations in difficulty or sudden jumps at certain points decrease learning speed and can make the game frustrating.

-Clarity of Goals, a clear understanding of the goals of the game, this is important for an enjoyable and intuitive game experience.

-Feedback refers to the speed and accuracy of feedback for the player. It tells them what they did was wrong and might give an idea of how it was wrong. Immediate feedback is generally best when making educational games unless the lesson intended refers to long-term implications.

Knowledge

The Knowledge section refers to the games overall ability to convey the desired knowledge and is in many ways the most important section for an educational game.

-Exploration is the ability for the player to find information on their own by exploring the game. It is especially hard to implement in smaller games.

-Authenticity refers to how authentic or genuine the views expressed in the game seem. The appearance of truth coming from the correct view point makes it more memorable.

Multiple Views interface refers to the ability for a player to have multiple viewpoints on the same issue. It creates a more accurate image of a problem.

Gender Inclusiveness is the use of both direct and indirect means of relaying information to players based on gender preferences.

-Transformation covers the ability for the game to change current thinking styles by gradual means.

-Tacit Knowledge reflects more nebulous concepts taught by games, such as techniques or that 'controlling a country is hard' while Explicit knowledge refers to individual facts taught by the game.

-Critical Thinking is the interface that deals with enforcing critical thinking.

-Discovery, ability to find out individual facts on your own.

-Goal Formation making player create their own goals and understand what defines them.

-Reflection, giving the player time and ability to reflect on actions within a reasonable period. Relevance giving the player relevant information.

-Model Building, whether the game builds an overall image or base-line process that the player can use in the future.

-Accommodation ability to change information already known by player (and show why it should be shown).

-Assimilation, ability for information to be integrated into already existent concepts.

-Dialog, a means of feedback with player for purpose of teaching.

-Role Models, highlighting certain concepts that the game wants to emphasize.

Integration

Finally there was the quality on which the knowledge was integrated into the game. A game that has knowledge well integrated has the lesson being taught fundamental to both game progression and story. A game with poor integration would be a game that merely has scatted facts on a subject.

Evaluating

Each game score was then totaled with a maximum of 100 possible points. The highest reached was 75 and a very well done game would get approximately 60. Poor games would receive around 30-40 in general.

The games evaluated were Democracy 2, The Typing of the Dead, Food Force, Egyptian Tomb Adventure, and a set of mini-games from the Museum of London. All evaluations were done in the exact same method regardless of the noticeable flaws found in the system. The system seemed to be a good evaluation of the quality of each game relative to one-another, but it had many faults when attempting to evaluate each game individually. It had no means of separating those games that attempted to teach only skills or only facts. The system was also very cumbersome at times. Evaluating each aspect when they were sometimes not entirely applicable was difficult.

The system of evaluation itself has many inherent flaws. This is most easily seen by the fact that even games that achieve their goal admirably and are generally very well done still do not generally score highly on the current system. The system itself is also fairly unintuitive, requiring a great deal of skill to use. Finally, the systems only can evaluate a given aspect on a fairly small scale of success. There is no making up for deficient aspects with very well done ones.

The failing of creating overly high standards is one that can be seen in all review examples. The highest result was a 75 with an average of about 50. This result does not evaluate games on an intuitive scale. While adjusted scaling for varying games is possibility in this regard, It would be awkward to determine which games adjusted to what ranged. In addition, certain categories of rating could vastly imbalance a games score. A game that is unplayable but covers a great deal of information is not a good game, it is an encyclopedia. It is also notable that there are certain trends in what varieties of game received points on what interfaces and in what areas.

It might be reasonable to in the future simply remove these interfaces from the calculation.

The inaccessibility of the system for non-experts is a serious issue that must be addressed. When a third party looks at the evaluation form itself they generally have no idea how to go about the evaluation without a long description. In order to accommodate for this more elaborate terminology and 'smooth' wording should be used. This will likely also fix the inaccuracies of the interface itself. By grouping together very similar aspects the evaluator will be able to make outstanding qualities make up for the faults of the game inside of the area of importance. They will also have a more general feel for what they should be looking for and therefore be able to rate the area more easily.

Phase III: Evaluation and Testing

The success of the evaluation form seems relatively high at this time. The average time to complete the form took approximately 5 minutes, with the highest extreme at about 10 minutes in total. The most variability was found within the knowledge area. The reason for this was simply found upon asking the individuals who evaluated the game. There was a great deal of variation between the expected and accepted educational goals of the game. If this was more clearly defined it is my belief that this variation would largely decrease. This is reasonable when the evaluation would be performed within the context of the games actual goals.

Category	Min Result	Max Result	Average Result	My Result	Avg Max
Gameplay	2	10	7	10	20
Story	3	10	4	5	12
Challenge	0	10	4	7	12
Flow	3	15	7	3	7

Knowledge	17	35	21	20	40
Integration	5	10	9	10	10
Total	43	62	53	55	100

The game evaluated by all five individuals was Egyptian Tomb Adventure from the National Museum of Scotland. The game was rated to be approximately a 53 out of 100, which by the standards of the system would mean a playable and usable game, but not one that efficiently uses that medium to its best abilities to teach the player much material. If it was assumed that the game had fully reached its educational goals (for these goals in general should be judged by the creator, not the evaluator) then the game would have achieved approximately an average score of 72/100 representing a passable game in the areas of gameplay, story, and challenge. Admittedly, it is very hard to create an educational game that scores highly overall with a great deal of creativity and insight. The system did not attempt to evaluate the appearance of the game, which is quite professional.

Conclusion:

Overall the evaluation format seems to have been highly successful in creating a relatively simple system for the complicated concept of game evaluation. A number of different aspects all needed to be covered, however the system manages to include them all with varying degrees of effectiveness between them. The foundational concepts behind the format are those pioneered by individuals such as Amory and Zhang in their theories of interface-based evaluation formats, and of the underlying importance of flow. Further applications of the format include additional testing in order to refine the process and improved implementation of the form itself.

Works cited

AMORY, A. and R. SEAGRAM. 2003. Educational game models: conceptualization and evaluation. South African Journal of Higher Education 17(2), 206 - 217
http://www.ukzn.ac.za/ited/amory/SAJE_Amory_Seagram.pdf

Zhang, P ; Finneran, C. Flow in Computer-Mediated Environments: Promises and Challenges.Communications of the Association for Information Systems (Volume 15, 2005) 82-101
http://melody.syr.edu/pzhang/publications/CAIS_05_Finneran_Zhang_Flow.pdf

William R Watson. FORMATIVE RESEARCH ON AN INSTRUCTIONAL DESIGN THEORY FOR EDUCATIONAL VIDEO GAMES. Indiana University, 2007

A. Amory. 2007. Game object model version II: a theoretical framework for educational game development. Educational Technology Research and Development, Volume 55, Number 1 / February, 2007
http://springerlink.metapress.com/content/f3m21551up787t70/fulltext.pdf

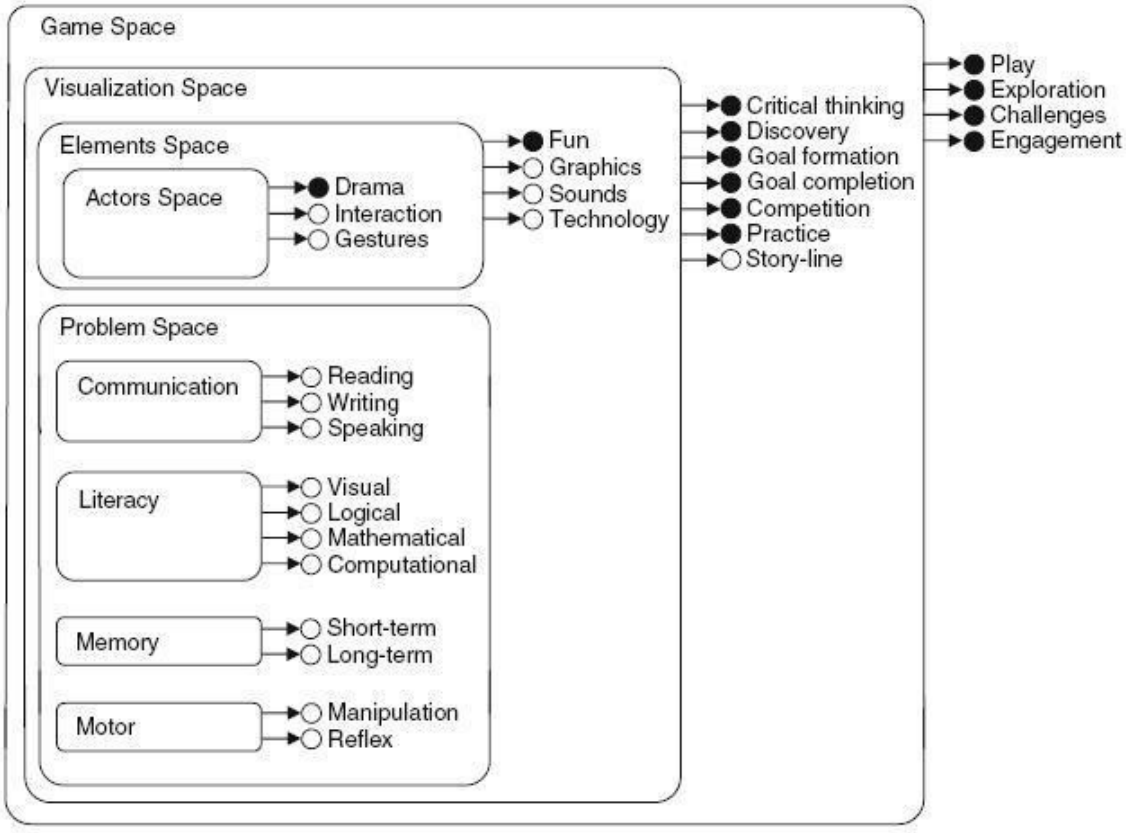
Kristian Kiili, Digital game-based learning: Towards an experiential gaming model, The Internet and Higher EducationVolume 8, Issue 1, , 1st Quarter 2005, Pages 13-24.
(http://www.sciencedirect.com/science/article/B6W4X-4FN2NF9-/2/4758a58555bff775fed79bd9db18c19f)

