

Virtual Movie Sets and Branching Video: Developing Interactive Educational Machinima with Second Life and YouTube

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Abstract: Machinima is the technique of using real-time 3D technologies such as computer games or virtual worlds in the creation of animated video productions. The Second Life virtual world provides an open landscape where inexpensive virtual movie sets, props, costumes, and characters may be created to meet specialized educational purposes. Interactive video techniques used to create online video simulations, virtual tours, adventure games, or interactive tutorials can be coupled with machinima to create interactive educational machinima products. YouTube supports this technique by providing both video hosting and the *Annotations* tool, which enables linking from video to video. Usage and demographic data may be collected on YouTube automatically to identify patterns of use. This paper illustrates the process of interactive educational machinima design and prototype development using a combination of Second Life and YouTube technologies. Usage data from YouTube is presented and its potential value for evaluation of interactive educational video design is discussed. Initial conclusions suggest directions for future research in interactive educational machinima.

Introduction

Over the past decade, the technique of using real-time 3D technologies such as computer games or virtual worlds for the creation of animated movies has become an established filmmaking genre. This style of video production is known as *machinima* (pronounced *muh-sheen-eh-mah* or *muh-shin-eh-mah*). The term was created from a combination of the words *machine* and *cinema* in the late 1990s after the *Quake Movies*, recorded using the Quake game, gained popularity (Hancock & Ingram, 2007; Lowood, 2006). One of the earliest and most widely known Quake Movies was *Diary of a Camper* (The Rangers, 1996), a short video that is often described as the first machinima movie. Numerous examples of machinima may be viewed at websites such as *Machinima.com*, the *Machinima Archive*, and *YouTube* (See the appendix for links).

The spectrum of real-time 3D technologies used in the creation of machinima include video games such as *The Sims* and *World of Warcraft*, 3D animation software such as *Moviestorm* and *iClone*, and virtual worlds such as *Second Life*. (See the appendix for links to information about each of these technologies). The decision to select a particular technology for machinima production is likely to depend on a variety of factors such as

personal preference, time and financial costs, project goals, and what the technology will allow the machinima designer to do.

Machinima is beginning to gain attention as an attractive option for the creation of academic video due to factors such as ease of access to virtual movie sets and production techniques, opportunities for both faculty and students to express creativity, its potential as a catalyst for learning, the efficiency of reusable video and content libraries, and the natural fit to 3D visualization and simulation projects (Middleton & Mather, 2008). The idea of using machinima production to promote creativity is particularly compelling given that creativity is specifically addressed in the latest version of the *National Educational Technology Standards for Students* developed by the International Society for Technology in Education (ISTE, 2007). Additionally, the revised version of Bloom's taxonomy includes a cognitive process domain category called *create*, which integrates design and production processes (Anderson & Krathwohl, 2001). Machinima design and production is a complex task, involving multiple creative activities such as script writing, storytelling, storyboarding, virtual movie set design, costume design, character design, 3D animation, and video production.

After machinima videos are produced they may be uploaded for online distribution through one or more of the many free video-sharing services on the Web. If basic hosting is all that is required, just about any of them should work. However, the selection of video-sharing service, much like the selection of machinima production tools, depends on multiple factors including what the technology will allow one to do. If the goal is to create interactive branching video, then YouTube is probably the best choice. YouTube provides an *Annotations* tool through which interactivity may easily be added through video to video links (YouTube, 2009). This simplifies the process of creating interactive adventure stories, games, virtual tours, interactive maps, simulations, and tutorials (See the appendix for interactive video examples on YouTube). The Annotations tool works directly through the browser to apply notes and links on top of an uploaded video. It does not require programming or helper applications such as the *ScriptEase* tool, which was designed to support interactive story development with computer games (Carbonaro et al., 2008).

