

Serious Games in Information Literacy:
The Creation and Analysis of Games to Teach
Information Literacy



WPI

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ABSTRACT

The purpose of this IQP was to find or design a game that could teach information literacy, or information seeking skills to students, and which could be used by Gordon Library to reach more students. The group began by researching the core concepts of both information literacy and basic game design, as well as searching for examples of games in information literacy which already existed. We also looked for examples of educational games in other fields. The team then created a prototype for an information literacy game based on our research, and eventually made a suggestion for a game that could potentially be made in the future.

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INTRODUCTION

While the growth of sophistication in interactive media started out rather slowly, it has since skyrocketed in the modern age, making its way into people's everyday lives in the forms of computers and computer games. The latter, usually created and designed for entertainment purposes, has also seen use in the field of education. Interactive media seems ideal for learning, yet games that have been meant strictly for entertainment have become extremely popular, making their way into homes and, more recently, onto the internet, while those meant for education have not enjoyed the same success. People would often gather to play games meant for entertainment together, sometimes planning entire evenings around these games. These games were "fun", their purpose being to give people feelings which they want to feel, like happiness, fear, a sense of satisfaction, as well as some sort of feeling of detachment from their everyday lives.

Educational games are, understandably, generally received in an entirely different manner. They are meant to be used to teach an individual a certain set of skills, and once this goal has been achieved, the game is often discarded and forgotten about, similar to a textbook, as it has no other primary use other than for learning. They tend to give players less positive feelings, typically those of boredom, if they don't have a strong motivation to learn the material (Conati, 2002). With the rising use of digital databases, it seems very appropriate to teach one how to use these databases for research with a computer game. This concept is a part of what is known as Information Literacy. According to Gordon Ambach in a 1989 report from the Presidential Committee on Information Literacy, a person who is information literate is "able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information."

For this project, we analyze video games from a strictly analytical point of view. To accomplish

this, we set two guidelines for the analytical process, which are addressed in Richard Rigby in his 2011 book *Glued to games: How video games draw us in and hold us spellbound*: The first, in Rigby's words, is to "stop thinking *primarily* about the content of video games (things like the guns, explosions, spaceships, and magic swords) when evaluating a game experience," since the content is only the superficial aspect of a game, rather than the depth of it. The second is to "stop thinking, 'people play games because they are fun.'" This tends to be the knee-jerk response when people are asked why people play video games.

This project was realized with the purpose of merging these two types of computer games together: to find or create a game which had a primary focus of teaching the player, but still provides the same feelings of tension, joy, and mental detachment that fun games provided.

This paper discusses the background research necessary to understand basic game design, the definitions of Information Literacy and its educational standards, reasons why people play videogames, and explains why a game is an ideal teaching tool. Next, this paper will discuss the experience of attempting to create an information literacy game. Finally, this paper will discuss the results of the game and our research, what we learned from the process, and how we recommend our ideas can be built upon in the future.

BACKGROUND

Research on Information Literacy

Information Literacy at WPI

A study was conducted in 2012 with the intent to observe researching habits of students at WPI. This study was conducted by an IQP group consisting of 4 students, Foley, Mann, Mitchell, and Moulton. In this study, 13 IQP groups were given a research topic, and a 20-minute interval in which they were to find the best 5 sources that they could locate for their research topic using internet search tools, such as Summon, Google, and Google Scholar. The study found that most of the students used a similar search strategy, which was to start out with Summon, then proceed to use Google and Google Scholar. According to the study, “fewer than half of the groups used any specialized academic databases.” Furthermore, if the full text for a source was not immediately available, students would often simply give up on that source entirely. Lastly, the study not only found that “few students used filtering or proper keyword search strategies,” but many students simply copied the research question that they were given into their search field, and didn’t attempt to narrow down the results. The study concluded by stating that “the observations indicated a clear need for continued research education, with emphasis on filtering techniques, finding full text, and advanced keyword searching.”

Another IQP group performed a similar study, observing student research habits, although this project assessed student research skills through a formal quiz. This group also consisted of 4 students, Dao, Katzoff, Lipson, & Pham. The group had 165 first-year students take an online test which was comprised of “11 questions mapped to the Association of College and Research Libraries (ACRL)

information literacy standards.” The group determined that a passing score for the test would be a score of at least 70%, a score which only 40% of students achieved, meaning 60% of students who took the test failed it. In their analysis, the IQP group states that students “did very well on questions related to the ethical use of information...but they did poorly on questions related to search strategies.” The group concluded by recommending that the library “focus on developing students’ search strategy skills.”

For these reasons, we chose to have our project focus on the teaching of search strategies.

ACRL Standards

The main educational focus of this project, the Association of College and Research Libraries (ACRL) Standards, list in great detail what an information literate individual should be able to do. These standards are generalized by the ACRL as the ability for an individual to:

- Determine the extent of information needed
- Access the needed information effectively and efficiently
- Evaluate information and its sources critically
- Incorporate selected information into one’s knowledge base
- Use information effectively to accomplish a specific purpose
- Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally

With a total of 5 standards, each with its own subtopics, we chose one specific idea to focus on, standard 2.1.a, which states that an information literate individual “Identifies appropriate investigative methods (e.g., laboratory experiment, simulation, fieldwork)” (Amback, 1989).

Games

Why People Play Games

When asked about why people play games, the common first response one would get is that people play games because they are fun. However, fun does not necessarily mean the same thing for every person. What one person finds fun about a video game another may find boring. For example, one may enjoy games that allow the player to explore, and are relaxed about the stress of the actions in the game. However, a different person may enjoy a game with a carefully crafted, linear path laid out by the game designer that the player would go through, designed around a player's ability to react quickly to increasing levels of danger.

While these elements of a game can entertain the user, there are more subtle things happening during a gaming experience that are satisfying the player on a more subconscious level. According to Richard Rigby in his 2011 book *Glued to games: How video games draw us in and hold us spellbound*, there are three primary feelings that video games provide to the people who play them: competence, autonomy, and relatedness.

Competence, the feeling of learning and mastering new concepts, is a need that fuels our desire to grow stronger and smarter. Even in the early months of human life, babies learn to master basic actions such as walking and talking, despite the great time of struggle in between the first attempt and first success. In video games, this need is satisfied in games that provide constant feedback to the player. More specifically, games often divide themselves into separate sections, often labeled "levels," or "missions," depending on the in-game context. Commonly, these levels will start out being very simple, having the player performing basic tasks so that the game can be sure the player knows the basic controls before presenting more difficult situations to the player. As the game progresses, the levels become more difficult, each presenting the player with a new challenge, constantly building upon their skillset.

This method of creating a game feeds the need for competence, and it is the reason that many game developers take this approach when structuring a game. By dividing a game into levels, the player is allowed a sense of accomplishment at the completion of each level. However, if each level were the same, or if they were all too easy, the sense of accomplishment would quickly dwindle into one of monotony. For this reason, game designers build upon the player's skill by increasing each level in difficulty. This allows the player to feel that they're mastering the skills that they were giving at the start of the game, and keeps that satisfaction of competence coming with the completion of each level.

Autonomy, the feeling of having freedom of choice, or the desire to use our "free will," is best reflected in games whose gameplay does not follow a set path. This idea could exist in something as small as being given an object to get from point A to point B in a game, and being given an option to choose one of two paths. On a much bigger scale, a game could drop the player into a virtual world with absolutely no instruction, leaving them to discover the contents of the game for themselves. The embodiment of this idea would be the viral game *Minecraft* by Mojang.

In *Minecraft*, once a game is started, the player is placed into a virtual world with randomly-generated terrain simulating biomes such as savannas, deserts, tundras, and mountainous regions. The player is given absolutely no instruction, no goals to accomplish, and thus is free to do as they please within the game. The player is able to gather resources in order to construct various tools and build whatever sorts of structures they can think of. The game's terrain continues to generate as the player explores the landscape, allowing the player to explore a virtually infinite game world. The amount of freedom in *Minecraft* has led it to not only become an immensely popular game, surpassing 14 million purchases on February 3, 2014 according to the official Minecraft website (minecraft.net/stats), but it has increasingly been used as a teaching tool, as shown by websites such as minecrafteu.com.

Games like *Minecraft* allow the player's need for autonomy to be satisfied by giving them near-limitless choices in the context of the game.

Relatedness, the feeling of having a meaningful connection to others, can easily be seen in our human desire to foster quality friendships, as well as fulfilling intimate and familial relationships, simply for the sake of having someone else to support and feel supported by. Camaraderie, a sense of belonging, and feeling that you matter to others are all examples of relatedness that are found in video games. Online multiplayer games give people the chance to interact with others, to play cooperatively or competitively, without the hassle of finding a friend whose schedule and tastes line up with your own. An entire genre of games is dedicated to this possibility, entitled Massively Multiplayer Online games (MMO). Games of the MMO genre typically have hundreds of players playing at once, allowing them to interact with each other in whatever manner the game is designed to allow them to do. Of course, many video games also allow people to play them together in the same room, giving the players a more personal interaction with whoever they are playing with. Online games are an efficient platform for satisfying the need for relatedness.

While there are many other ways to satisfy these human desires, games have three advantages that make them especially good at satisfying these needs. These advantages are the immediacy, consistency, and density of games.

Immediacy refers to the availability of video games. In his 2011 book *Glued to games: How video games draw us in and hold us spellbound*, Richard Rigby writes, "video games have [the] ability to transport us to rich worlds filled with opportunity and challenge almost instantly." Whereas activities like sports require preparation in order to participate, video games are as easily accessible as walking over to the computer or console, turning the device on, and booting up the game. A sports

event requires traveling to the field or court and outfitting oneself in the proper equipment; this can happen only if the scheduling can be properly coordinated between all of the participants. A video game can have the player playing a sports game, or even being the leader of a virtual empire, without any of that hassle. The immediacy of video games allows players to get any of the three needs satisfied virtually whenever they want. The player could be playing a game with either their friends or complete strangers in minutes to satisfy their need for relatedness.