Appendix A

Educational and Game Models

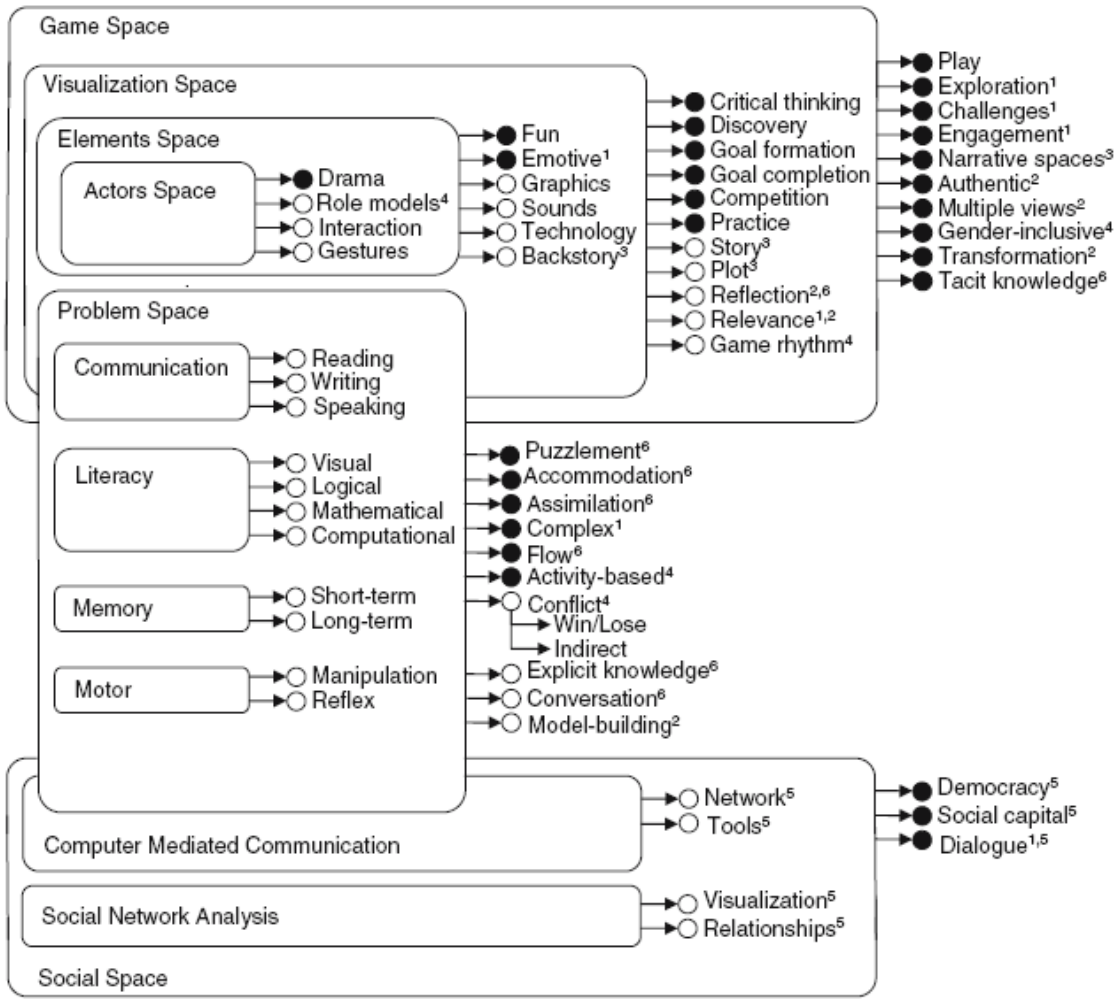
Example 1a: GOM

Game object model



Example 1b: GOMII

Game object model version II

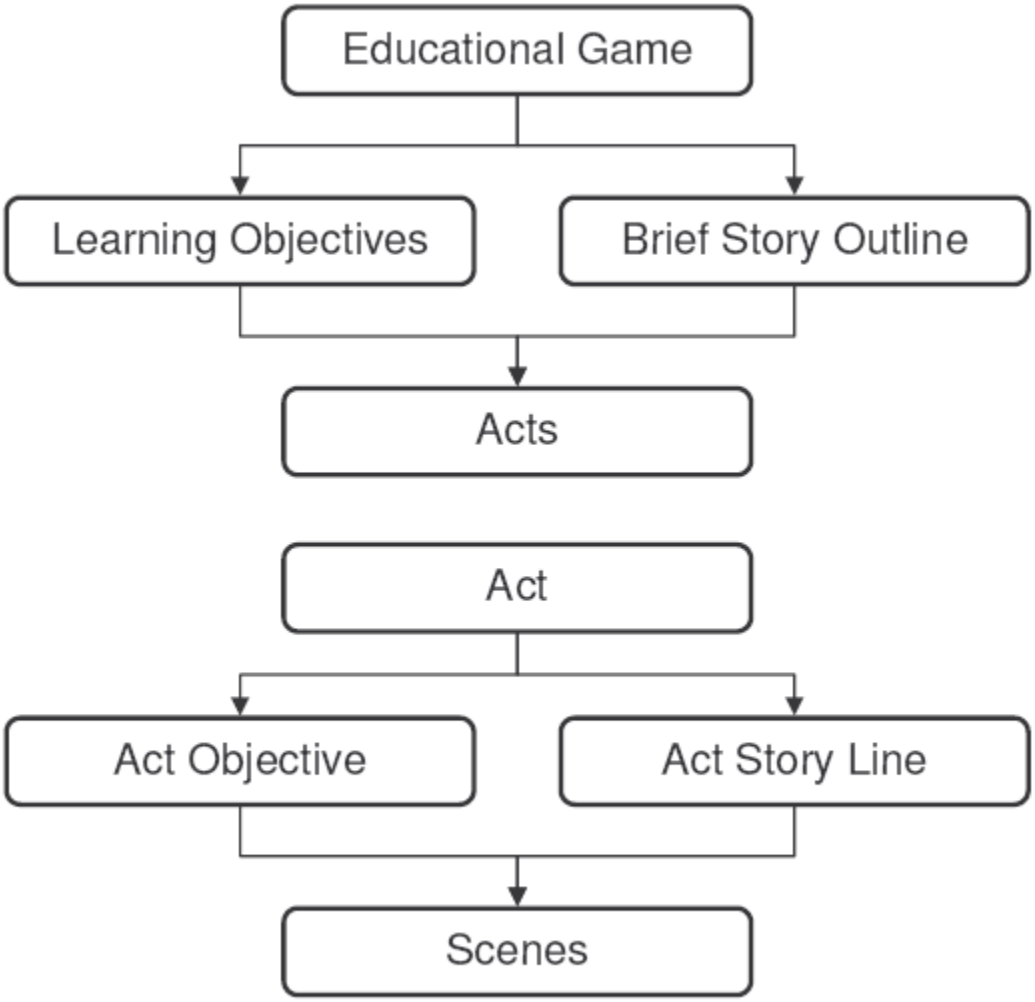


Example 1c: Paul Waelchli

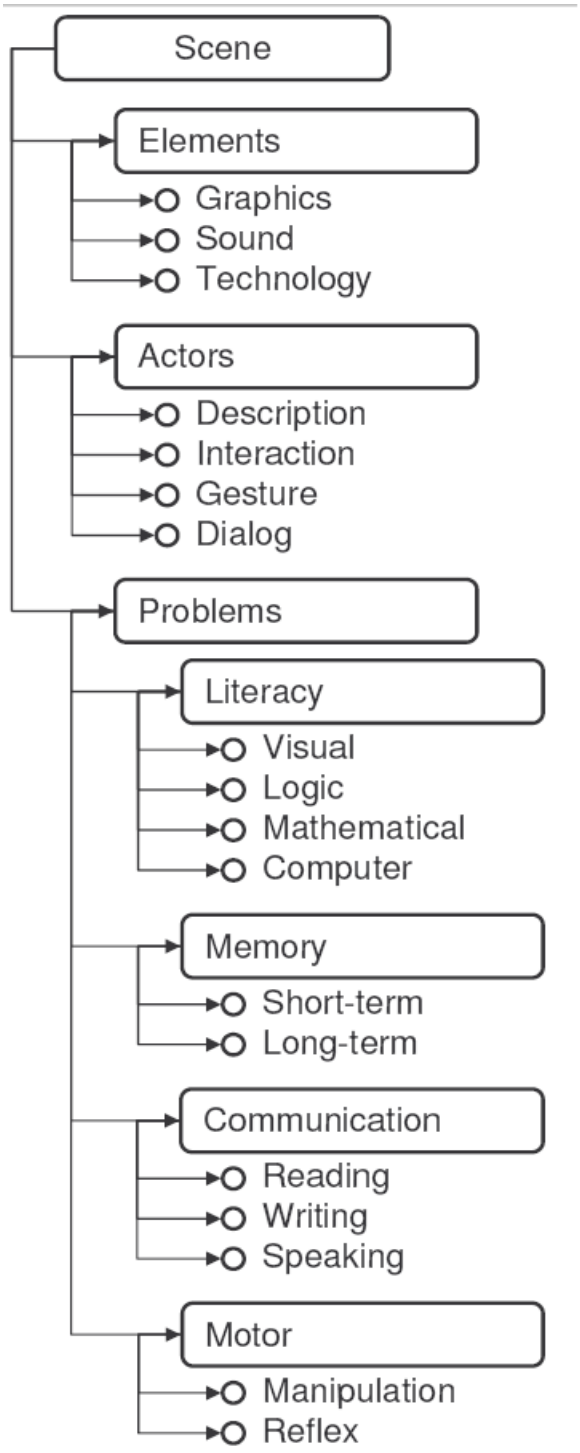
Fantasy Football GOM

1) Game Space
    - o Play: Fantasy football content and play is a recreation choice of about 18 million Americans (source: Fantasy Sports Trade Association, 2007)
    - o Exploration: Freedom of resource path and choice, not 1 right path source
    - o Challenge: Not clear answer for #3, no consensus of opinion
    - o Engagement: topic of invest, student directed outcome, inclusion of student voting
    - o Visualization Space
        - + Critical Thinking: ACRL outcomes
        - + Discovery: searching and collection of data
        - + Goal Formation: research question, #3 draft pick
        - + Goal Completion: voting on draft choice, reaching decision
        - + Competition: OT activity is organized, 2 min drill is informal, “who’s source is best?”
        - + Practice: 2 min drill is in class practice, discussion allows reflection on that practice
        - + Storyline: context of students making a draft choice in their own league
        - + Elements Space
            - # Fun: hopefully the content of entertainment is interesting and even fun
            - # Graphics: limited visual component, graphs through voting
            - # Sounds: no sounds incorporated, could use Fox Sports NFL and ESPN theme songs/intro music
            - # Technology: limited use, mainly computers and internet access to perform research
            - # Actors Space
                - * Drama: librarian created dram of “who to pick” limited role
                - * Interaction: student/librarian engagement, students interact with each other debating who is the best pick