Design and Implementation of an Interactive Educational Machinima Prototype

During the fall 2009 academic semester, an interactive educational machinima prototype called *Save Princess Dot* (See the appendix for links) was developed to serve as a working example of interactive video for an online graduate course called *YouTube for Educators*. Because the program that offers this course also offers courses in Second Life, the instructor sought to develop a prototype that would demonstrate how Second Life and YouTube technologies could be used together to create unique educational video products. The design and development process is documented in this paper to illustrate the process for those who may be interested in pursuing similar projects. This is followed by a discussion of the data collection structure for the interactive video system, along with preliminary data, to illustrate how the design of a project like this can be evaluated.

The interactive educational machinima project proved to be somewhat complex due to the need to develop a concept and storyline, design and build the virtual movie set in Second Life, develop characters, obtain costumes, and produce, upload, and link the videos into an interactive system on YouTube. Project development naturally unfolded within four phases that generally flowed in a linear manner, although some earlier phases were revisited as the project design evolved. The four phases have been labeled for discussion purposes as: (1) conceptualize the idea, (2) create the virtual movie set and characters, (3) produce the videos, and (4) upload and link the video clips. These are described one at a time to illustrate the design and development process involved in the project. The core processes involved in these phases (i.e., planning, building, production, uploading, linking, etc.) are foundational and likely to appear in other interactive educational machinima projects, especially those using Second Life and YouTube as production technologies.

(1) Conceptualize the Idea

The instructor who created the interactive educational machinima prototype had prior experience developing projects with Second Life, YouTube, and online video. Nevertheless, the interactive educational machinima project proved to be challenging due to the multiple techniques and technologies involved. Conceptualizing and advance planning proved to be critical activities in the production process. These activities were managed through a multi-phase storyboarding approach, which made it possible to maintain a schematic of the overall project and how all of the interrelated elements connected as development progressed. The initial storyboard was simply a hand-drawn diagram with notes scribbled along the margins. As the project progressed, the storyboard was updated and revised to reflect current status of the design. The final version of the storyboard is available online and linked from the appendix due to its length. A screenshot of the first page of the final storyboard is shown in Figure 1.

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Storyboard for Save Princess Dot: Interactive Branching Story	
Screen or Segment	Production Notes
<p>This is a storyboard for the "Save Princess Dot" interactive branching story on YouTube.</p> <p>This interactive branching video story was created using both Second Life and YouTube. I have a small piece of virtual land in the Second Life virtual world where I constructed a movie set and characters for this video story. If you have an account with Second Life you can visit the set here: SLURL: http://slurl.com/secondlife/Jingyo/229/119/50</p> <p>The beginning of the story on YouTube is here: http://www.youtube.com/watch?v=aaaN1eJhCdg</p> <p>**Although I often use a three-column format, I found it easier to use a two-column storyboard format set to landscape layout this time. It provides ample space to describe the overall features of the project and each segment. Screenshots of each segment provide a visual representation and the production notes serve to explain how each portion was created.</p>	<p>List of Software and Materials Used</p> <p>Second Life: Virtual world where the set was created for the screen recordings (video) and still images.</p> <p>Camtasia (PC): Screen recordings, editing, and final production in widescreen+HDmp4 format for YouTube.</p> <p>Adobe Premiere Elements 8 (PC): Video editing software used to create electrical effects and music loops with <i>SmartSound QuickTracks</i>.</p> <p>Adobe Fireworks (PC): Image editing for title slide.</p> <p>Audacity (PC): Record voice narration with sound effects and flourishes in the background.</p> <p>Garage Band (Mac): Create sound loops.</p> <p>QuickTime Pro: Used to edit old movie clips and extract music.</p> <p>YouTube Annotation Tool: Used to add questions and links.</p> <p>Absolute Sound Effects Archive: http://www.gsites.com for additional sound effect files. These are available for free.</p> <p>Microphone: Audio Technica AT2020-Cardioid-Condenser USB Mic</p> <p>Internet Archive: Public Domain movie clips available for free download.</p> <ul style="list-style-type: none"> • → Night of the Living Dead (1968) • → Tarantula (1955)

Figure 1. Screenshot of the first page of the final storyboard.