Consistency refers to the high likelihood that a game will provide for the player the needs that they crave. Obviously, this cannot be said for the quality of every single video game in existence, as that depends on the quality of the development of the game. Rather, consistency refers to the fact that, when one plays a video game, the expected experience will match up with the desired outcome. Outside of video games, numerous factors can interfere with consistency. For example, you can't participate in the championship sports competition because you got injured during training, or you have to find a temporary place to live because your house has to be treated for an insect infestation. Quality video games, however, present to the player their rules and expectations and stick to them, allowing the player to feel confident that they won't be let down. There is little doubt that working hard towards a goal will result in completion of that goal. This helps a player feel at ease, knowing that, for example, their house in *Minecraft* will still be there, ready and accessible, whenever they come back to the game, whenever they want to come back to it, and any addition put onto it can be made without worry of complete destruction of the house by a bad rainstorm, or a natural disaster such as a tornado.

Density of games refers to the ability of video games to deliver frequent satisfaction. A high quality game will give the player constant feelings of satisfaction, the most obvious example being that of games built with the "levels" structure. A game can give the player hundreds of levels to complete, each

instilling the player with feelings of competence. A game could also give the player multiple goals to complete. The player can complete at their leisure, which gives them a sense of autonomy. Finally, a game's well-structured rules can allow for a platform in which many people can come together and participate in endless enjoyable experiences, limited only by how much content can be produced by the developer, and in some cases, such as *Minecraft*, the players themselves. Unlike in real life, where people are restricted by basic aspects such as time and space, video games allow for any number of unlimited possibilities. A player can start with an empty field spanning miles in each direction and have an entire city build, populated, and running within a few hours, or could play through the entire life of a character in a few days, each giving the player the satisfactions they desire.

The immediacy, consistency, and density allow for easy satisfaction of the desires for competence, autonomy, and relatedness.

Serious Games

Game-Based Learning

According to Maura Smale in a 2011 article for *Journal of Library Innovation*, the idea that games are strictly a leisure activity is a common criticism of game-based learning, while education is strictly serious work. Therefore, any combination of the two is usually dismissed as an ineffective waste of time. However, there are many elements of games that assist learning, for example:

- Players are allowed to assume a new identity, immersing them in the game experience.
- The interactive nature of games allows players to perform tasks and receive feedback, gaining simulated hands-on experience with the game's goals.
- Risk-taking is easily done and encouraged in games, as players are allowed to fail a task and attempt it again as many times as they like, using what they learn from their failures in each subsequent attempt until success.
- Games are designed such that players will learn basic skills in the beginning of a game, and as the game progresses, these skills are greatly expanded upon, requiring the player to expand their own knowledge of these skills and combine them in order to complete these later stages of the game.

These factors come together to form a product that heavily encourages learning. The immersion given by the player assuming a new identity allows the player to essentially mimic the role presented in the game. This makes the learning feel more natural, and less forced upon the player, as the knowledge suddenly seems much more relevant to the player. For example, it would feel more natural for a player to learn about a fireman's duties if they were to mimic the role of a fireman in a game, rather than being told by a fireman about their duties. Some commercially successful games use this role to foster the player's interest about certain periods of history, motivating them to want to learn more about these periods. The *Assassin's Creed* series developed by Ubisoft Montreal sets the player in the role of a fictional character during historical time periods such as the Italian Renaissance in *Assassin's Creed II* (2009), and the American Revolution in *Assassin's Creed III* (2012). During each of these time periods, players are able to explore re-creations of important cities and locales from these time-periods, interact with in-game representations of important historical figures, and read documents written by these

people. The ability to interact with a virtual Leonardo Da Vinci and share his frustrations of attempting to build and test a flying machine can foster interest for the player to research the topic more than it would in a history lecture. Playing the role of a Native American during and after the American Revolution can call the player's attention to the hypocrisy of the freedom that the colonists sought more than a textbook could. Historical games have the power to motivate students to learn more about their settings. In a more general scenario, if one were to learn a task, they could read a manual for the task, or they could be put in a simulation of the task through a game.

Potential Barriers to Game-Based Learning

While we've seen that game-based learning can be effective, there are also barriers to game-based learning. The first one is that making a game can be costly. A game needs a lot of time, effort, and often money, in order to be made well, as opposed to a presentation, which can be made much quicker, with no monetary cost. Another barrier to game-based learning is that games take time to learn. While a presentation or a lecture presents the information to the student in a very straightforward manner, presenting information to a student through a game requires the student to learn about not just the information being taught to them, but how the game works as well, which to many professors would likely seem as time better spent learning the material. A third barrier to games is that accessing the games could be difficult, whether the game is digital or not. Digital games may have certain hardware or software requirements in order to be played, and non-digital games must have enough physical supplies for the game to be played. If any of these problems occurred, the game would not be able to be played by everyone, and so the game will be a wasted effort to some. The last barrier to games is that some students simply won't want to learn through games. Just like how many students prefer different teaching methods, a handful of students will simply not want to learn from a game, and thus a game will not be an

effective means of learning for those people.

Game principles for Information Literacy Instruction

According to Smale in a 2011 article, “Game mechanics and principles are the structures of and actions or strategies used while playing a game, and may also be used in information literacy.” As research includes hunting for information across a broad spectrum of knowledge, games can include this concept as well. The *Legend of Zelda* series puts the player in the middle of a vast virtual world which contains a large amount of items designed to aid the player in conquering the various puzzles in the game. This idea is very similar to the spirit of research, in that students search for various sources and pieces of knowledge that aid them in completing their task, this task often being a research paper. The puzzles in *Zelda* always require some use of the items that the player has collected, forcing them to weigh the relevance of each item’s use toward the immediate puzzle, just as students would weigh the values of various sources. Eventually, *Zelda*’s puzzles become fairly complex, requiring the combined use of many different items for one puzzle, just as many sources come together to form the basis of a research paper.

Successful Serious Games

Code Spells

While many serious games struggle to find the balance between being a game and being an educational tool, a few have been successful. Codespells is a serious game designed by the UCSD School of Engineering to help teach programming skills. Writing code involves using a sequence of letters and words to produce a result. Coincidentally, casting spells is often done in a similar way. By connecting

the thing you're trying to teach with a gaming aspect, you can create a game that truly feels like a game while being educational. Spells are simply coding methods. Here is an example of a spell:

Level 1 Spells

Flame Spell:

Used typically to catch objects in the world on fire.

```
import june.*;

public class Flame extends Spell
{
    public void cast()
    {
        Enchanted target = getTarget();

        target.onFire(true);
    }
}
```

Figure 1: CodeSpells example code

CodeSpells takes the user (a wizard) on a series of quests. Having goals that can be achieved throughout the game keeps the user engrossed. As the wizard completes the quests, he or she is able to cast more advanced spells. Rewarding people for success is another way to keep them involved in a game. Advanced spells can be unlocked in the game by acquiring a magical staff. Here's a list of some of the quests you go on during gameplay:



Figure 2: CodeSpells Quests

MIT Education Arcade

The MIT Education Arcade is a website that has serious games that focus mainly on STEM learning (Science Technology Engineering and Math).

Radix is one such game that focuses mainly on teaching biology and math skills. In Radix, an evil ruler prevents the inhabitants of a world similar to earth from learning about science. The user is part of a secret organization that is trying to take science back. Like CodeSpells, Radix has a series of quests that the user receives feedback on. Unlike many other serious games, Radix is meant to be used concurrently with a class and even can give feedback to a teacher on how a student using the game is doing. Here's a sample image from Radix:



Figure 3: Screenshot from Radix

Lumosity

Lumosity is a website that uses a series of small games to help improve cognitive skills. After surveying the user on their goals and testing them in a few different cognitive skills, Lumosity builds a personalized training program to help you improve. Lumosity takes a very scientific approach to learning through games and has research backing its effectiveness. One benefit to Lumosity compared to an individual serious game is that there is much less risk of the user not liking the game. In addition, the games are very simple and easy to pick up, so the barrier to entry is low. They also are the type of games that even people who don't regularly play games might enjoy. Here is an example of a mini game from Lumosity:

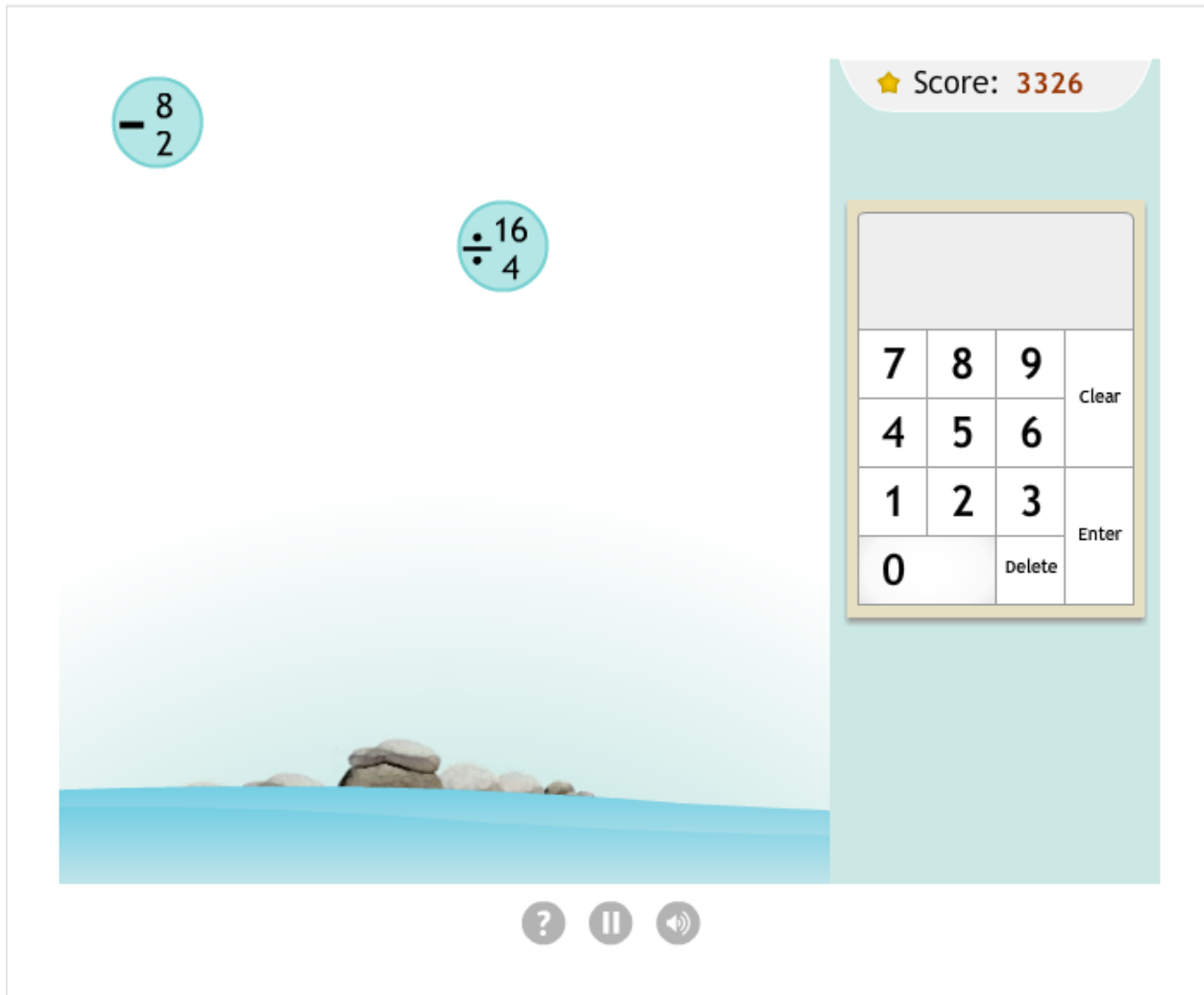


Figure 4: Example Lumosity game

Informational literacy games

During our research process we inspected several informational literacy games which were on different information seeking skills. Some of them teach how to improve searches, while others define which data source is better to use (Smale 2012). Information literacy games are also divided by non-digital which is more commonly used by librarians during classroom sessions, and digital which are used mostly on library websites. Most of the information literacy games were created as part of

research in information literacy by librarians or computer science students under librarians advising (Smale 2011).

Library Scene: Fairfield Edition

Library Scene is an educational game that teaches students about library functionality and library instruments. In general this game is an interactive presentation, students who play in Library Scene go through predefined sets of continuously changing scenes. All scenes in this game mostly look the same and purely relate to each other. Figures 5 and 6 show average scenes where a group of friends discuss advantages of a library service and how this service can help them in the process of studying. Because the game lacks ethos, the user is less likely to remember the information presented than from a more engaging game. The graphics of this game may seem confusing because of some inconsistencies. Each scene of the game is a combination of real photos and drawn character images, which can distract the user.



Figure 5: Library Scene game, scene one



Figure 6: Library Scene game, scene two

Scott Rice and Amy Harris Information Literacy Game

This information literacy game is a digital board quiz game. The board is a combination between a Monopoly board and a Trivial Pursuit board. While the game contains many different looking squares, the only action the user takes regardless of where you land is answering a question on information literacy. Essentially, this game takes an information literacy quiz and packages it inside a game. The connection between the game and educational components is a bit weak, and there is a clear focus on the educational component. A game like this is very similar to a quiz that gives you the correct answer to each question after answering.

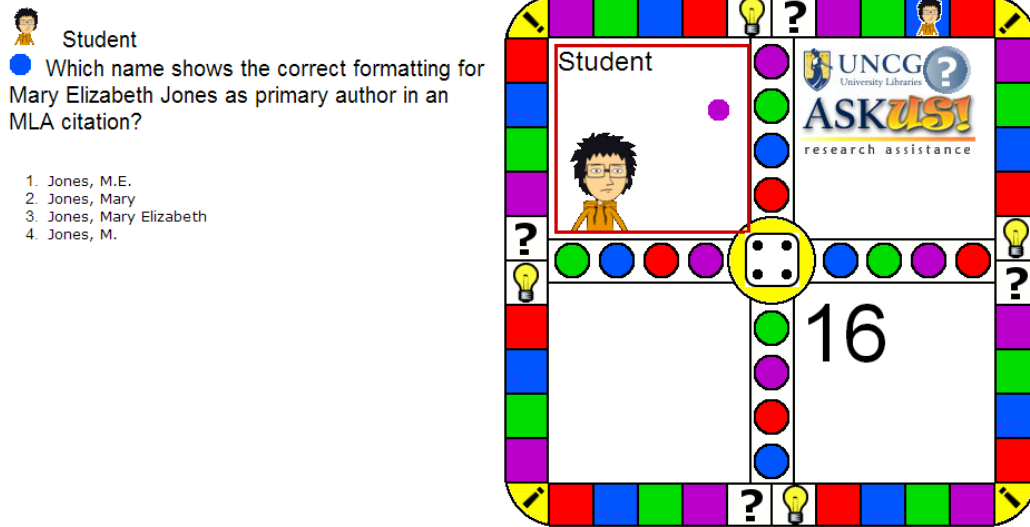


Figure 7: Scott Rice and Amy Harris Information Literacy Game interface

Secret Agents in the Library

Secret Agents in the Library is an informational literacy Flash-base game created at Lycoming College. (Broussard 2010). The game focuses on finding information and is designed for freshman. The game consists of both digital and non-digital components. The digital component is a Flash-base computer game which is located on the university website. The game has a series of different mini games, shown in Figure 8. The non-digital component is students play in groups and compete between groups. Some mini games encourage students to interact with the library. For example, the game might suggest the user look for a code which is hided in a book with a specific title.

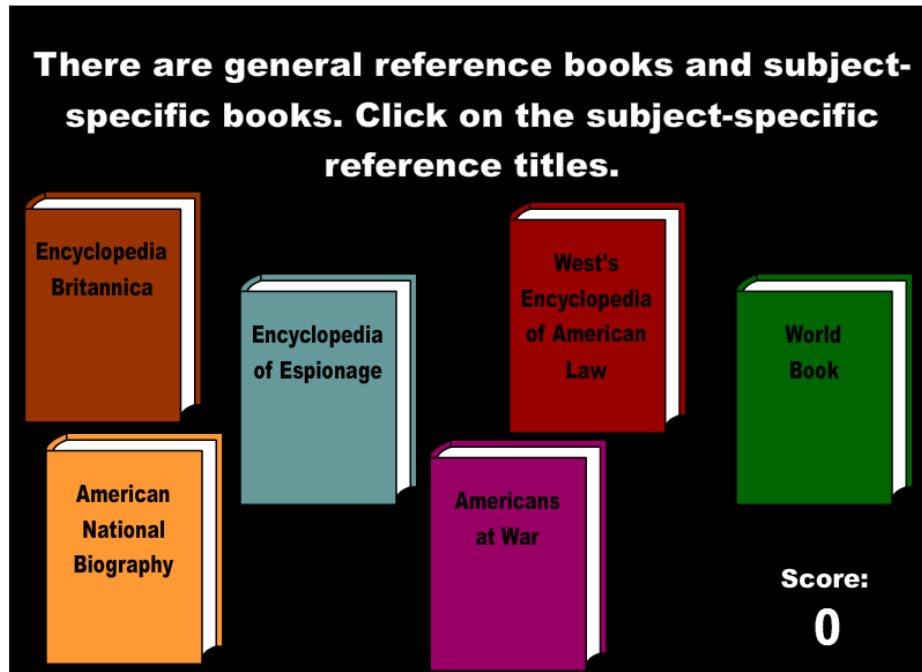


Figure 8: Secret Agents in the Library mini game

Gaming Against Plagiarism: Frenetic Filing

Frenetic Filing is the second in a series of three games, entitled Gaming Against Plagiarism, designed to teach the player about different forms of plagiarism. The objective of the game is to collect books that come onto the screen by the library door and bring them to the evaluator, who, after a brief waiting period, will allow the player to retrieve the book, after which the evaluator will give a brief explanation about what is wrong with how the text is cited. The player then must identify which type of plagiarism this falls into, and deliver the book to the correct file. The player is allowed 2 mistakes in delivering the book to the correct file, where a third mistake results in the player losing the book, forcing them to start over with a new book.

Most aspects of this game put emphasis on fast-paced, simplistic gameplay and quick decisions. The music of the game is upbeat and steady, giving the game a sense of urgency, and the 8-bit style of

the music supports its similarly-8-bit graphics style and sound effects. This style of visuals and sounds supports the simplistic feel of the game. The explanation from the evaluator for what is wrong with each book is always very short and distinctive for each category of plagiarism, minimizing the time the player must spend reading, allowing the game to maintain its fast-paced flow. There are no fewer than 3 books at a time in front of the library door, ensuring there is never a moment where the player must wait for more books to come in. This leads to the player always having several books to bring to the evaluator, who can be given several books at once. This system ensures that the evaluator always has a book ready to be filed, as the time it takes for a book to be evaluated is less than the time it takes to file a book and bring back another one.

Unfortunately, the game struggles in two key areas: a reason for the player to replay the game, and accessibility for people with no prior knowledge to the types of plagiarism. The game starts off giving the player a list of the 7 types of plagiarism and their definitions, and this screen may be revisited anytime during gameplay. The definitions are also displayed on the top of the screen when the corresponding folder is moused over. While this system does allow someone with no knowledge of plagiarism play the game, it doesn't allow the game to have the flow that it works to create. Anyone who isn't already familiar with these terms will have to read each individual definition before deciding where to file the book, which brings the game's flow to a grinding halt. This could be fixed by adding a simplified version of the game in order to introduce the player to each definition gradually, so that only after being familiar with each term will the game give the player a faster challenge. This idea is toyed with in the tutorial before the main game begins, in which the player is guided through the steps of picking up the book, bringing it to the evaluator, and filing it. Unfortunately, the tutorial never introduces any of the 7 terms for plagiarism. Rather, the game throws them all at the player at once, not giving the player a

chance to learn all of the definitions without having to stop the game.