                - * Gestures: librarian movement throughout classroom to assist in engagement and student classroom management
    - o Problem Space
        - + Communication
            - # Reading: content analysis of research/fantasy football findings
            - # Writing: recording of website, date, author, and player ranking
            - # Speaking: classroom discussion on findings, peer communication on ranking
        - + Literacy
            - # Visual: ability to read and understand charts and tables included in rankings
            - # Logical: ACRL outcomes
            - # Mathematical: season stat analysis to predict and judge performance
            - # Computational: averaging draft ranking to determine new value, weighted average of ranking based on source quality
        - + Memory
            - # Short-term: website evaluation
            - # Long-term: application of criteria and process to academic work
        - + Motor
            - # Manipulation: physical navigation of websites
            - # Reflex: no direct application

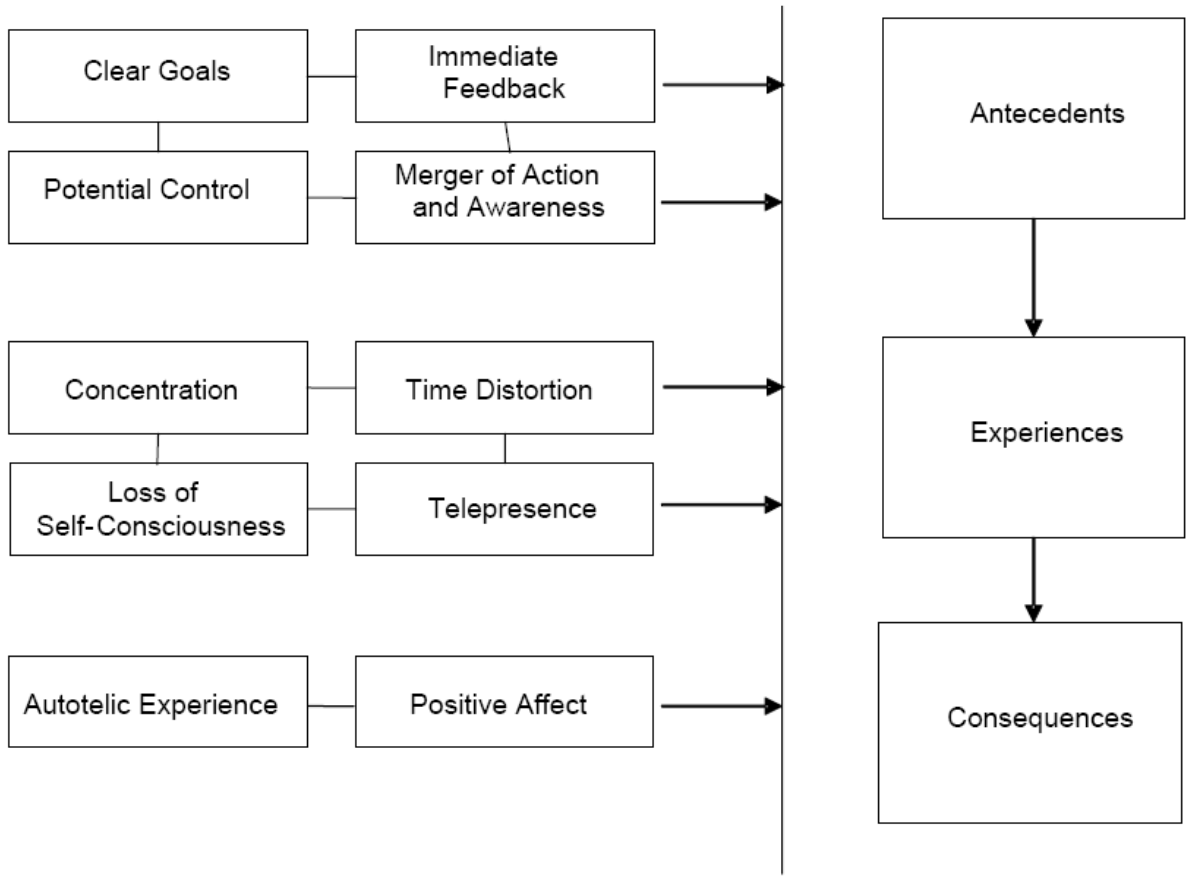
Example 3a: GAM



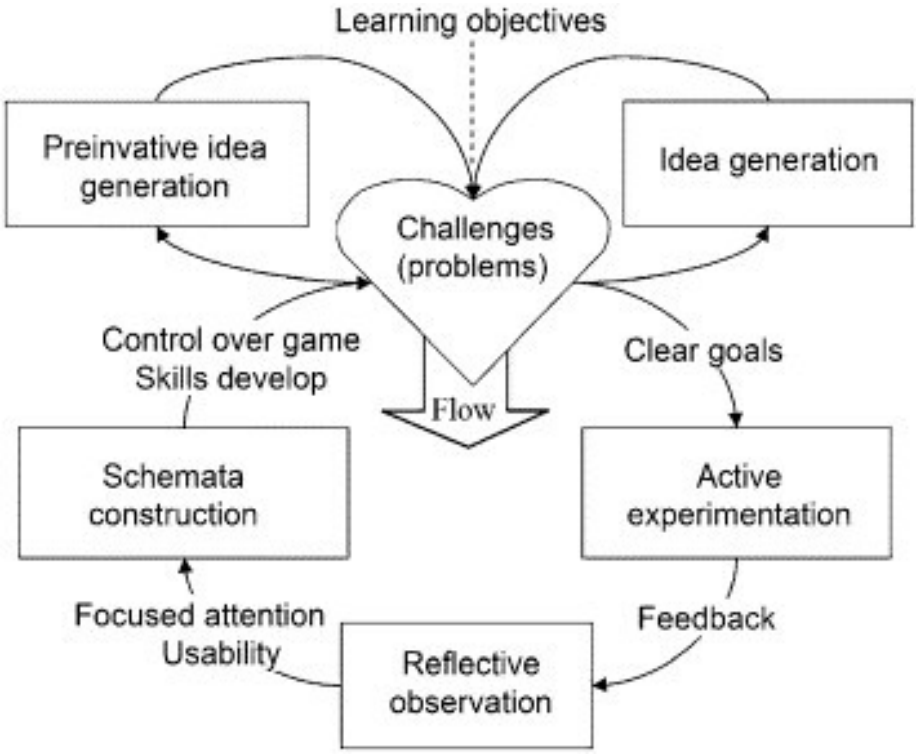
Example 3b GAM part 2



Example 4a: Standard Model of Flow



Example 4b: Kilii's Model



Example 5: Example Evaluation Version 1 of the form, no changes made

Evaluation Form:

Game interfaces are evaluated depending upon which aspect of the game they are most important to according to scale and area of importance. Game Space is the game as a whole, Visualization Space is that seen by the player at a given time. Problem Space is all of the difficulties of the player. Elements Space consists of those basic aspects given by the game at any moment. Actors space are specific action-like interfaces, many of which can occur at a time.

Gameplay: On a fundamental level how entertaining it is to play the game.