One of the most essential parts of the conceptualizing process was identification of the topic and storyline. In other words, the initial goal was to build an example of an interactive video on YouTube, but the educational purpose and central premise of the project had to first be defined. Given that machinima arises from a gaming history and interactive video supports interactive game design, the decision was made to create a small game or *micro-game* (Snelson, 2006, October) in the basic style of an adventure game (Premsky, 2001). Multiple examples of interactive video games on YouTube were reviewed for ideas on branching structures and game design (See the appendix for links). Ideas for the central storyline were sought by referring to books on story plot (Booker, 2004; Tobias, 1993) and ideas for characters were generated by referring to a book about master characters (Schmidt, 2001). An escape plot was selected along with archetypal characters. The basic storyline for the *Save Princess Dot* interactive machinima is that of an evil queen (Queen Hexia) pursuing an innocent princess (Princess Dot) through a set of rooms in a maze-like building called the *Hall of Doors*. The chosen storyline aligned with the interactive elements of the planned movie set and interactive video prototype concept.

The educational challenge for the Save Princess Dot prototype was conceptualized in this initial design phase as a set of general science questions that users would have to answer correctly to help the princess escape the evil queen. A plan was drafted to build in revision capability so that the questions could be changed as desired after the prototype had been created. A basic script was written for the introductory video to provide the

backstory, where the background information pertinent to understanding the premise and challenge of the game is explained to users (Miller, 2008).

(2) *Create the Virtual Movie Set and Characters*

After initial conceptualization and planning, the next phase was to create the virtual movie set, props, and characters in Second Life. The movie set was constructed on a small piece of virtual property owned by the instructor who designed and created the prototype. Virtual land in Second Life is obtained in parcels measured in square meters. The Hall of Doors movie set was constructed on a small and narrow lot of 512 square meters. Building on such a small plot of virtual land presents a challenge due to space limitations and building constraints imposed by the 117 prim limit. A prim is a primitive building block such as a cube or cylinder and these form the basic elements of structure within Second Life. It was necessary to use low-prim building techniques to stay within the prim limit. For example, each room was created with a single hollowed cube prim with a cut path applied to carve an opening for a door. This eliminated the need to create each of the four walls with separate prims. The entire building, including props, was constructed with a total of 107 prims. The six doors and theme for each of the rooms is indicated in Figure 2. Those who have a Second Life account may visit and explore the completed set, which is open to the public. A SLURL (Second Life URL) to the Hall of Doors virtual movie set is provided in the appendix.

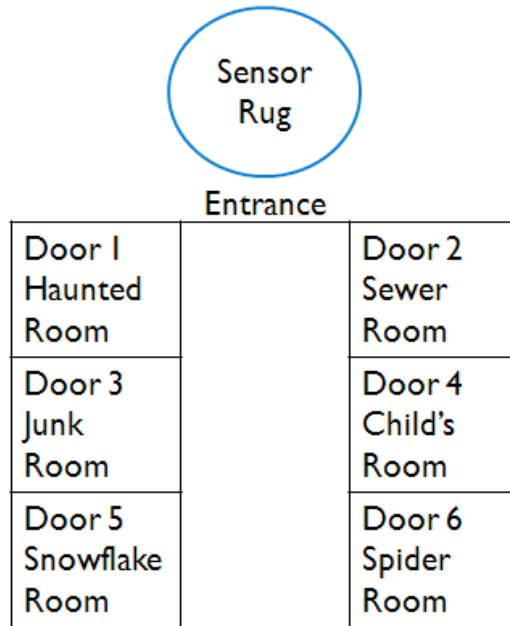


Figure 2. Diagram of the basic Hall of Doors layout.