Frenetic Filing's goal seems to be to test the player on their knowledge of these 7 terms for different types of plagiarism instead of to teach them about their definitions, and this test is only fun for one round in the game. Frenetic Filing lacks any sort of scoring system; it gives no numerical value, or any indication at all, by which the player can measure how fast they completed the game. More importantly, this prevents the game from showing the player if they have improved their score after another round. If a player knew how fast they completed a round, they would be more compelled to try to beat that time, to improve their speed. Unfortunately, since no such scoring system exists, the player is given no compelling reason to replay the game once it has been completed. This is counterintuitive to the process of learning; one must practice a concept in order to master it, but the game does not urge the player to do this. Frenetic Filing presents a neat concept, but fails to grasp what would help a new player learn the different types of plagiarism.

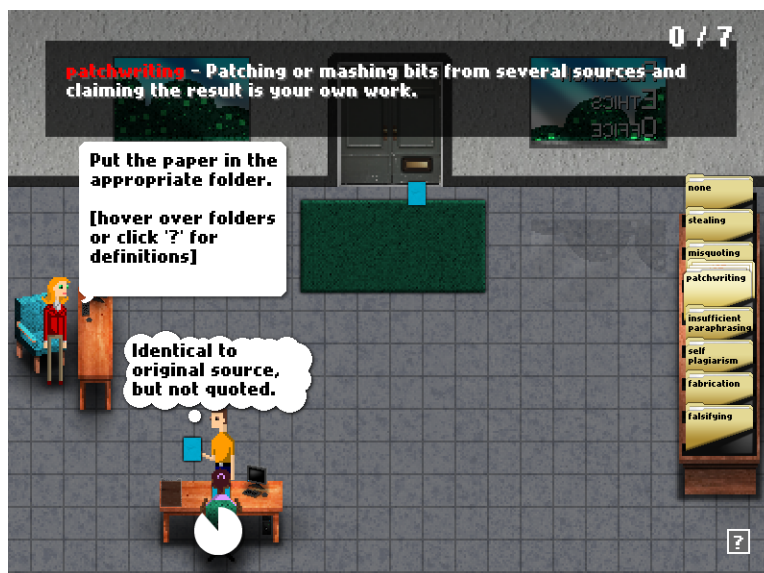


Figure 9: Frenetic Filing gameplay

METHODOLOGY

Research Methods

Game design research methods are different from scientific research. In many cases the goal of game design research is unclear and usually starts from searching for a creative game idea.

Crowdsourcing is one of the best tools for this, since the union of opinions and partial ideas of many specialists or related people can produce a creative game idea. This idea or concept can be supported by scientific facts or statistical data.

Testing games is an important part of game design research. While playing different games, a researcher can obtain knowledge about different aspects of the game, such as gameplay, atmosphere, or difficulty, which he can't obtain from anything else, and understand why a game has been successful or not by personal experience. One can also determine what kind of game elements helps it to reach players feelings or keep a player playing for a long time.

Different people in a game may test it in completely different ways. For example, an artist might stand on top of a building in a game to see how the details look from afar. Or, they might zoom into an object to see how it looks up close. A programmer may try to break the game and find bugs. No one is testing a game simply for fun. Testing should always have a purpose.

Technical Aspect of Game

One of the goals for this game is popularity and availability, most educational games including informational literacy games are not popular in a broad audience, because they don't have a visual appearance which can give a player a good first impression and most of those games are hard to find without a direct link to them.

Our game can overcome these issues if we use modern game development technology during prototyping the game. First, we looked at the scale of our project and resources which we have, since we have only three member in our research group and not all of us have strong programming and designing experience, we decided to make a small scale game with better quality elements like gameplay, graphics and story, rather than a large scale game with poor elements. This is why we decided to make our game in two dimensions, rather than three dimensions. It will be better for our game to use a third person perspective than a first person one. This allows us to make engaging graphics using our resources. Also, we are planning to make the game for a web browser using the latest web development technology like HTML5 canvas. This allows players to easily access for the game and easily share it.

Game Balance

Serious games are games where people are learning some educational material by playing, and where gameplay and education can not be separated. The educational game CodeSpells is a good example of such a game. In this game actual programming on the programming language Java is a part of the gameplay. However, many educational games including most information literacy games that were tested during our research process have a lack of balance between the educational aspect of the game and gameplay. Authors of these games provide a lot of learning material and a small portion of poor gameplay which in most of the cases is just an interactive quiz about previously learned material, as seen in Figure 10. Some games like Library Scene do not have gameplay at all and the game seems more like an interactive presentation where the player can choose which slides he wants to see first. Information literacy games' gameplay in most cases is totally disconnected from the learning material. For example a player can read 10-15 minutes of material, and then play some totally unrelated game.

Balance between gameplay and provided material is crucial for serious games including information literacy games, since without it games lost their value as an education tool.

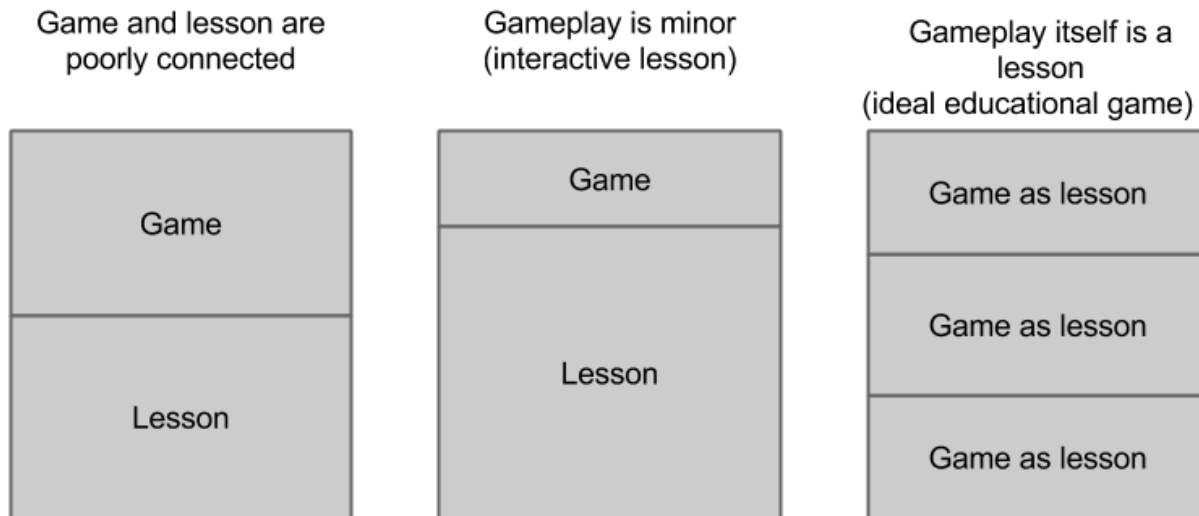


Figure 10: Balance between game and educational aspect

Our Game's Concepts

Scalability and segmentation were crucial when making our game. The game is divided into separate parts, called islands. Each island represents one ACRL standard or substandard. This allows us and future research teams or external game developers to make additions to the game. Also, the changes of one part of the game will not affect the other parts, which gives more stability in game functionality.

During research of information literacy games, we noticed that their gameplay is complicated. Some games provide long instruction guides; even people with gaming experience may have a problem understanding their gameplay. Reading of instructions makes those game not attractive for people, as seen in Figure 11. Simplicity of understanding game rules is the main factor of a game's success. For a game to be successful, gamers have to be able to start playing a game without learning any game rules,

and slowly gain an understanding for the rules as they play. Commercial games are more successful in teaching new players how to play the game than the information literacy games we researched. Usually in commercial games the difficulty of the game increases slowly, and the interface of the game has dynamic suggestions.

Availability of games is another factor of their success. Games have to be available on different devices, including mobile devices.

The Information Literacy Game

[Play the Game!](#)

Rules

Players take turns moving around the board, answering questions. There are four categories, and two questions must be answered correctly from each category in order to win.

The Categories are:

- Category 1 - Choose Your Resource
- Category 2 - Searching/Using Databases
- Category 3 - Cite Your Sources/Avoid Plagiarism
- Category 4 - Library Wild Card

As you answer a question correctly from each category, you will receive a light corresponding to the color of the category. Once you receive a light for each of the four categories, you are placed on the Home Stretch.

On the Home Stretch, you must answer a question from each category correctly in order to advance a space. Once you have answered all four categories correctly, you win!

There are 3 special squares you can land on:

- > Light Bulb: This space will ask you to compare two different websites, or evaluate one website for different kinds of information. These websites will pop up in new windows, so be sure to close them when you are done.
- > Exclamation Point: This space will randomly do one of several things, such as giving or taking away lights, allowing you to choose an opponent to lose a turn or a light, etc.
- > Question Mark: This space will randomly choose a category and ask you a question. If it is a category you have not yet answered correctly, you will receive a light for a correct answer.

Single Person Play

Single play is much like the group game, with two additions. For regular category questions (those questions that you get when you land on a colored square), you have 20 seconds to answer the question. If you do not answer within the time provided, the question will be marked wrong. In addition, you are only allowed 4 wrong answers for regular category questions. If you get a fifth answer wrong, then you lose the game.

Keyboard Commands

- > D - Roll the die to start the next player's turn
- > H - Opens/closes the Help Window
- > S - Toggles game sounds on or off
- > 1-4 - Select the correct answer to questions

Figure 11: Information literacy game guide rules

Game structure

The game is constructed from three abstract section which represent the different study process stages, as seen in figure 12.

- Village - Educational section, where the player can gain knowledge about a subject and game rules by speaking with game characters and reading obtained game documents.
- Cave - Practice section of the game, where the player can practice what they learned from the village section by completing small quests, or virtual assignments.
- Boss - Examining section of the game. The game tests the player's knowledge and skills and grades the player based on the results of this section.

This game structure broadly follows the model of classical role-playing games (RPG) like Diablo or Massively multiplayer online role-playing games (MMORPG) like World of WarCraft. The worlds of those games are divided into similar sections. For example, they have villages or towns where players can peacefully communicate with other players or non-player characters (NPC) and get information about the game world, or places for practice where they can practice their gameplay skills, and find useful items, which they can use on other challenges against the bosses of levels.