Game Space:
Play:
Engagement:
Visualization Space
Game Rhythm:
Problem Space
Activity-Based:
Elements Space
Fun:
Graphics:
Sounds:
Technology:

Story: The relation of the gameplay itself to the challenges it presents. The story is an important aspect of the game's immersion giving reason it it's existence. It becomes more important as the game becomes more complicated.

Game Space
Narrative Spaces:
Visualization Space
Story:
Plot:
Problem Space
Conversation:
Elements Space
Backstory:
Emotive:
Actor Space
Gestures:
Interaction:
Drama:

Challenge: Challenge represents the difficulty of the situation as it changes throughout the game.

Game Space:
Challenges:
Visualization Space
Goal Completion:
Competition:
Challenge:
Problem Space:
Conflict:
Puzzlement:
Complexity:
All Problem Sub-Spaces***
Very Important

Flow: Half-way between knowledge and challenge, Flow experience relates to ideally matching ones current skill level with the difficulty of the situation.
Though not interfaces in the normal senses, flow breaks down into a few aspects than can be rated.
Artifact Usability:
Progression of Challenge and Skill:
Smoothness of Progression:
Clarity of Goals:
Feedback:

Knowledge(learned): Knowledge represents what is gained by the player by playing the game, either in the form of factual knowledge or skills.
Game Space
Exploration:
Authenticity:
Multiple Views:
Gender Inclusiveness:
Transformation:
Tacit Knowledge:
Visualization Space
Critical Thinking:
Discovery:
Goal Formation:
Reflection:
Relevance:
Problem Space
Explicit Knowledge:
Model Building:
Accommodation
Assimilation:

Social Space
Dialog:
Actor Space
Role Models:

Overburdening***
Do not exceed capacity of player
Integration: Integration represents how well the knowledge is integrated into the game itself. This includes both the integration into the game-play and the storyline.

Integration, like flow does not easily break down into interfaces, instead it reflects the integration of the educational (knowledge) interfaces into the game structure instead of remaining outside of it. Functionally this is an evaluation of how necessary the knowledge aspects are.

Example 5: Experimental Reviews 1-6 of Evaluation for Version 1

Game:Museum of London

http://www.museumoflondon.org.uk/English/EventsExhibitions/Games/

These games are nearly entirely flash games based on British or other European history. They cover periods of time between 1300-1700 AD. The games were also likely designed at about the same time and clearly have the same art style and general game-play. It is for this reason that I will review them together as a whole, the differences between them are not substantial enough nor are the games themselves large enough to warrant individual evaluations.

Gameplay is fairly standard between all of them. Generally a problem is introduced that is generally trivial (i.e. Purchasing goods from a shopping list) and it is up to the player to solve the problem using some sort of basic interface related to the problem. Generally this interface is a general click and drag system where they must place the an object at the point where it belongs or is a simple multiple choice question. Wrong answers are met with encouraging hints as to encourage the player.

Gameplay: 10/16

Play: Game play works intuitively and easily. 2

Engagement: Again, relatively low, there is no inherent attachment to how you do. 1

Game Rhythm: A good pace of progression though not forced. 2

Game can be considered activity based loosely. The activity though is basically the entire scope of the game because they are so small. 2

Fun: On a simple level not very 'fun' inherently, entertainment mostly gained from novelty 1

Graphics: Graphics are well designed for the purposes and engaging. 2

Sounds: No

Technology: Nothing used

Story: 7/16 Different standards used because of size, this is fine.

Narrative Space: Used

Story: No real story involved

Plot: Basic game plot does exist 2

Conversation: None

Backstory: exists at least vaguely 1

Emotive: exists at least vaguely 1

Gestures:0

Interaction:0

Drama: Exists well for size 2

Challenge: 7/16

Challenges: 1

Goal Completion: 2

Competition: 0

Challenge: 0

Conflict: 1

Puzzlement:1

Complexity: 0

Inherent Problem Qualities (1-4): 2

Flow: 8/10

The interface worked as well as could be reasonably expected and challenge level did not significantly increase over time, though it was not necessary for it to do so. The games were very short (about 1-2 minutes in length) and becoming adjusted to them took the entire duration. Goals were very clear as well as feedback on your progression and mistakes.

Artifact Usability: 2

Progression of Challenge and Skill: 1

Smoothness of Progression: 1

Clarity of Goals: 2

Feedback: 2

Knowledge: 14/32

The goal of the games was to create a general understanding of the differences between past and current England. Exploration that occurs is relatively minor and only caused by a sort of trial and error in the games. Functionally they are just a guided set of questions about the period phrased in such a way as to give you a better idea about the time. There is time for reflection after the game is finished and during but it is not truly encouraged.

Exploration: 1

Authenticity: 1

Multiple Views: 0

Gender Inclusiveness: 1

Transformation: 2

Tacit Knowledge: 1

Critical Thinking: 1

Discovery: 1

Goal Formation: 0

Reflection: 1

Relevance: 1

Explicit Knowledge: 2

Model Building: 0

Accommodation: 1

Assimilation: 1

Dialog: 0

Role Models: 0

Integration of Knowledge: 9/10

The game itself, at most every aspect is linked inherently to the Knowledge that it intends to teach. The images are made in the style most associated with the time and all means of progression in the game is based around the actual knowledge the game teaches. Overall the only fault of integration is that one can easily progress by random guessing, though that is more of a fault of the inherent game system.

Summary: 55/100

The games themselves are actually quite good for such short games. They achieve their goals adequately and are sufficiently entertaining as to encourage one to play them for their length. Upon finishing this and looking at the basic score, I believe that the size or length of the game should be factored into determining the scaling of a point based review. That considered, this was in my opinion an above average quality set of games for their size and well within the acceptable limits for any realistic goals.

Game: Food Force

http://www.food-force.com/

Food force is a relatively simple game for the PC designed to teach people about the difficulties of many foreign groups and show the importance of groups that supply food to the needy. The game is made up of several sections and there are videos found between each of the sections. Background information on the condition of the group you are helping in the story is frequently mentioned as well as the difficulties of providing aid. Each game section is made of a different mini-game including a helicopter search game, a food formula balance game, and a food airdrop game.

Gameplay is simple in each of the games and is never very challenging. Each game takes a few minutes to reasonably complete and is at a skill level such that most people can expect to succeed at the first try. In order to ensure this, each game has a thorough introduction and tutorial before it is played. If anything this causes the game to become too easy. With generally slipping difficulties and relatively simple gameplay, attachment to the game comes from the storyline.

The storyline itself is a fairly standard rendition of the condition of an island called 'sheylan' in the game. It is beset by a number of problems that are quite common in many regions of the world. The goal of the player is to provide support to the island in order to ensure that the natives do not starve during this especially harsh year caused by military struggle and ecological damage.

Gameplay: 15/16

Play: Game play works intuitively and easily. 2

Engagement: Again, relatively low, there is no inherent attachment to how you do. 1

Game Rhythm: A good pace of progression if somewhat forced. 2

Game is fundamentally activity-based 2

Fun: On a simple level not very 'fun' inherently, desire to play stemmed mostly from story

Graphics: Graphics are well designed for the purposes and engaging. 2

Sounds: Sound is well done and engaging 2

Technology: Graphics are well done but they use a wide variety of technology to support different aspects including a series of videos. 2

Story: 10/16 Different standards used because of size, this is fine.

Narrative Space: Used

Story: Game is basically made out of story, creating a new fictional island the player must help. Story however does not truly develop. 2

Plot: Basic game plot does exist 2

Conversation: None

Backstory: Well established back story for game including the organization and nation 2

Emotive: exists at least vaguely 1

Gestures:0

Interaction:1 Does interact with a population, but interaction generally one sided 1

Drama: Exists well for size 2

Challenge: 6/16

Challenges: 1

Goal Completion: 2

Competition: 0

Challenge: 0

Conflict: 1

Puzzlement:0

Complexity: 0

Inherent Problem Qualities (1-4): 2

Flow: 7/10

Interface worked well, however it should be mentioned that there was basically no actual lead up to anything in the game from a game play or flow perspective. Instances of play were basically closed packages separated from one-another.

Artifact Usability: 2

Progression of Challenge and Skill: 1

Smoothness of Progression: 0

Clarity of Goals: 2

Feedback: 2

Knowledge: 16/32

The goal of the game was clearly to spread knowledge about the existence of food crisis in various locations of the world and to establish the importance and difficulties of helping. The game attempted to do this by showing you step by step how the problem would be solved and by going over the current status of many locations in short videos between missions.

Exploration: 1

Authenticity: 2

Multiple Views: 1

Gender Inclusiveness: 0

Transformation: 2

Tacit Knowledge: 1

Critical Thinking: 0

Discovery: 1

Goal Formation: 0

Reflection: 1

Relevance: 1

Explicit Knowledge: 2

Model Building: 0

Accommodation: 1

Assimilation: 1

Dialog: 1

Role Models: 1

Integration of Knowledge: 5/10

The game itself, at most every aspect is linked inherently to the Knowledge that it intends to teach. The images are made in the style most associated with the time and all means of progression in the game is based around the actual knowledge the game teaches. Overall the only fault of integration is that one can easily progress by random guessing, though that is more of a fault of the inherent game system.