The Hall of Doors movie set was created as an interactive building through the use of the Linden Scripting Language (LSL). Some of the scripts were derived from examples and documentation at the *LSL Scripting Portal* (linked from the appendix) and the rest were derived from a book of Second Life script recipes (Heaton, 2007). The scripts provided several forms of interactivity:

- A sensor script in the sensor rug at the entrance welcomes avatars by name and sends a daily traffic report by e-mail to the set designer once per day.
- The entrance door opens when clicked (touched by the avatar) and locks for two minutes after being opened to restrict escape temporarily and encourage exploration for the exit.
- The six inner doors provide a notecard when clicked as shown in Figure 3. The avatar must answer the science question on the notecard by typing it into the open chat channel. A listener script will open the door if the answer is correct. If incorrect, nothing happens and the door remains closed.
- All of the rooms contain sensors that initiate sound effects when an avatar is in the room.
- A teleport script is available in the room behind door 5 and teleports the avatar outside and in front of the Hall of Doors building. This is the escape route for the Hall of Doors.

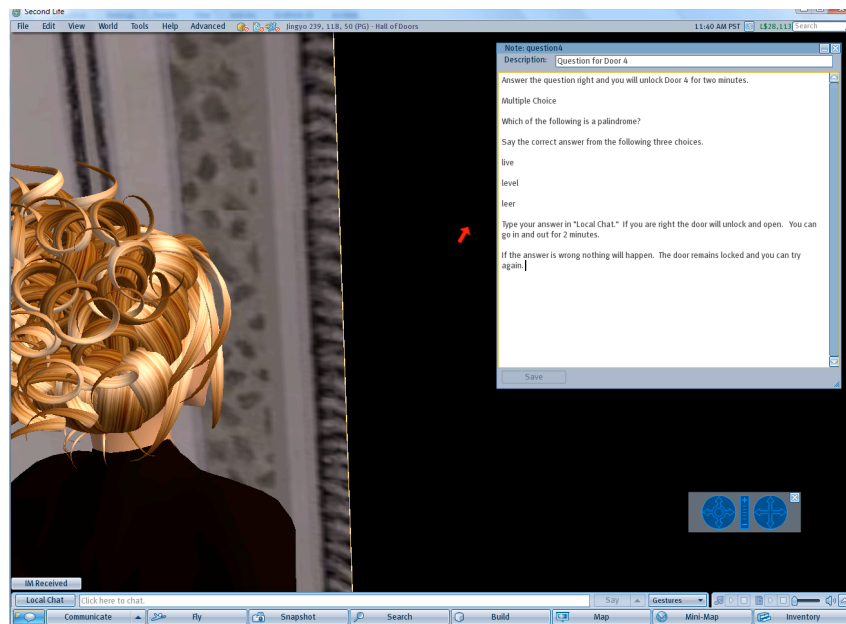


Figure 3. An Avatar receiving a notecard inside the Hall of Doors.

In addition to building the set, the two characters for the Save Princess Dot machinima were created. Two different avatars were used, one for Princess Dot and the other for the evil Queen Hexia (see Figure 4). Costumes were purchased from stores inside Second Life. These two avatars served as digital puppets that were manipulated on the virtual movie set, using mouse and keyboard, thus becoming the actors for the movie sequences.



Figure 4. Princess Dot (left) and the evil Queen Hexia (right).

(3) Produce the Videos

A series of video clips were recorded and edited using *Camtasia Studio*, which is a screen recording program with editing capabilities. Videos were captured with width and height dimensions set at 1280 x 720 to correspond with the widescreen video player used on YouTube. It is possible to hide the user interface in the Second Life viewer so that menus and controls will not appear on the screen while recording video. However, in this case it worked better to leave them visible and position the recording area inside the Second Life viewer with the camera controls available outside of the recording space so that they could be used without being recorded in the video. A series of video clips were recorded that could be edited together while producing the video series. Two videos were recorded in each room within the Hall of Doors to create variation in the game. For example, the first video recorded in the sewer room showed rats running across the floor and the second version featured a growling mummy. A total of 12 videos were created from all of the recorded clips. The complete set of finished videos, used to create the interactive machinima, are available in the Save Princess Dot playlist linked from the appendix.