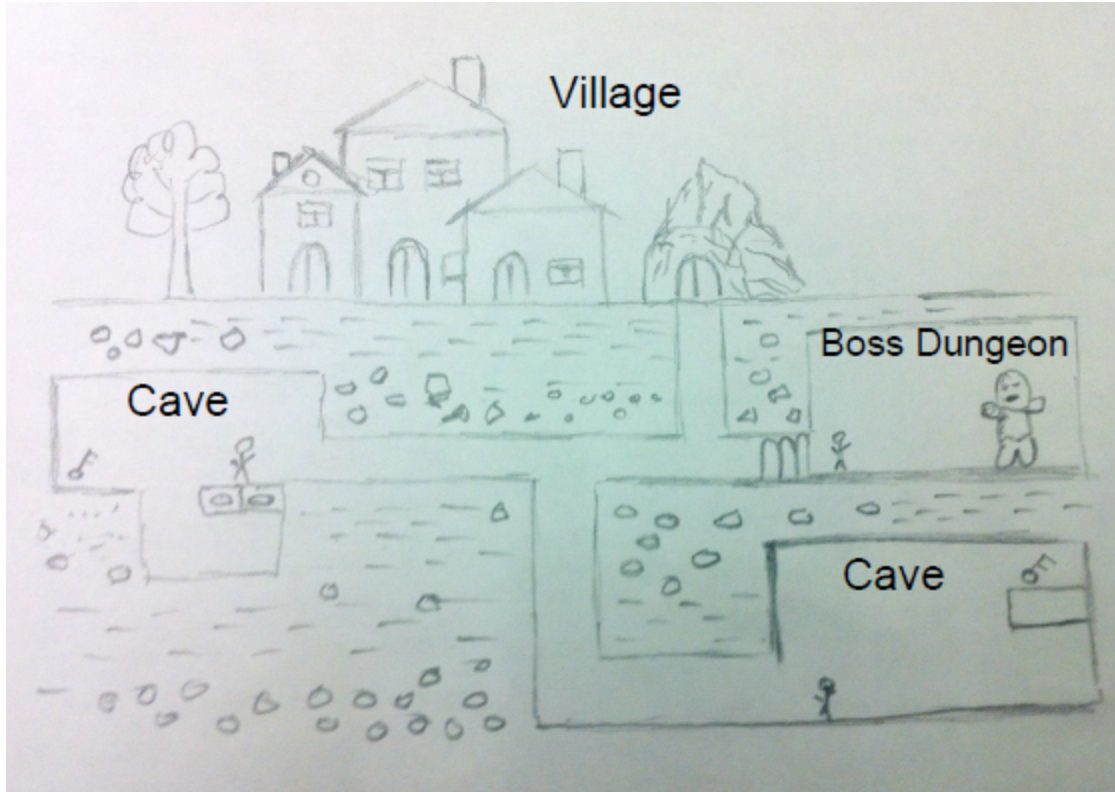


Figure 12: Game structure sketch

Building a Prototype

In order to test our research in the form of an actual game, we opted to quickly build a prototype that would represent what we want in a game in regards to gameplay and overlying concepts. We chose to use the game-making software most accessible and familiar to us at the time, Game Editor. This would allow us to create a playable game for us to test our ideas on, to see how they would play out in a game environment.

Prototype Gameplay

Using art assets from previous personal projects, we created a working prototype of a small

portion of the game: the player starts already in the cave section with 3 pieces of equipment to use, each one a tablet with a different category-type that could be used to describe potential research sources. In order to progress, the player needs to collect an item that would allow them to progress further into the cave, in this case a drill for clearing passages blocked with stone, and 3 keys which would open 3 doors which block the path to the final room of the cave. In order to obtain the item and the keys, the player must seek these objects in the cave by moving their character around the cave, traversing the landscape until they found a room which housed either the drill or a key. In three of these rooms, there is a tablet on the wall with a definition of one of the three categories that the player has. The player needs to match one of their tablets to the definition on the wall. When done correctly, the room structure changes, allowing access to the key or drill item. In the last room which houses a third key, the player uses solely the drill item in order to obtain the key. The purpose of this puzzle is to test the player on their basic knowledge of the terms they were given in the village, to make sure they know how to use them. Once the three keys are collected, the player is allowed access to the final room of the cave.

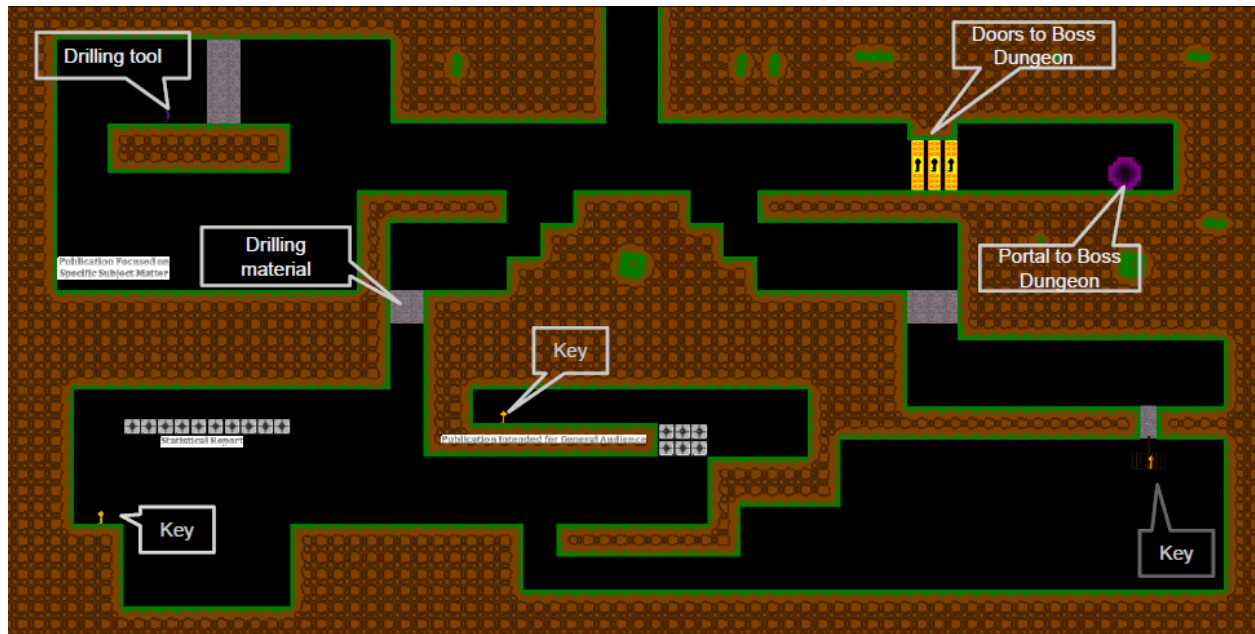


Figure 13: Cave - practice part of the game

In this final room, the player encounters a large monster which launches tablets at the player which resemble the tablets seen throughout the cave previously. Rather than showing simple, straightforward definitions, these tablets show questions that revolve around the theme of the room, which is stated on a tablet at the top of the room. This topic and series of questions is designed to simulate a student receiving a research question, represented by the theme of the room, and the series of questions a student would want their research to answer, represented by the questions that the monster launches at the player. The player must employ similar logic to their solutions for the main sections of the cave and use their 3 tablets to describe what types of sources would be needed to answer the questions presented by the monster. However, a lot more thought is required from the player in this section: rather than simply matching a word with its definition, the player must consider the word and its definition and use critical thinking to determine which one of their three terms would best suit the question given to them, building on their skills developed by the previous puzzles and challenging the player further.

The player is given clear feedback in this challenge. If a wrong match occurs, the tablet used by the player is propelled through the air in the opposite direction, giving the player clear feedback that their solution was incorrect. If a correct match occurs, both the player's tablet and the monster's tablet vanish, and the progress meter at the top of the screen goes down, indicating to the player that they are making progress. Once this meter drains completely, the monster is transformed into a villager similar to what would appear in the village section of the game, signifying that the player has reversed a curse that turned the villager into a monster, and has completed that section of the game.

Prototype Complications

Possible issues with the prototype include the distribution of the prototype, and enabling others to play the game. Since the prototype is not written in a format that allows the game to be played through a web browser, the game file must be downloaded to an individual's computer in order to play it. The solution to this issue would seem simple: send the file in the same manner that we would send out the link to the game if it were compatible with a web browser, the only difference is the extra step of downloading the game file to one's computer before playing. While this step may not seem detrimental, it is likely that many people will not want to perform this step, for any number of reasons, whether because they do not want to take the extra time to download the game, or that the individual or their computer do not trust .exe files from the internet, and may misread the game as a potential threat to the computer. There could also be the issue of any potential player's computer lacking sufficient memory on which to store the game file, although this is unlikely due to the small size of the game file, 1.5 MB.

Another issue is that of making additions to the prototype. Game Editor is not as widely used as other game engines such as Unity3D, so the likelihood of a team of designers, or even anyone outside of

this IQP group, having sufficient knowledge of Game Editor to make changes and additions to the game in its current state is very low, as the team may not know enough about the program to be able to use it.

RESULTS AND DISCUSSION

Prototype Results

After writing the prototype, the group determined that the game would not be successful in teaching research strategies for three reasons, the first being that the game presents very little in terms of autonomy. The prototype does not offer the player any sort of free choice in the puzzles, as each room contains exactly one correct answer, and all other possible answers are considered wrong by the game. This ideology is contrary to how research is conducted, as when one researches a topic, the journey that is research can begin in any direction, and branch off into multiple paths. If we think of the act of researching for a paper as a maze, then the maze would have hundreds of paths branching from the beginning, with many of them running parallel to each other, intersecting, and leading to dead ends, and the maze itself would have many exits. Each blockade in the maze would have multiple solutions to bypass them, some being more effective than others. Our game, on the other hand, looks like a maze, but really, due to the design of the game, forces a single, pre-determined path that the player must take, with each blockade having one answer that will bypass the blockade, all other answers being of no use. A researcher is allowed to go in nearly any reasonable direction they wish, and our game not only fails to reflect this, but it discourages this thought by implying that there is one correct path for research which must be sought out, rather than allowing the player to find their own path.