Summary: 59/100

The game itself is actually quite good at achieving its goal and does so through a wide variety of fairly interesting means. The main problem of the game, however, is that most of what is taught in independent of the game itself and is in fact even skipable. This means that the player more

than likely will not be receiving some or even most of the material meant to be taught by the game, decreasing it's educational value. In addition, without the gameplay being built around teaching the lessons, the player will not retain as much from the game in the long term, further decreasing value.

When evaluating this game it has become more clear that one should account for the budget applied to the game and the nature of the material being taught as part of the rubric. Both create a very different game experience and have significantly different focus'.

Game: The Ducking-stool Game

http://www.nationalarchives.gov.uk/palaeography/game/default.htm

The game is an extremely simple word fill-in game in which the player must determine what has been written in the box and write the answer. It follows the same pattern of words over and over again and does not itself give any significant hint on how one might decipher the script, but instead is part of a larger site on the subject. Graphics and interface are meant to and succeed in keeping the game light and relatively interesting.

Gameplay basically consists entirely of novelty and a desire to be able to progress further in the game.

Gameplay: 5/16

Play: 1

Engagement: 0

Game Rhythm: 1

Activity Based:0

Fun: 1

Graphics: 2

Sounds: 0

Technology: 0

There is basically no story besides a short plot of why you are playing. This is all that is really necessary for the games size.

Story: 7/16 Different standards used because of size, this is fine.

Narrative Space: Used

Story: 0

Plot: 1

Conversation: None

Backstory: 1

Emotive: 0

Gestures:0

Interaction:0

Drama: 2

Challenge from the game is very high and reinforces learning elsewhere in the site. For this reason the game itself cannot be looked upon completely separately as it is then basically both impossible and enjoyable in all ways. As it is though, the game is merely extremely challenging.

Challenge: 7/16

Challenges: 2

Goal Completion: 2

Competition: 0

Challenge: 0

Conflict: 1

Puzzlement:1

Complexity: 1

Inherent Problem Qualities (1-4): 3

Flow: 5/10

Interfacing with the game itself proves no problem, however the game appears to have been designed for a skill level above mine. After a half-hour of study of the techniques involved later in the site I still was unable to advance significantly in the game. There appears to be no ramping difficulty in the game which would be extremely useful and feedback is limited to right/wrong and the correct answer. Details on the differences of this word's spelling are left up to the player to research.

Artifact Usability: 2

Progression of Challenge and Skill: 0

Smoothness of Progression: 0

Clarity of Goals: 2

Feedback: 1

Knowledge: 9/32

The game was clearly designed to help a person self-evaluate their progress in reading old-fashioned hand-writing and encourage their development. It itself is not designed to teach per se therefore it falls outside the normal scope of these evaluations. That said, it performs that goal very for a number of reasons.

Exploration: 0

Authenticity: 0

Multiple Views: 0

Gender Inclusiveness: 0

Transformation: 0

Tacit Knowledge: 2

Critical Thinking: 1

Discovery: 1

Goal Formation: 0

Reflection: 2

Relevance: 1

Explicit Knowledge: 2

Model Building: 0

Accommodation: 0

Assimilation: 0

Dialog: 0

Role Models: 0

Integration of Knowledge: 10/10

The game itself really isn't anything except the knowledge it is trying to teach, if anything to a fault.

Summary: 42/100

The game itself falls outside the scope of a normal evaluation by these means and this will need to be adjusted for. Particularly of note is that the game itself is not designed to teach so much as evaluate what has been learned already by the player and to encourage further learning.

Game: Democracy 2

http://www.democracygame.com/

Democracy 2 is a complex political simulation game designed to teach players both about the financial and political workings of the united states government on a more intimate scale than one is normally acquainted. The player basically takes control of the country for one presidential term and attempts to (in theory) steer it towards the best outcome, pleasing as many people as possible. The game itself though technically falls under the category of a simulation as it has no explicitly defined win condition. The game itself is also fairly complex, covering nearly all aspects of governmental control and incorporating the nature of policy resistance as an underlying concept.

Gameplay is not intuitive, but it is encompassing and engrossing. The player is able to cover all aspects of government quickly and thoroughly without the appearance of effort. On a more novel level the simulation aspects a fundamentally entertaining and simple regardless of the overall complexity.

Gamplay: 14/16

Play: Game play works intuitively and easily. 2

Engagement: Again, relatively low, there is no inherent attachment to how you do. 2

Game Rhythm: A good pace of progression though not forced. 2

Game can be considered activity based loosely. The activity though is basically the entire scope of the game because they are so small. 2

Fun: 1

Graphics: 2

Sounds: 1

Technology: 2

There is not a story in the normal sense, but the player creates the story of the game as he goes. There is a basic back story to the occurrences of the game, but nothing developed.

Story: 5/16

Story: 0

Plot: 2

Conversation: None

Backstory: exists at least vaguely 1

Emotive: exists at least vaguely 1

Gestures:0

Interaction:0

Drama: 1

Challenge level is very high, especially earlier on in the game before you are aware of what your actions might mean. Competition can be very high if the game is done in groups or with yourself if played multiple times. It is easily possible for the game to bring about unexpected results in the long run leading to replayability and forcing critical thinking.

Challenge: 14/16

Challenges: 1

Goal Completion: 2

Competition: 2

Challenge: 2

Conflict: 1

Puzzlement:1

Complexity: 2

Inherent Problem Qualities (1-4): 3

Flow: 8/10

The interface is very challenging earlier on but quickly becomes intuitive simply because of the amount that the player will find themselves using it. Challenge seems to progress gradually as the player builds up ability but this is often just because they have increased the challenge for themselves with early poor decisions. This may or may not be intentional but has the same effect in the end.

Artifact Usability: 1

Progression of Challenge and Skill: 2

Smoothness of Progression: 1

Clarity of Goals: 2

Feedback: 2

Knowledge: 26/32

The goal of the games was to create a general understanding of the differences between past and

current England. Exploration that occurs is relatively minor and only caused by a sort of trial and error in the games. Functionally they are just a guided set of questions about the period phrased in such a way as to give you a better idea about the time. There is time for reflection after the game is finished and during but it is not truly encouraged.

Exploration: 2

Authenticity: 2

Multiple Views: 1

Gender Inclusiveness: 1

Transformation: 2

Tacit Knowledge: 2

Critical Thinking: 2

Discovery: 2

Goal Formation: 1

Reflection: 2

Relevance: 1

Explicit Knowledge: 2

Model Building: 2

Accommodation: 2

Assimilation: 2

Role Models: 0

Integration of Knowledge: 8/10

The game itself is of course linked directly to what it teaches in almost every way. One can get around this by having no appreciation for what they are changing, but the lesson is a fundamental part of gameplay. If one is to do well in the game they will have to learn something from it.

Summary: 75/100

The game is very well done by most reasonable standards. I lack the the personal knowledge to judge the accuracy of the economic and political concepts inherent in the game, but I believe that from what I have seen it could be used as a college level aid. It teaches it's lessons well and completely as an inherent concept of the game. Gameplay is inclusive of a wide spectrum of decisions and is quite engaging.

The Typing of the Dead

Them Demo of the game was used for evaluation purposes. The full version only adds more levels and options. The game progresses through a number of levels where-in the player is attacked by zombies. In order to defeat them the player must type out words as quickly as possible. The game rewards both speed and accuracy.

Gameplay: 13/16

Game is entertaining and engaging at its core even though its sole activity is typing.

Play: 2

Engagement: Nothing really to attach player 2

Game Rhythm: A good pace of progression though not forced. 2

Game can be considered activity based loosely. The activity though is basically the entire scope of the game because they are so small. 1

Fun: On a simple level not very 'fun' inherently, entertainment mostly gained from novelty 2

Graphics: Graphics are well designed for the purposes and engaging. 2

Sounds: 2

Technology: Nothing used

Story: 9/16 Story itself is fairly limited to the moment, but the game has a storyline that develops over time, encouraging the player to play more. Unable to fully determine with demo version, but it seems like this trend will continue.

Narrative Space: 1

Story:1

Plot: 2

Conversation: 1

Backstory: 0

Emotive: 1

Gestures:0

Interaction:1

Drama: 2

Challenge: 12/16 Challenges solid and consistent

Challenges: 2

Goal Completion: 2

Competition: 1

Challenge: 2

Conflict: 2

Puzzlement: 0

Complexity: 0

Inherent Problem Qualities (1-4): 3

Flow: 9/10

Artifact was merely use of keyboard to type with obvious input requirements. Game progressively gets more difficult as the player learns to type more effectively. Very good progression if at times inconsistent.

Artifact Usability: 2

Progression of Challenge and Skill: 2

Smoothness of Progression: 1

Clarity of Goals: 2

Feedback: 2

Knowledge: 8/32

The knowledge transferred is more a skill therefore this section does not apply as consistantly.

Exploration: 0

Authenticity: 2

Multiple Views: 0

Gender Inclusiveness: 0

Transformation: 0

Tacit Knowledge: 2

Critical Thinking: 0

Discovery: 0

Goal Formation: 0

Reflection: 2

Relevance: 1

Explicit Knowledge: 0

Model Building: 0

Accommodation: 1

Assimilation: 0

Dialog: 0

Role Models: 0

Inclusiveness: 10/10

The game consists entirely of the activity it intends to teach, typing.

Summary: 62/100

The game is extremely good at encouraging the player to continue and to provide an environment to learn typing skills. The game is lacking in few ways, but the score would seem to imply significantly more. Most point loss is in the knowledge section, because of incompatible teaching goals.

Further development should include this difference.