Music, voice narration, and sound effects were added during video editing in *Camtasia*. Voice recording was accomplished using a USB computer microphone through both *Camtasia* and *Audacity*, where sound editing and special effects could be applied. Music tracks and the electrical discharge effect were created using *Adobe Premiere Elements*. Additional sound effects were downloaded from the *Absolute Sound Effects Archive* or generated using *Garage Band* software. The sound clips were imported into *Camtasia* where they were added to the video timeline to evoke the desired mood for the interactive machinima game. Links to these resources or information about them are available in the appendix.

(4) Upload and Link the Video Clips

All of the video clips were uploaded to YouTube. A link to the first video (the starting point) was included in each video description to redirect users who may have started in the wrong place. Then, the Annotations tool was used to add true/false science questions and links from each response to other videos (see Figure 5). The questions appeared at

the end of each video clip and remained on the screen for approximately 30 seconds to allow user response time. This added a time challenge to the game.

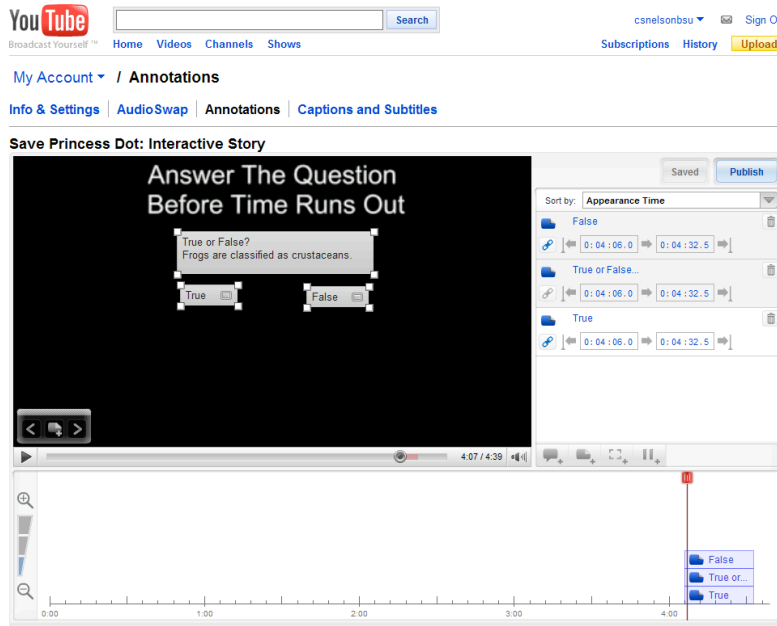


Figure 5. The Annotations tool in YouTube.

Clicking a true or false answer redirects the user to a new video as described in Table 1. Feedback is provided on each linked destination video to specify that the response was correct or incorrect. All of "a" videos are linked from correct responses and the "b" videos are linked from incorrect responses (i.e., 2a, 2b, 3a, 3b, etc.). Exit points occur at win and lose segments of the game, shown in bold text in Table 1.

Table 1. Link patterns for the Save Princess Dot project.

Video	True/False Questions	Linked from Correct	Linked from Incorrect
Intro/1a	Frogs are classified as crustaceans.	2a	2b
1b	Eratosthenes was the first Greek to calculate the circumference of the Earth.	2a	2b
2a	Hertz is a unit of frequency.	3a	4b
2b	The Sun is a star.	3a	3b
3a	The Doppler effect applies to both light and sound.	4a	4b
3b	No question: Lose and exit	---	---
4a	A spider is an insect.	6a	1b
4b	100 kilometers equals 1,000 meters.	6a	1b
5a	No question: Win and exit	---	---
5b	Igneous rocks form when magma cools and solidifies.	6a	6b
6a	Zero on the Celsius scale is also known as absolute	5a	5b

zero.

6b No question: Lose and exit

Data Collection Methods

The link structure described in Table 1 can be depicted as a system of nodes and pathways as illustrated in Figure 6. In the branching system, each video forms a node, or decision point, where user selection determines the path through the system. Loh (2007) has suggested that this type of structure has potential value for assessment, because user choice at decision points (nodes) demonstrates knowledge or lack thereof. This type of data can be collected automatically as the user clicks through the system if the technology supports it.