The second reason the prototype would not be successful is that it presents the player with no motivation to continue playing after learning how to play the game for two reasons: an ineffective difficulty curve, and a lack of risky in-game situations. A difficulty curve exists in the village--cave--boss structure, however, the problem with this structure is that it causes the difficulty curve to be so stretched

out that the player may not feel as though they are actually learning. The increases in difficulty are so gradual that the points during the game in which the player actually feels challenged are very spaced out, and without challenge, one won't feel a sense of learning, or growing stronger. The gratification of mastering the concepts of the game are too sparsely placed to give the player a strong enough sense of competence to make the experience satisfying. When the player does not feel as though they're learning, they likely won't have confidence in a game that is supposed to be helping them learn.

The lack of risk in the game further hampers the difficulty curve, as well as the actual learning taking place, because it does not give the player any sort of consequence for failure. The purpose of making a well-thought out decision is to avoid the consequences of a wrong decision. More simply put, risk forces us to think about our actions. A student must put a lot of thought into each answer they give during an exam, because otherwise, they would likely fail the exam. An individual giving a report to their boss must put a good amount of time into all different aspects of the report, lest they appear to not be on par with their boss' standards, possibly resulting in a pay cut, or being fired. If we look at the prototype using the same logic, we can see that risk does not force the player to make thoughtful decisions. There are virtually no consequences to a player answering a challenge with the incorrect solution, so there is no reason for the player to put a lot of thought into each puzzle. A player could pass through the entire game without even knowing which tablet they are using to solve each puzzle in the cave. Even if a player does choose to carefully think about each puzzle before coming up with a solution, solving each puzzle isn't very satisfying because there was never anything at stake to begin with, thus, to the player, it doesn't truly feel as if any real problem was solved, and the puzzles seem monotonous as a result.

Video games are special in that they can not only provide a situation to the player with great risk

associated with it, but it can undo all the consequences of a failed attempt at the push of a button. This allows the player to be presented with a risky decision, and if they fail, they can simply restart the situation from the beginning, using what they learned from their previous failure in each subsequent attempt until they succeed, unlike real life, where consequences are most often permanent. In this way, not only can video games simulate risk-taking very well, they actually encourage risk-taking, and the fact that the prototype does not make use of this feature is counterintuitive to the point of having the learning experience being a game.

Another issue is that the game does not include the real-world tools that a student would use for research. While the game strives to teach more abstract concepts, it is difficult to translate these concepts from in-game use to real-world use. Ideally, the student would master the concepts taught to them from the game in the game environment, and those skills would directly translate to skills that the student would use in real-world research. However, due to the abstract nature of the skills taught by the prototype, without a mechanic that strongly resembles how research is done outside of the game, the skills learned from the game may not easily, if at all, translate to skills the student can use in their research. A solution to this problem would be to use the tools that the student uses in their real-life research in the game environment, or a game mechanic that closely resembles those tools. This would not only allow the player to build strong associations between the abstract ideas the game is teaching them, but also give the player a controlled environment in which to practice with the research tools used outside of the game, one which could provide direct, immediate feedback towards the player's actions, facilitating the learning process.

Finally, and perhaps one of the most important issues, is that our prototype does not appeal to people who don't normally play video games on a regular basis. The concept of a video game world

such as the one we sought to create in our prototype is a large concept to take in, especially if the player is not used to immersing themselves in a foreign digital world. This aspect can make a video game intimidating to someone who doesn't normally play video games, and thus they will not want to play the game or learn from it. This is a very big issue due to the fact that people who play videogames are generally a minority in most schools; the activity is not a widespread or widely accepted use of time among society. Thus, there exists the possibility that most people, when presented with the game, will dismiss it as useless or too complicated before they even play it, which would nullify the effectiveness of the game if they were to play it.

The concept of a game world could also detract the focus of the player away from the learning aspect of the game, however it could also help draw in players. If the game world is interesting enough, then players who may not be drawn in by the information literacy part will be compelled by the interesting setting to play the game, and in turn would still learn and accomplish the learning goals set by the game. However, if the details of the game world detract too much from the information literacy part of the game, players may not pay attention to, or remember the research skills that the game teaches. Our game though, with its simple setting and lack of detail in the game world, does not run across the issue of distracting the player, but it also does nothing to try to immerse the player in the world, either. Given these shortcomings, as well as the strengths, of our game, we believe this concept, or a similar one, is a good foundation for a proper information literacy game.

CONCLUSION AND RECOMMENDATIONS

After taking in what we learned about serious games from both other games and our

own, we decided to suggest a series of puzzle games to teach information literacy skills. Puzzle games are a great teaching tool because they effectively mesh the game and educational components of a serious game. In addition, they are usually a bit easier for people who do not regularly play games to understand and enjoy.

A series of small puzzle games has a lot of benefits over an individual more complex puzzle games. It helps tackle the broadness of information literacy as each game can focus on an individual aspect. It also can have more replayability as a player is never prone to get too bored of any one game. Having a variety of games on different topics can also help customize towards each individual user's weaknesses. Having some sort of diagnostic test precede playing the games could help figure out the user's needs.

One example of an information literacy mini game would be a search game similar to "Guess Who". Players could use search terms to help whittle down a field of options to get a target. For example, if your targets were a cat and a dog, but the picture also had a shark, a human, and a pencil, you could search animal to eliminate the pencil, search AND mammal to eliminate the shark, and search AND has tail to eliminate the human. This helps practice both using the right keywords and using advanced search functions like AND, NOT, and quotation marks for narrowing down a search.

While we may not have found the perfect information literacy serious game, we do believe that it is possible. Many serious games have proven to be effective, and there is no reason to think that one can't be made for information literacy.

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Appendix 1: Information Literacy Games Websites

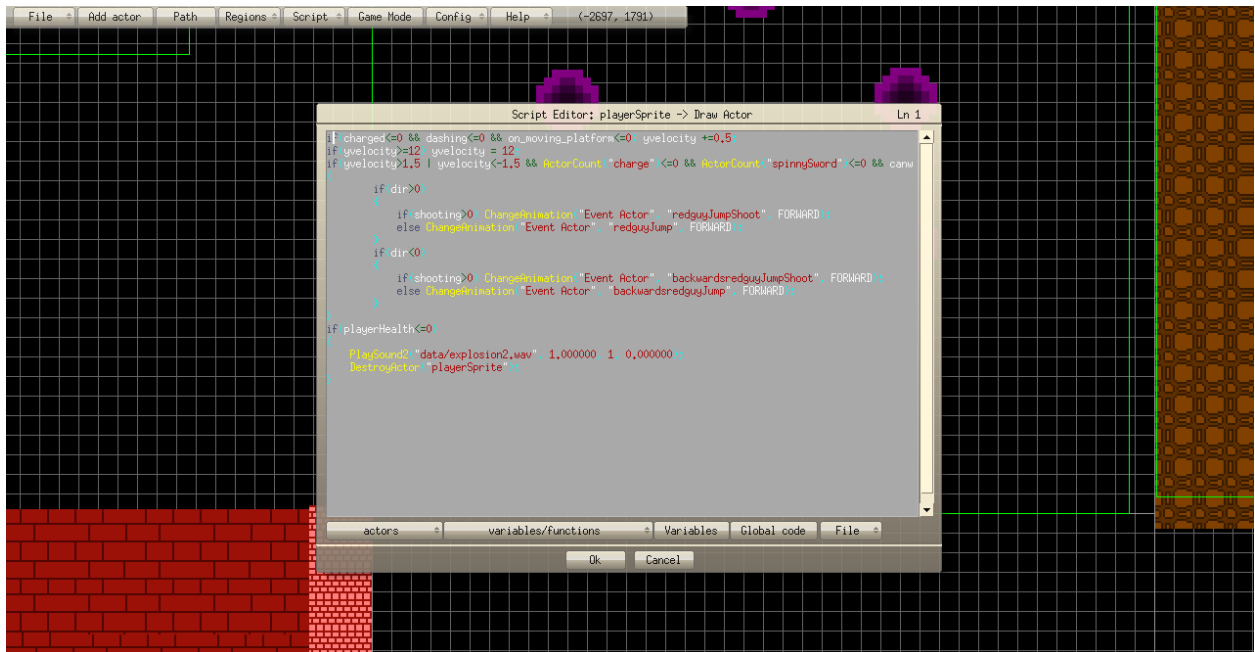
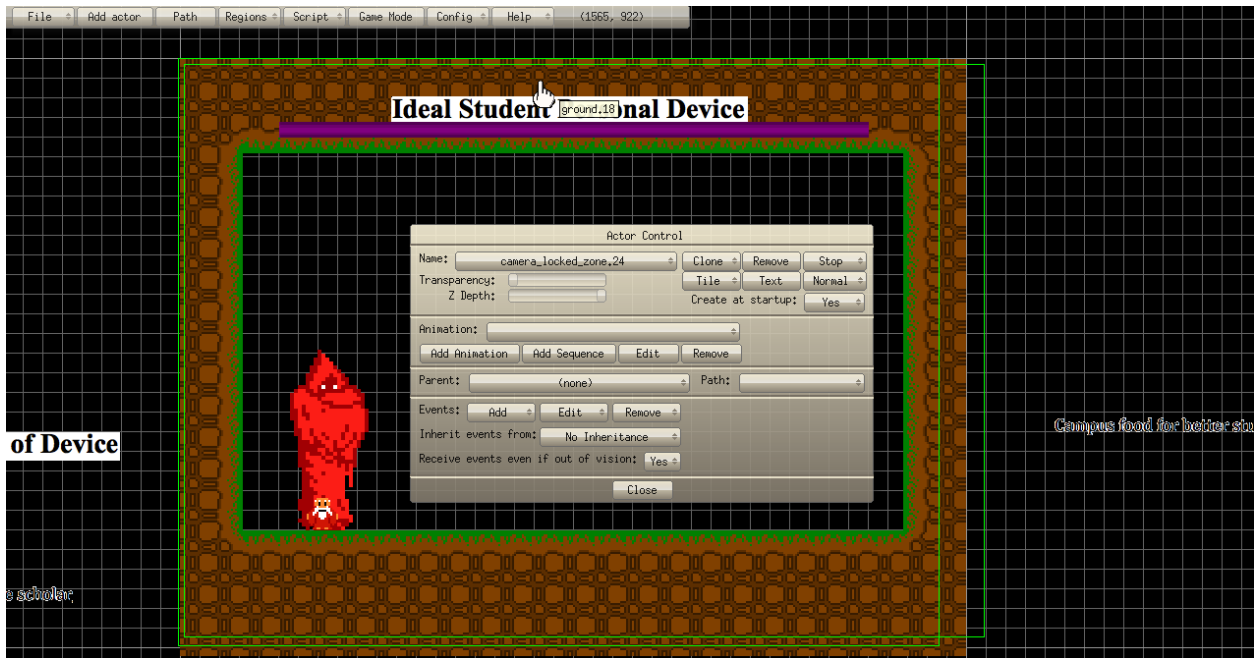
- Secret Agents in the Library at Lycoming College,
<http://www.lycoming.edu/library/instruction/tutorials>
- The Information Literacy Game at UNCG, <http://library.uncg.edu/game>
- Game Overview: Gaming Against Plagiarism at George A Smathers Libraries,
<http://cms.uflib.ufl.edu/games/gap/gameoverview>
- Library Scene: Fairfield Edition at Fairfield University,
<http://faculty.fairfield.edu/mediacenter/library/scene/>
- Radix: <http://education.mit.edu/blogs/carole/2014/02/04>
- CodeSpells: <https://sites.google.com/a/eng.ucsd.edu/codespells/home>
- Lumosity: <http://www.lumosity.com/>