Example 6
Evaluation Form Version II

Determine the importance of each section. The total should add up to 100%. When evaluating ask yourself how well the game follows certain aspects mentioned below. Not all will always be used, but most usually will (or should be).

___/20
Gameplay: Always 20% value. Gameplay is the overall quality of playing the game. It represents how enjoyable the game can be and on what levels. A game that is fundamentally enjoyable if it has good gameplay.
Questions to ask yourself are:
Is the game enjoyable to play?
Is this only overall, or also at any given time during play (is it always enjoyable)?
Is game-playing engaging (does it remove you from your surroundings or make you wish to continue)?
Does the game media (visual and audio) draw your attention and further the game experience.

___/___(Max 5-15)
Story: Between 5-15% depending upon game size and ability to implement. Story at its highest levels is the quality of the writing and the interactions between characters, but on a simpler level it is the players grounding in the game. It answers the question of why they are doing what they are doing, and provides interest to the player to find out what happens next.
Questions to ask yourself are:
Is the game long enough to warrant any involved story?
If so, what is the quality of this story, how engaging is it as a whole?
Does the game have at least a basic plot that can be followed by the player?
Are the game's characters believable? Is there significant interaction with them? If not, was there any way for this to occur given the type of game? Would it have been meaningful?

___/___(Max 10-15)
Challenge: Between 10-15% depending upon design of game. Games that act as a medium for conveying information (games that have low integration of knowledge) should have a lower score than games that have good integration. This area does not focus as much on the difficulty as the quality of the challenges presented. A good challenge is one that is clearly present and solvable by the player. This area represents how much effort a player will put into the game.
Questions to ask yourself are:
Does the game have clearly designated goals?
Are the individual problems that make up these goals clear and challenging?
Are the goals themselves complex enough to retain interest?
If goals or problems are not clear, is it in such a way that promotes interest (puzzling, etc)
Does the game promote competition in any way?

___/___(Max 5-15)
Flow: Between 5-15% depending upon size of game. The larger the game (at least the larger the expected play time in a session) is the more important Flow is for the game. It represents how fundamentally engrossing the game is. It reflects both the challenge of the game and the rate in which it teaches. A game that has good Flow is a game that will always be challenging its player with harder and harder problems but the perceived difficulty from the player will be the same. This cannot be observed, though, when the player is restricted in a situation because they do not know what needs to be done or cannot correct themselves easily.

Questions to ask yourself are:

How hard is the interface with the game to use? Does this detract from or add to improvement.
Does difficulty increase with skill level? Is this at the same rate or does it jump too high often times?
Is the player always aware of their current goal?
Does the play receive quick and useful feedback? Do they know what they did wrong?

___/___(Max 30-40)
Knowledge: 30-40% depending upon the goals of the game. Knowledge reflects what is taught and how easily the player can learn it. A game should always be judged against its own goals.

Questions to ask yourself are:

Can the player search for the information themselves to learn it? Is this even possible?
Does the game provide time for the player to reflect on the game?
Does the game relay information through events such as dialog between characters?
Does the game teach through both passive and active means?
Does the game focus on abstract concepts?
If so, does it help a player to develop a mental model of the issue?
Does it focus on changing already existent ideas related to the concept?
Does develop tacit understanding of the concept from playing the game?
Does it provide opportunities for critical thinking on the subject?
If not, does it cover much information given the length of the game?

___/10
Integration of Knowledge: 10%. This reflects how well integrated knowledge is into the game. A game that is made of minigames about driving a boat and was attempting to teach about poverty would likely not have very good integration. Basically, integration is the relation of the problems of the game to the material being taught. A test, for example, is a terrible game but has perfect integration of problems and desired lessons to be taught.