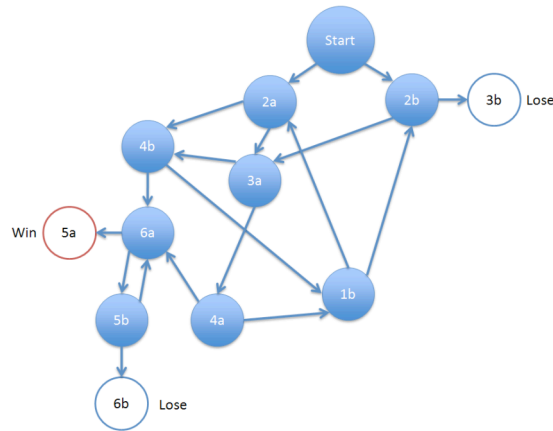


Figure 6. Diagram of the *Save Princess Dot* interactive video system.

YouTube provides a mechanism where video owners may obtain aggregated usage data through the *Insight Statistics* panel illustrated in the screenshot in Figure 7. Number of views and user demographics can be viewed from the panel or downloaded in a csv format that opens in spreadsheet software.

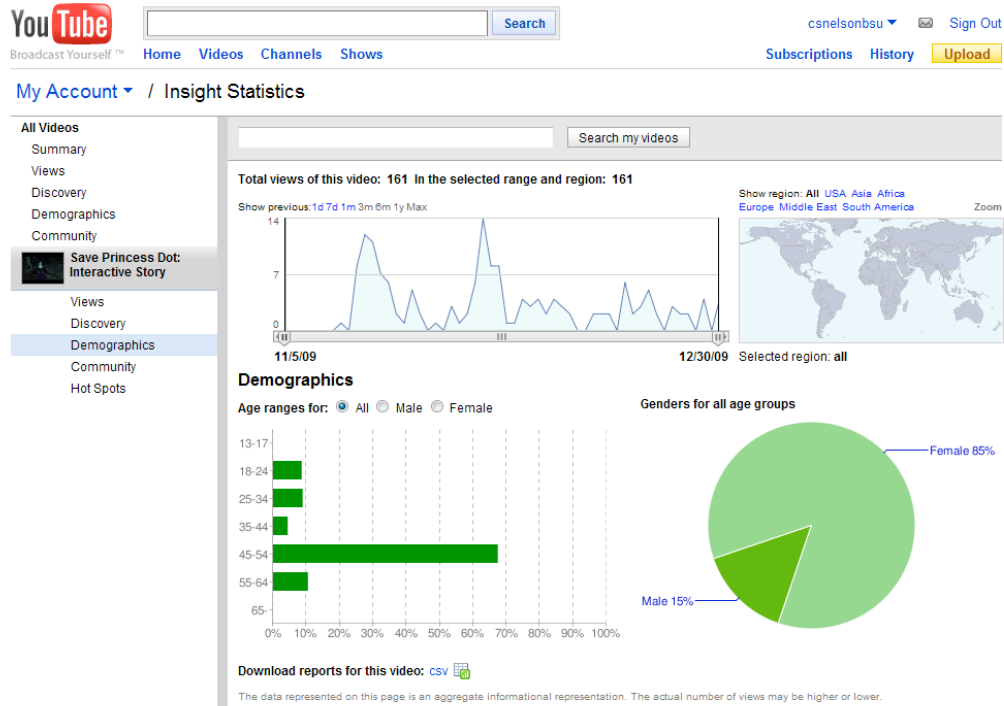


Figure 7. Insight statistics panel in YouTube.

