Using Games, Mobile and Wireless Environments to Construct Meaningful and Motivating Learning

Two Cases: Adventure in the Castle of Oulu (1651) and Virtual Snellman (1822)

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Abstract:

The traditional notion of a learning environment has expanded to cover virtual spaces. Today, these virtual learning environments are often network-based and readily wireless accessible to a certain group of students. Virtual meeting places are extremely popular among young people. Their very popularity can occasionally even present problems in everyday schoolwork. Thus, attempts to harness these new tools and environments for learning purposes are worth undertaking.

These considerations have inspired the present project that has produced a 3D virtual learning environment with the aim of providing a space for learning activities. The space itself and its virtual inhabitants in these cases are based on historical data. The players who enter this environment learn by interacting with the characters and each other.

The game offers challenges the players try to solve as a team. It emphasizes group work skills, group interaction, and cooperation in various conflict situations that have to be negotiated inside the virtual world. Historical information plays a key role in game play and thus the learning experience is integrated to the events of the game, making learning fun. The environment utilizes both verbal and non-verbal communication and it does not contain violent or destructive elements and therefore it is suitable for children of all ages and both sexes.

One of the important goals of realizing the Snellman game is to make sure the application can be transported to other networks and is able to utilize different learning environments through, for instance, mobile devices. The use of mobile technology raises a number of questions in terms of production. How central a role should mobile devices assume in game play? In what way should information acquired via mobile devices mesh with the virtual environment?

1. Introduction

The game concepts were produced in cooperation with the Department of Education of the City of Oulu and Ludocraft, the Game Design and Research Unit of the University of Oulu led by Dr. Tony Manninen.

This article describes two projects whose aim was the creation of a virtual space designed to enhance learning. The activities embedded in this virtual space offer a game-like environment that supplies the players with bits of information which carry the plot of the games and provide an interactive learning experience. The convergence of gaming and learning environments expounded through the description of these

projects challenges traditional notions of teaching and learning, changes the way these concepts are viewed, and creates an alternative perspective to the distribution of information. Briefly, the examples are the following:

Case I: Adventure in the Castle of Oulu

-historical environment based on the ancient castle of Oulu in the year 1651
-virtual environment with a maximum of 30 participants
-3D game engine, allows verbal communication between participants via headsets

Case II: Virtual Snellman

-J. V. Snellman, a historical statesman, father of the Finnish currency
-an open virtual network environment
-includes tools for mobile technology applications

1.1. Gaming Technology for Educational Purposes

1.1.1. Youth Culture and Social Change

Young media consumers want to be active participants in rather than passive observers of information. This is particularly apparent in their use of the Internet – they are at home in networks and virtual environments. Previously, the Net was conceived merely a source of information, but today the social and communal nature of virtual network environments is recognized. Information is actively constructed online through the exchange of opinions and images. Furthermore, users want to be able to influence their virtual environment and not only act as consumers but as producers of information as well. In the learning environments of the future users will be able to manipulate content to suit their present needs. These developments, in turn, will present challenges to individual schools as well as pedagogy in general.

Young students are constantly applying new technologies creatively to suit their own purposes. According to the Scandinavian eLearning Nordic (2006) study, the use of information technology does improve learning results. The problem with new technologies is that teachers often feel unqualified to apply them to teaching. Teachers and students inhabit different digital worlds and this mismatch is reflected on the learning experience. The effective use of information technology requires a departure from traditional teaching methods and available pedagogical frameworks.

1.1.2. Games as Viable Learning Environments

Games and play are natural activities and part of everyday life. Before the advent of mobile and wireless technologies games were tied to specific occasions and locations. Today, games are capable of producing a forum where people can establish and uphold relationships with others. The societal role of games is transforming gaming from a mere pleasure-seeking activity into an incremental part of modern society, especially in youth culture.

People use games as a means of expression. Gaming is a phenomenon that touches nearly everyone. Games and game environments provide a space wherein one can

solve problems, interact with others, and build social networks. They also present opportunities for exploring and developing one's emotional life. Furthermore, as shown by Gee (2003, p. 205), games operate with solid principles of learning that are better than those in many of our skill-and-drill, back-to-basics, test-them-until-they-drop schools. Games are often multilayered and can contain a vast variety of activities, address any number of interests, and provide countless possibilities for human interaction. In the future, it is crucial to develop genuinely innovative educational games for large audiences in order to counterbalance the mass of violent games on the market. As such, games will have an increasingly important part to play as learning environments and methods of teaching (cf. Lim et al. 2006).