Total ___/100

Appendix B

Intermediary Works

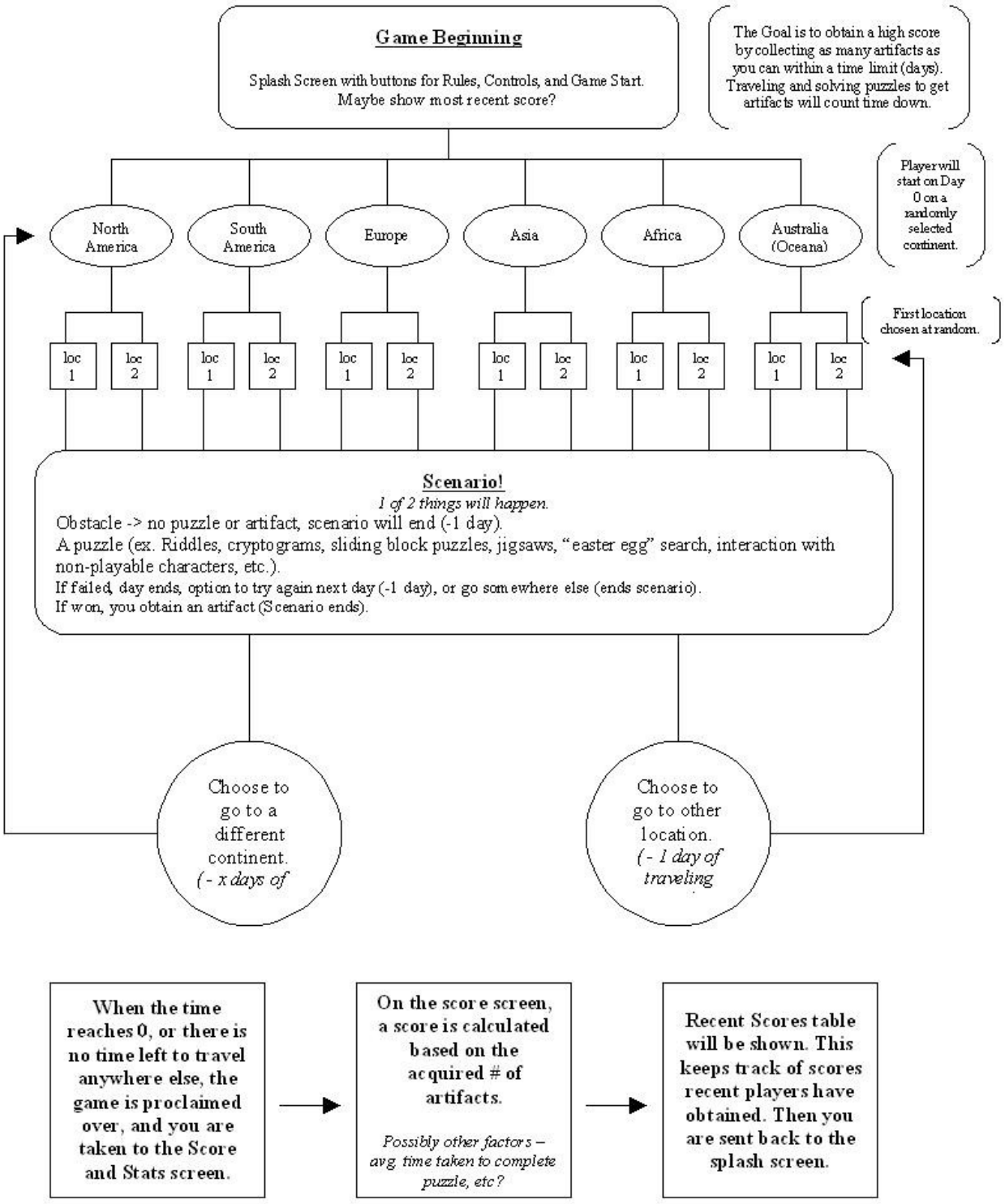
B-1: Game Design Flow Chart

B-2: Original Game Notes

B-3: First Period Progress Report

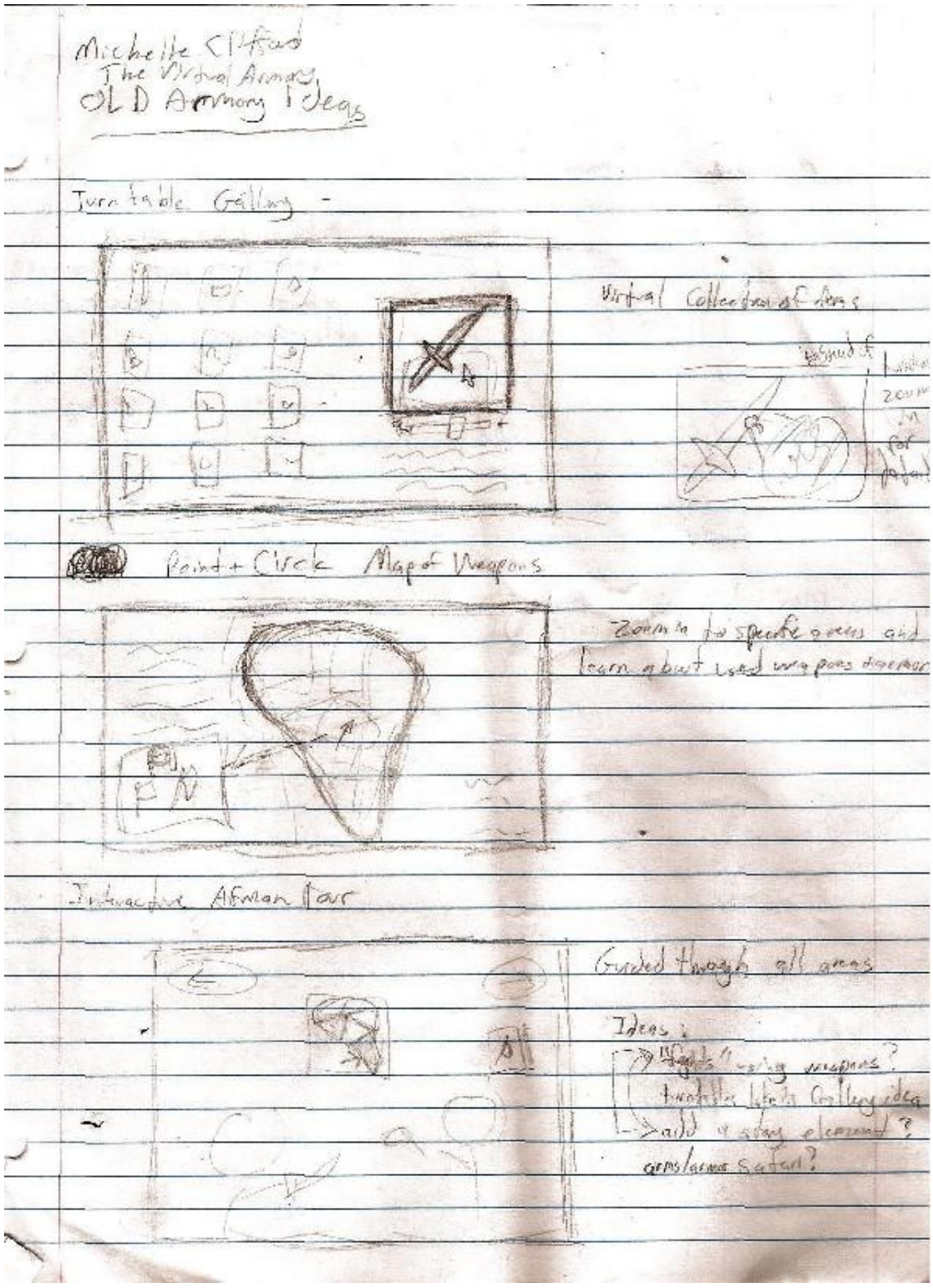
B-4 Quicktime VR Research

B-5 Early Concept Art



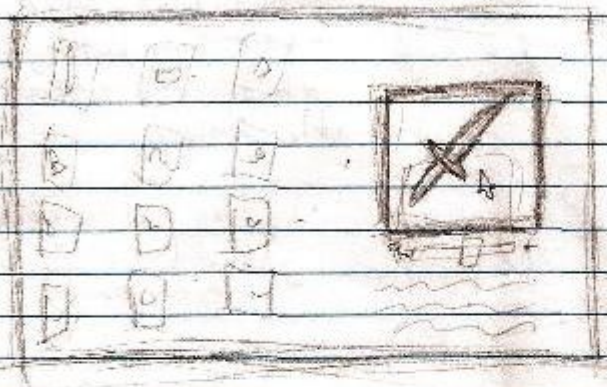
B-1: Game Design Flow Chart

B-2 a-d: Original Game design Notes



Michelle Clifford
The Virtual Armory
OLD Armory Ideas

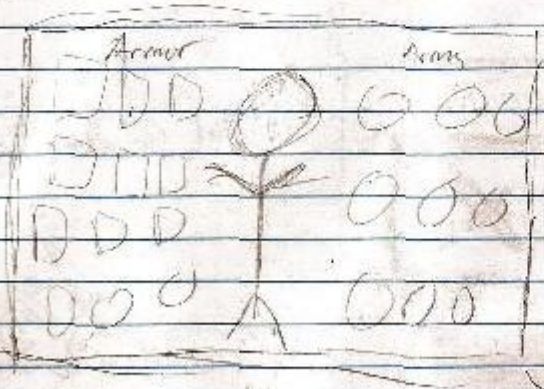
Turn table Gallery -



Virtual Collection of Items

Point + Click Map of Weapons

Create-An-Avatar Warrior



Make dolls and dress up warrior for battle, learning about arms + armor on the way.

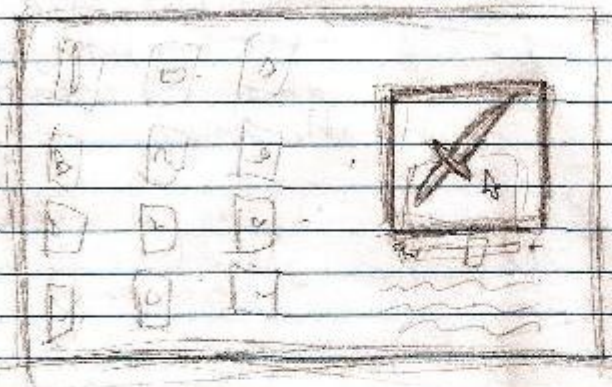
Then maybe see how well your dress-up works in battle in Orin ceremony

Design your own!

"Family Tree" of weapons
(Throwing knives)

Michelle Clifford
The Virtual Armory
OLD Armory Ideas

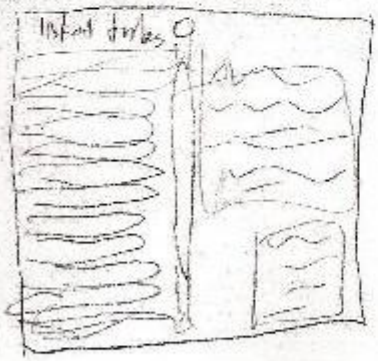
Turn table Gallery -



Virtual Collection of Items

Point + Click Map of Weapons

Michelle Clifford
The Virtual Armory
Old Game Idea



Beginning - Picka tribe

Only use a few "starter" tribes -> 3 or 4

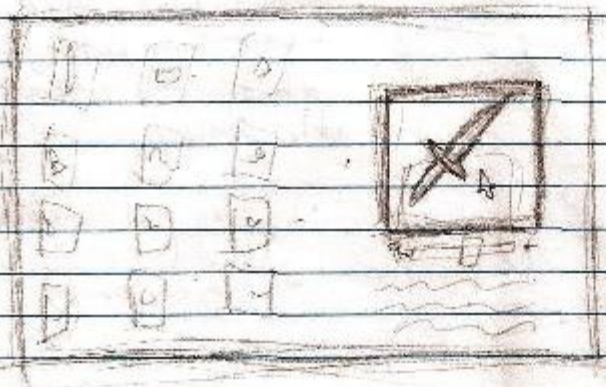
other tribes included in game via trading + su

On the hunt for items + Materials

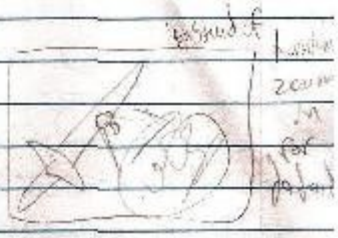
- point + click with res. Hs

Michelle Clifford
The Virtual Armory
OLD Armory Ideas

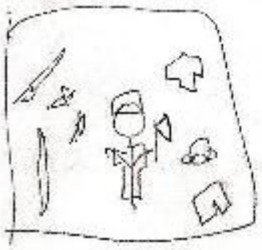
Turntable Gallery -



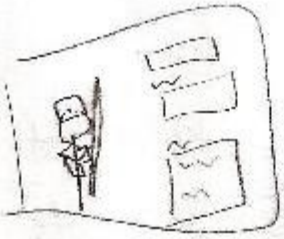
Virtual Collection of items



Paint + Click Map of Weapons



Dress up interior
with things you've made



Maybe add a function to show off your
finished character via email or html link
?

B-3: First Term Progress Report

Amanda Strnad
2/25/2008

This term, I was primarily responsible for creating everything but the artwork in the game. This involves figuring out the necessarily logic, as well as inserting the artwork I get from Shelli and Edmund. I also kept up the websites for both the database and for the game.

You can find a full set of the games iterations on the website at http://users.wpi.edu/~strnad/IQP . There has been great improvement since we started in both the artwork and the abilities of the game.

Specifically, I created the cryptogram and riddle puzzles, as well as hint mechanisms for both of these. The hint mechanism will allow us to put in questions or information that normally we could not expect to be reasonably solved by everyone. I've picked out a number of riddles from the Exeter book to use that will be themed to the game. I've managed to simplify two of the riddles enough to include, and am working on doing the same with the others. This is because most of the riddles are too long to fit on the screen, without shrinking the text and making it hard to read. I also want to keep some of the flavor of the original riddle.

Although I did not do much with the magnifying glass puzzle, I was able to ensure that it gives feedback for an incorrect answer, and integrate the puzzle into the game.

Along with the puzzles, I had to create a way to randomize everything so that the puzzles would not be predictable when the game is started. Due to limitations in Flash, the locations of puzzles could not be randomized, but the player will not be able to predict the order of any puzzle.

I also created the entire framework of the game, which controls the flow. I also make sure the game watches for time to run out and the game to end, and tell the player their score.

Since I got visuals in two completely different styles, I did some work to unify them. I think I succeeded partially, although I am no artist. I've also carefully watched the file size and worked to reduce the amount of load time the player must sit through.

B-4:QuickTime VR Research

During part of A term and most of B term I had been tasked to research the possibility of using Quicktime VR (QTVR) as a media method for displaying artifacts from the museum online. While at the time it was deemed neither time nor cost-effective, future groups might want to utilize this knowledge.