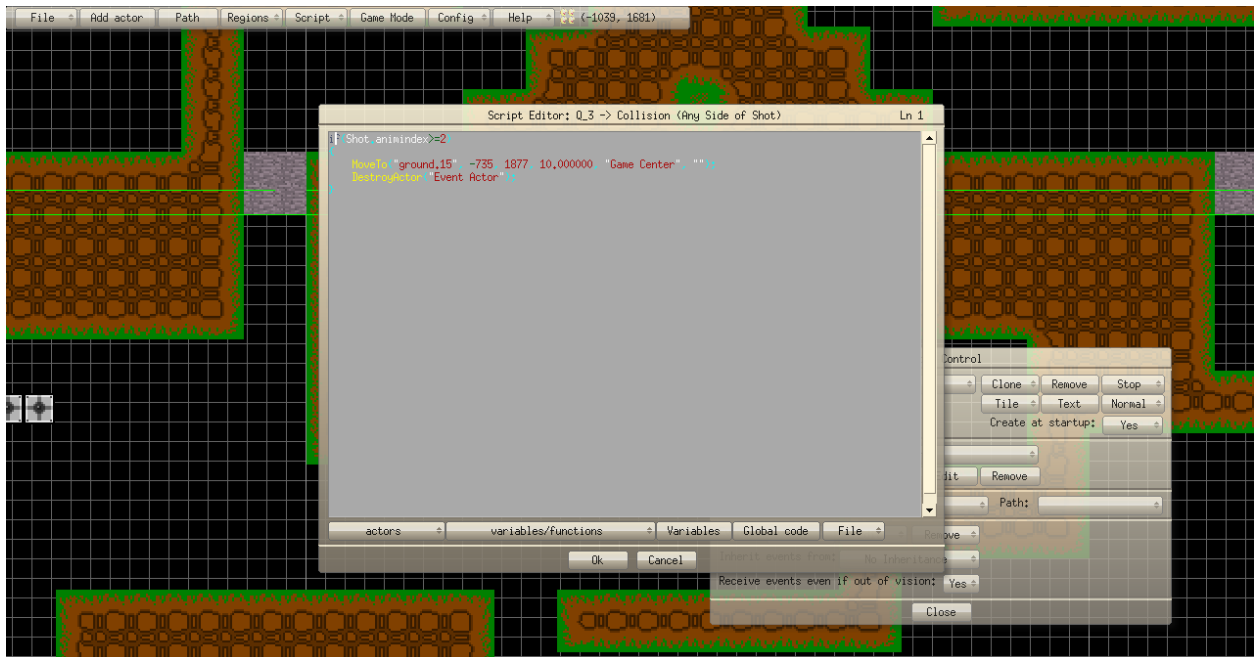
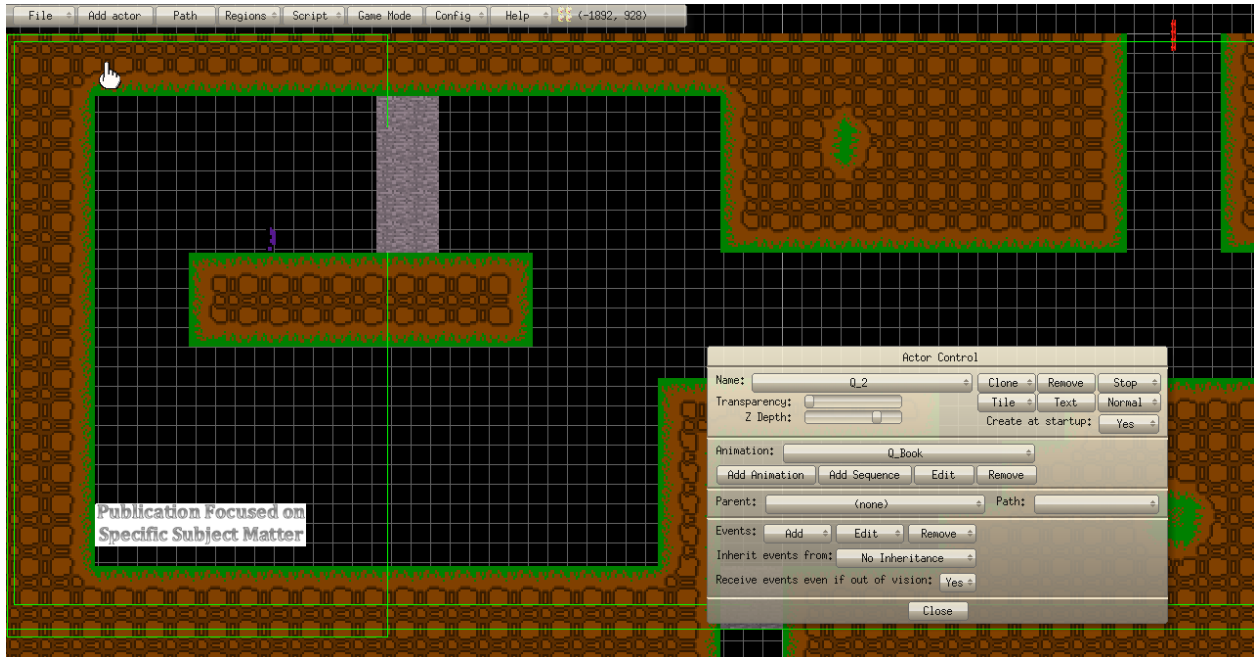
Appendix 2: Game questions

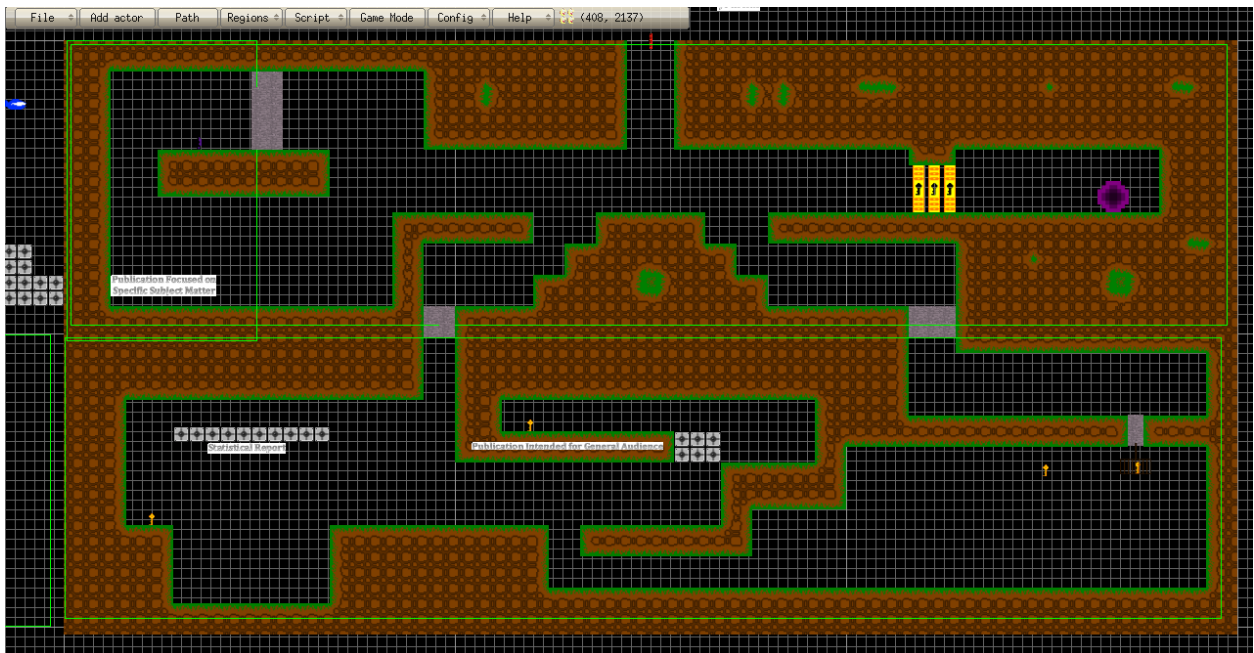
Questions	Category	Classification
Campus food for better student diet		
Daily calorie needs	Gov't Report Journal Book	Magazine (Science)
How are other projects like this done at other universities?	Journal	
What kind of food is nutritious?	Gov't Report Book	Handbook
Cost of nutritious foods	Technical Paper Journal	Corporate
How long food can be stored?	Book Technical Paper	Handbook Corporate
What do students like to eat?	Journal	Magazine (Other)
How many students on campus?	Technical Paper	Corporate? or Other?
What is a healthy student diet, ages 18-23?	Journal	Magazine (Science)
What are some common special needs/diets?	Book	Encyclopedia
How many people can one vending machine supply?	Product Manual	
Importance of hot food?	Journal	Scholarly
How long food can be stored?	Journal	
Average percentage of students who rely on campus food.	Technical Paper	Corporate? or Other?
Cultural food?	Book	Handbook
Ideal Student Personal Device for College to		

balance education and entertainment		
What do students do for fun with their electronics?	Journal	
What are the most common programs used in school? What are they compatible for?	Technical Paper	Corporate
Ideal weight?	Journal	Scholarly

Appendix 3: Screenshots from Building of Prototype







Appendix 4: Gameplay videos

- <http://www.youtube.com/watch?v=9kp32RAMxBM&feature=c4-overview&list=UU4sORgSB7otpXlSZuu2Qvtg>
- https://www.youtube.com/watch?v=r8-_8fsoDuU&list=UU4sORgSB7otpXlSZuu2Qvtg

Serious Games in Information Literacy: The Creation and Analysis of Games to Teach Information Literacy

Matthew Nass, Alex Taubert, Sergey Zolotykh

Introduction

- Researched Information Literacy and Serious Games individually found successes in both
- Researched information literacy games and found that they had issues
- Designed and created prototype for information literacy game that solved some problems
- Suggested game to be potentially made in the future

Ways to Teach Information Literacy

Is it better to teach a specific research skill or a variety of research skills?