A limitation of the YouTube Insight statistics is that it does not reveal information about unique individual activity. However, it does provide information about patterns of group usage including overall number of views and the age and gender breakdown of viewers. This information can be useful for specific types of research or evaluation goals where issues such as user affinity for design variables, such as storyline, are of interest. For example, an interactive video project featuring a battle with tanks and guns may attract a different age or gender of user than one that focuses on a bunny seeking a magic carrot. If, over time the tanks and guns video project is visited predominantly by young males and the bunny story is visited by young females then this indicates a natural affinity by these groups of users for the storyline. This is the approach taken with the Save Princess Dot prototype. Usage data was obtained for each of the 12 videos to evaluate patterns of engagement with the interactive video system. It should be noted that this is preliminary data obtained after the videos had been online only a few weeks, so the findings should be interpreted cautiously.

Results

The number of views, age range, and gender recorded for each video in YouTube is shown in Table 2. The demographic data is obtained from users who have logged in to a YouTube account. A few things stand out from this initial data set that may warrant further investigation. First, the number of viewers for the starting point video was much higher (161) than the views for the three exit points. Winners (34) outnumbered losers (20 and 16) slightly, but not dramatically. The age range for users who started the interactive machinima was 18 to 64, but narrowed considerable from the first node

forward in the branching video system. The majority of views overall were in the 45 to 54 year-old range. Demographic statistics also revealed that both males and females viewed the start video, but females dramatically outnumbered males (85 to 15 percent). After the starting point there were no male viewers at all, meaning that the audience of logged-in YouTube users interacting with the video system was entirely female after the first video.

Table 2. YouTube Insight usage and demographic statistics for videos.

Video	*Views	Age Range	Male %	Female %
**Intro/1a	161	18-64	15	85
1b	30	45-54	0	100
2a	63	45-54	0	100
2b	48	45-64	0	100
3a	51	45-64	0	100
**3b (Lose)	20	45-54	0	100
4a	31	45-64	0	100
4b	31	45-54	0	100
**5a (Win)	34	45-54	0	100
5b	13	45-54	0	100
6a	55	45-64	0	100
**6b (Lose)	16	45-54	0	100

Note. *Views are from November 5 through December 30, 2009. **Entry and exit points are in bold.

Discussion

The YouTube Insight statistics appears to show that an audience of older females were engaged with the entire interactive machinima prototype, while males and younger users abandoned it after the first video. It is possible that there were viewers who did not log into the system and their demographics were not recorded. Nevertheless, it is intriguing to consider this preliminary data and what it may reveal about design of this prototype. One issue to consider is that the storyline featured a princess being pursued by an evil queen. It is possible that this particular storyline was not compelling for males. It would be interesting to design another interactive machinima project with a different storyline to see if the gender pattern of usage changed. This line of research could provide insights into the qualities of interactive educational machinima design that different groups of users find engaging. A similar question arises with the overall age of the users, which was predominantly middle-aged. One possible explanation for the age range is that the interactive machinima prototype was used as an example in a graduate course. However, this does not completely explain the age demographic, because some of the students were younger adults and the videos were also available for public viewing by any user. Anyone can watch these videos and anyone who watches after logging into YouTube will contribute demographic information to the group usage statistics. Additional research is needed to address these questions.

Conclusion

Virtual worlds, machinima, and YouTube have all emerged in recent years as entertainment technologies that are now being adapted for educational purposes. The interactive educational machinima prototype described in this paper integrated all three of these technologies. After designing, implementing, and evaluating the prototype design through analysis of usage data, several preliminary conclusions can be drawn.

First, careful planning is an essential first step in a project like this. In addition to storyboarding and scriptwriting, the designer will find it prudent to consider time and financial requirements. The Save Princess Dot project was created by someone with experience and skills in Second Life, YouTube, and digital video production. Yet, design and production of the prototype required about forty hours of work from start to finish. Novices are likely to require more time to create a project like this. However, machinima development can be easier, less expensive, and faster than traditional filmmaking approaches because the location, props, and actors are all virtual. Free hosting and usage tracking on YouTube can also keep overall costs down.

Second, usage statistics can be helpful when evaluating the design of an interactive educational machinima project. Usage and demographic statistics obtained from YouTube revealed a possible gender and age preference issue with the prototype. This finding sparks a question for further research. Does the design of an interactive educational machinima production naturally attract a certain type of user? A comparison of usage patterns among various designs may begin to answer this question. However, the caveat here is that YouTube usage statistics are limited to an exploration of group usage. It is not currently possible to track individual users on YouTube without creating separate projects shared privately with unique users.