Software Research

Early on I began to seek out what software would allow us to create the necessary Object VRs. Apple's main QTVR site provided me with some leads, and after some searching I came to the conclusion that we'd either want to look into using VR Worx or SpinImage DV as our authoring software. SpinImage had the added advantage of having bundles that included a small turntable (for creating the 360 degree object VRs), as well as the fact that the software was being used by Barnes & Noble for the exact purpose we were planning to use it for.

Hardware Research

With software options covered, I decided to look into options for Hardware, namely a turntable. I went to the Academic Technology Center on campus and talked with Bruce Fiene, the Video Systems Specialist. He gave me some advice on what would have to be done as far as utilizing a camera, but he also said there was a chance there was still a turntable left over from some project years ago. While he went to try and locate it, I spent some time researching how much it would cost for us to build our own turntable. I found one really good tutorial, which taught us how to build a decent turntable with parts you could find in a junkyard for about $100. Ultimately this would probably become the path we'd have to take since the turntables provided by SpinImage wouldn't be large enough and Fiene was unable to locate the turntable he thought he had after weeks of searching.

Implementation Research

While it was seeming more and more unlikely we'd be using QTVR, I did take some time to look for tutorials on how best to implement QTVR into a web-based application. Coincidentally enough (given the path we took in the project later) I found a tutorial to put QTVR media into Flash applications, which seemed like the most logical approach for the guidelines of the Virtual Armory.

Conclusions

Since we were already a bit behind schedule, and the acquisition of software and hardware seemed time-consuming and cost-prohibitive ($100 at minimum, $1500 at maximum), we decided not to utilize QTVR for the project, and instead leave it for the possibility of future groups.

B-5: Early Concept Art and Reference Photos

When we were entertaining the idea of hand-drawing a majority of the art, Ed looked at a lot of reference photos of vehicles and even a couple backpacks from the 20s and 30s. From those photos he made some rough sketches for the game should the group have planned to go in that direction. Ultimately that track was abandoned, but the concepts have been saved here, as well as some reference photos.

Figure 4: The rucksack belonging to Jack Kerouac (reference photo)

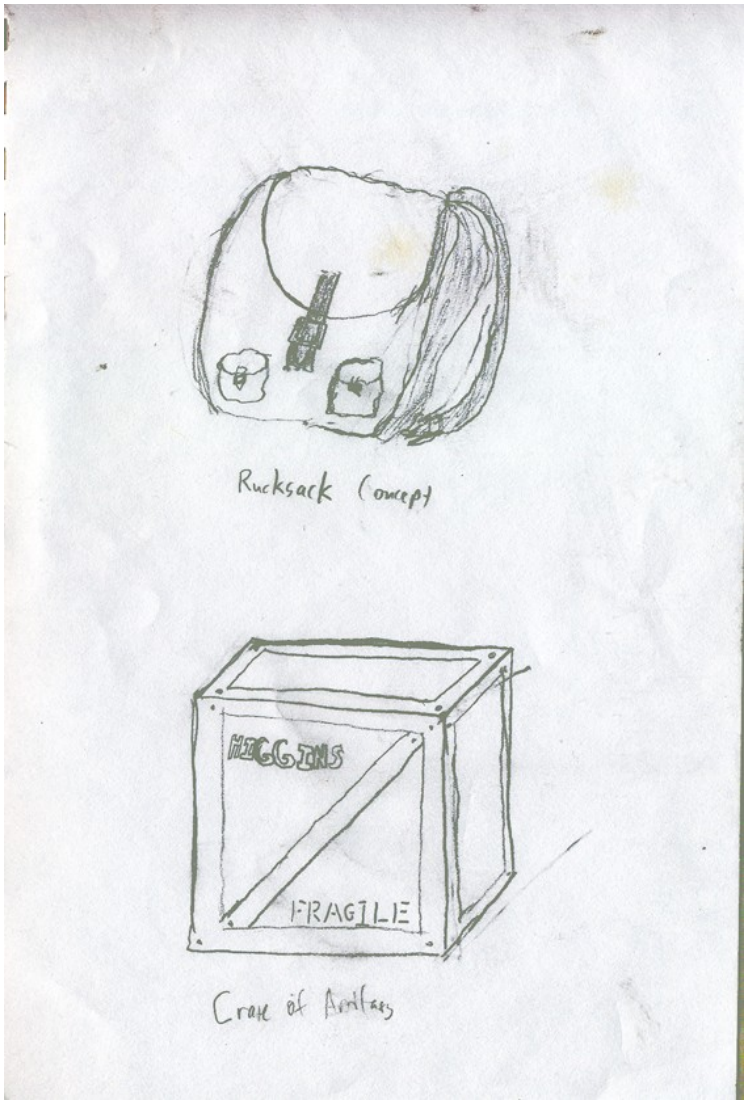


Figure 5: Rough Concept sketch of a backpack that would've been the artifact bag. Eventually replaced by a crate, which is also seen here in a conceptual form. The final version of the crate used for the game was drawn and vectorized by Michelle Clifford.

Figure 6: A version of a Ford Model B Deuce Coupe from the 1930s (ref. photo)

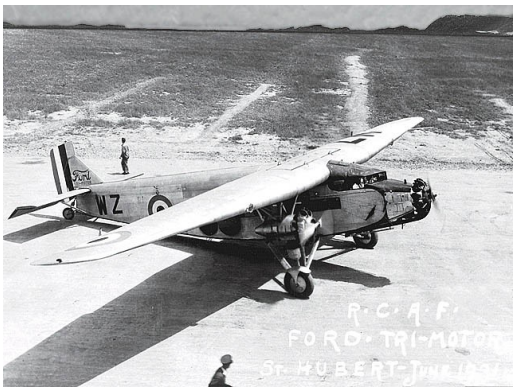


Figure 7: Ford Trimotor Plane (ref. photo)

Figure 8: Boeing 247U Passenger Plane (ref. photo)

Figure 9: SS Pennsylvania: A passenger liner in service during the 20s and 30s (ref. photo)

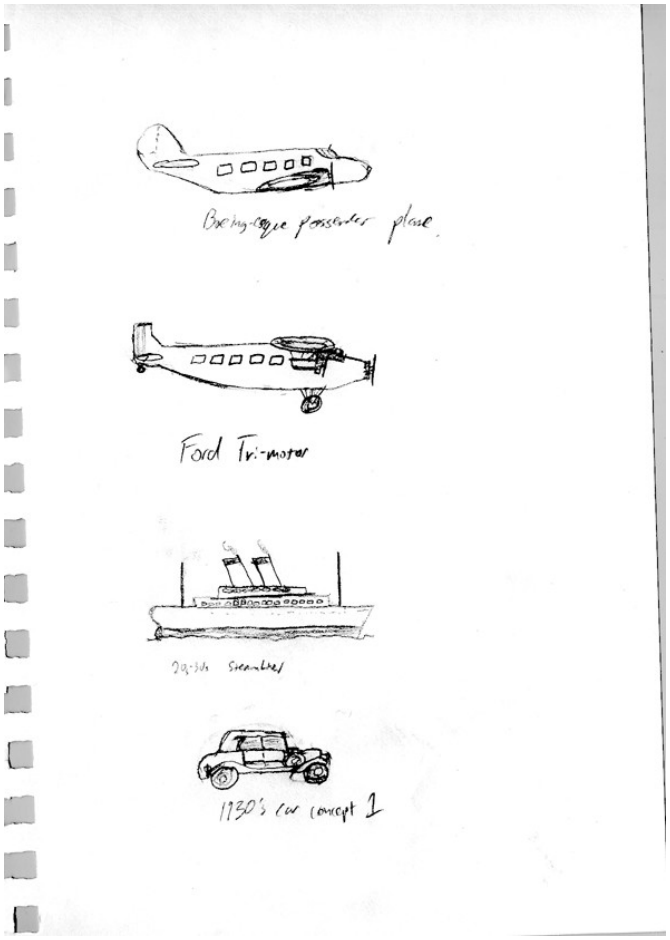


Figure 10: Concept sketches of 4 vehicles based on the reference images shown above

Appendix C

Step by Step

Download and install FastStone Resizer from http://www.faststone.org/FSResizerDetail.htm.

Open FS Resizer.

Select the files you want to add the watermark to.

While they are selected, click "Add" so that they will be affected.

Choose a folder to output the images to. You probably want to pick an empty folder so that you don't overwrite any original images.

Check "Use Advanced options (Resize...)"

Click it

Go to the Text tab.

The appropriate text is

©Higgins Armory Museum

($C1)

The following settings should be selected:

Set the text to be right aligned

The font should be Tahoma, 10, Bold

Check shadow and background.

Set the foreground to black

Set the background to grey (235, 235, 235) for the rgb values

Check round

Position: bottom right

XY offset 0, 0

Opacity 45

click ok

click convert

wait. This may take hours if you are trying to change all the images, although each individual image does not take an unreasonable amount of time.

congrats, it's converted!

Appendix C

Group Bio

From Left to Right

Kevin Piala

Major: System Dynamics
Graduation Year: 2009

Project Contributions: Creation of Game Evaluation System, Compilation of Final Report

Michelle Clifford

Major: IMGD-Art
Graduation Year: 2009

Project Contributions: Art Design for Game, Assistant Coder of Higgins' Hunt

Edmund Dubois

Major: IMGD-Art
Graduation Year: 2009

Project Contributions: Art Design for Game, Pre-Compilation of Final Report

Amanda Strnad

Major: Computer Science
Graduation Year: 2009

Project Contributions: Creation of Database; Lead coder of Higgins' Hunt