Challenges Teaching Information Literacy

- An IQP group that focused on “Assessing First-year Information Literacy at WPI” found that “[Students] [do] poorly on questions related to search strategies (Dao, Katzoff, Lipson, & Pham, 2011).
- The results showed that only 40% of entering students scored above 70% on the test.
- “However, over the course of the year, only 32 general research workshops were given to 224 students.”(2012 IQP)

Elements of Information Literacy we want to teach

- Choosing the proper sources for different types of information
- Using the most appropriate databases for different types of research questions
- Citing sources correctly
- Making effective search queries

Different type of research methods

- Research methods are different in different fields of study
 - Traditional Research Methods
 - Game development methods
 - Testing games as a part of research
 - Crowdsourcing
 - Subject Specific Databases
 - JSTOR

Why Game-based Learning is Effective

- New Identity
 - Player takes control of, or becomes, a character
- Interactivity
 - Players control the action
- Risk-taking
 - No fear of failure
- Skill Progression
 - Basic skills compounded into advanced skillset

Smale, 2011

Why People Play Games

- “Stop thinking *primarily* about the content of video games (things like the guns, explosions, spaceships, and magic swords) when evaluating a game experience.”
- “Stop thinking, ‘people play games because they are fun.’”-Rigby, Richard 2011

Why People Play Games

- Competence
 - Feeling of mastery over a concept
- Autonomy
 - Feeling of choice
- Relatedness
 - Feeling of meaningful connections to others

Why People Play Games

Competence

- Learning, practicing, mastering
- Noticeable growth gives satisfaction



Why People Play Games

Autonomy

- Having control over your life
- Being able to choose how you handle a situation



Why People Play Games

Relatedness

- Friendship, Family
- Knowing you matter to others



Why People Play Games

Games are good for these because their inherent:

- Immediacy
 - Always available, can be picked up at any time
- Consistency
 - No setbacks that deter from the game experience
- Density
 - Can have as much depth as technology allows

Examples of serious games

- CodeSpells
- Lumosity



Level 1 Spells

Flame Spell:

Used typically to catch objects in the world on fire.

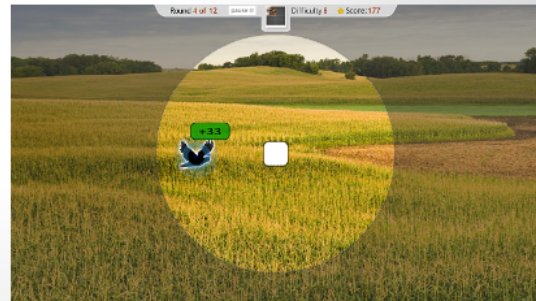
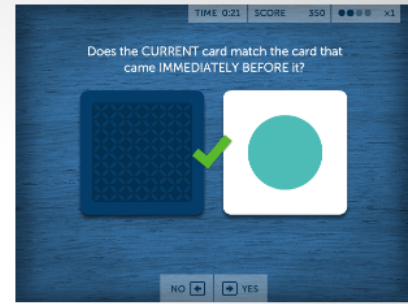
```
import june.*;

public class Flame extends Spell
{
    public void cast()
    {
        Enchanted target = getTarget();

        target.onFire(true);
    }
}
```

Lumosity

- Series of games to work on different cognitive skills
- Gender Neutral



Balance between game and educational aspect

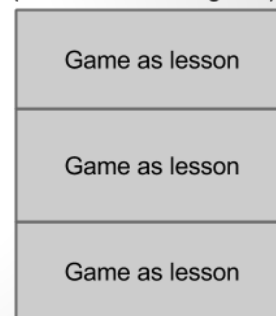
Game and lesson are poorly connected



Gameplay is minor (interactive lesson)

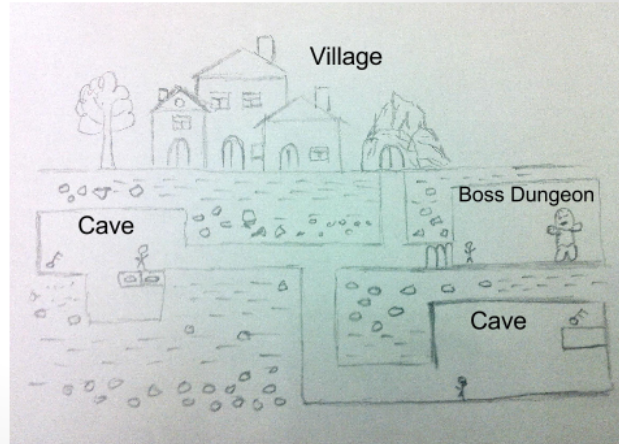


Gameplay itself is a lesson (ideal educational game)

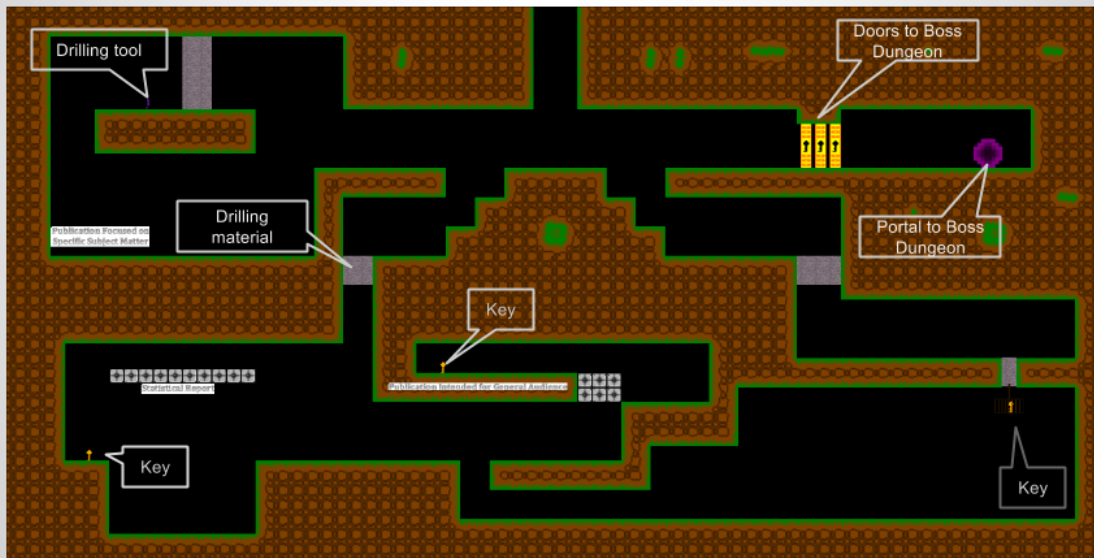


Designing our game - Concept

- Village
 - Learning section
- Cave
 - Practicing section
- Boss Dungeon
 - Examining section

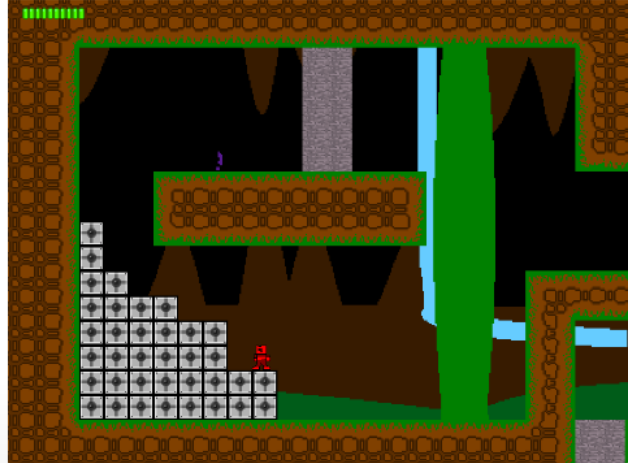


Designing our game - Gameplay



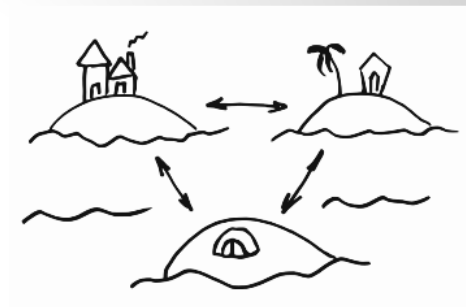
Designing our game - Challenges

- Challenges with making a creative game



Strengths of our game

- Clearly defined structure
- Scalability
- Lack of violence



Weaknesses of our game

- Gameplay and education portion connection
- Too targeted at game players
 - Can reach game playing audience
 - Can be hard to understand for people without gaming experience



Conclusion (Suggestion for future game)

- Puzzle game using searches(Like “Guess Who”)
- Involving real search tools in gameplay
- Using physical library space
 - Augmented Reality games
- Series of mini games like Lumosity