With respect to the use of YouTube Insight statistics, it should be noted that design testing on YouTube can be either public or private. The videos uploaded to YouTube for the Save Princess Dot prototype were all made available for public viewing. This was done to increase the potential audience and gather a larger pool of usage and demographic data. The development of a compelling design may be indicated by the popularity of the project, which indicates high interest. However, there may be times when the designer wishes to explore usage by a controlled group of users. This can be done by making all of the videos private in YouTube. Then, access to those videos can be restricted to specific YouTube users who comprise the research or evaluation group. Private videos can only be viewed by those who have both logged into YouTube and been given permission to view them by the owner of the video. This would assure that the number of views and demographic information came only from a specific group of users rather than the general audience of YouTube users. It should be reiterated that, at the present time, YouTube appears to be best suited for analysis of group behavior unless a private video is shared with only one user.

Finally, the complex interplay of skills, knowledge, and creativity required to design and produce interactive educational machinima inspires questions about the potential value of student design within this genre. Given that creativity in teaching and learning aligns to contemporary educational technology standards, research along these lines would advance understanding of the interplay between creativity and technology as it manifests in student productions. The tools currently available to support this type of research are becoming increasingly abundant, user-friendly, and affordable making research in educational machinima design and production easier than ever. It is also compelling given the popularity of video games, avatars, and 3D technologies and the possibilities these technologies offer for creative teaching and engaged learning.

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Appendix: Links to Machinima Examples and Resources

Save Princess Dot Interactive Machinima Project

- Virtual movie set in Second Life: <http://slurl.com/secondlife/Jingyo/229/119/50>
- Starting point of Save Princess Dot on YouTube: <http://www.youtube.com/watch?v=aaaN1eJhCdg>
- Storyboard: <http://edtech.boisestate.edu/snelson/yt/branchingstoryboard.pdf>
- Playlist of all the videos in the Save Princess Dot project: http://www.youtube.com/view_play_list?p=5ED58D809885260D

Real-Time 3D Animation Technologies

- The Sims: http://thesims2.ea.com/help/detail.php?help_id=64
- World of Warcraft Machinima: <http://www.worldofwarcraft.com/community/machinima/>
- Moviestorm: <http://www.moviestorm.co.uk/>
- iClone: <http://www.reallusion.com/iClone/>
- Second Life: <http://secondlife.com/>

Second Life Resources:

- Second Life Machinima Wiki: <http://wiki.secondlife.com/wiki/Machinima>
- Second Life LSL Portal (Linden Scripting Language): http://wiki.secondlife.com/wiki/LSL_Portal

Video Production Resources

- Adobe Premiere Elements: <http://www.adobe.com/products/premiereel/>
- Audacity sound recorder/editor software: <http://audacity.sourceforge.net/>
- Camtasia Studio: <http://www.techsmith.com/camtasia.asp>
- Garage Band: <http://www.apple.com/ilife/garageband/>
- Absolute Sound Effects Archive: <http://www.grsites.com/sounds/>

Machinima Examples:

- Machinima Examples on YouTube: http://www.youtube.com/results?search_query=second+life+machinima
- Second Life Channel on Machinima.com: <http://www.machinima.com/channel/view&id=10>
- The Machinima Archive: <http://www.archive.org/details/machinima>

Branching Video Examples on YouTube

- Playlist of Branching Videos with Possible Educational Value: http://www.youtube.com/view_play_list?p=6633E5F0C2F55315
- Playlist of Interactive Adventures: http://www.youtube.com/view_play_list?p=FF71721629BAE928
- Playlist of Interactive Games: http://www.youtube.com/view_play_list?p=7215176DBCFCB548F
- Playlist of Interactive Tours and Maps: http://www.youtube.com/view_play_list?p=4427BD3E28B63522