1.1.3. Using Games to Construct Meaningful and Motivating Learning Situations

Earlier research has suggested that games can have a positive impact on learning, since they support intrinsic motivation, and give opportunities for imitation and learning by providing feedback, fantasy, and challenges (Rieber 1996). The purpose of play is to practice everyday skills. In order to motivate the player, a game must have a goal. This goal produces a challenge for the player and motivates him or her to develop the skills that are required to reach it. Digital games fulfill the central requirements of purposeful play (Ermi et al. 2004). Learning need not be the explicit objective of play, but any given game requires some learning to take place. The charm of play and the popularity of digital games inevitably lead to the question: Can gaming be used in teaching? Through games, children are often prepared to go to great lengths in order to achieve their goals.

Playing games develops one's style of thinking towards an experimental, game-like approach to problem solving. The activities that take place within a game are circumscribed by a set of rules that have been agreed upon beforehand (Salen and Zimmerman 2004). In addition, the game acts as a learning space in which the learner is able to take risks where real-world consequences are lowered (Gee 2003, p. 62).

Online games and various virtual game environments are steadily gaining in popularity. Gaming is as much a hobby as reading books, but often this is not recognized by parents. Children are especially attracted to action and adventure games. Furthermore, children more often than not resort to their circle of friends in their choice of games and thus gaming is at the outset a social affair. Young students view games as meaningful and motivating environments that enable them to exercise their faculties, actively explore various subjects, meet with friends, and create and uphold relationships with others. In contrast, most parents and educators view games as entertainment.

This framework is the basis on which the present research on virtual learning environments in Oulu has been built. The Department of Education of the City of Oulu and the university's game research unit have produced two projects in which it has been possible to observe the benefits of educational gaming in practice. The following two cases provide information and discussion about the value of gaming in education. The cases consist of two games that bring history to life.

Figure 1: Bird's eye view of the area surrounding the Castle of Oulu

2. CASES

2.1. CASE I: ADVENTURE IN THE CASTLE OF OULU (1641)

Educational Gaming Technology: an Experiment in Design and Application

2.1.1. Background

In 2005, the City of Oulu celebrated its 400th birthday. The very same year, the city hosted an event known as the Festival of Schools and welcomed 12,000 school children and teachers from all over the country to participate in activities associated with the event. One the largest workshop at the Festival was dedicated to communication and media skills and the workshop needed something new and exciting to attract students. This need was met by designing an educational 3D gaming environment.

Figure 2: Gamers in action

Research on the application of virtual environment technologies to education has been pioneered in the University of Oulu by the Research Unit for Educational Technology at the Department of Educational Sciences and Teacher Education with the leadership of Professor Sanna Järvelä. In this work, game design and development have been the responsibility of the university's game research unit, LudoCraft, led by Tony Manninen. These efforts have focused mainly on higher education and they have been documented in various publications (see, for instance, Hämäläinen et al. 2004, Hämäläinen et al. 2006, Manninen and Korva 2005). Drawing from this research, the present project aimed at developing students' communal skills in a virtual environment as well as exploring further advancements in the field.

2.1.2. Realization and Pedagogical Objectives

2.1.2.1. Production and Design Team

The team in charge of the realization of the project consisted of a game development group of eight people who supplied all the essential skills required for designing and constructing a game. The team was lead by a producer and a lead designer. Among the areas of expertise of the participants were programming, level design, 3D modeling, animation, audio design, script writing, graphical design, and concept art, to name a few. With this approach, it was possible to acquire the required level of quality for the outcome of the project.

The game development team was supported by a group of pedagogical experts who planned the functional and educational features of the game and made sure it met the needs of players aged 9 to 16 years. The seamless collaboration between game developers and pedagogical experts enabled the project to harness two very different knowledge bases.

2.1.2.2. Platform

The platform chosen for the project was the Unreal game engine by Epic. An end user license agreement of €50 per workstation secured the use of the platform for non-profit, research, and educational purposes. A client version of the Unreal environment was installed to a number of workstations which were then connected to a server that controlled the flow of the game. Most modern PCs with adequate memory and a competent 3D graphics card can perform these tasks.

2.1.2.3. Game and Gameplay

The virtual game environment emphasizes group interaction and cooperative skills, testing these skills in various challenging conflict situations that have to be resolved through teamwork. The game itself is a multiplayer game designed for up to 30 simultaneous players. It should be noted that the objective of the designers was to avoid the inclusion of any violent or destructive elements in order to ensure the applicability of the game for educational aims and younger players.

The environment is a faithful representation of the area surrounding the Castle of Oulu in 1651. The model is based on historical documents and drawings from that period. Some fictional elements were added to enhance gameplay.

The moderator sets up the game on the server according to the age and number of participants, assigns a preferred duration for the game, and adjusts the difficulty level. Each player is assigned a name, a character, and a specific mission. The assigned characters are based on typical professions and social classes of the period such as peasant, clergyman, merchant, or soldier. A typical mission statement reads: "You are a shopkeeper and your job is to buy and trade as much merchandise as you can. In addition, you have to contribute to the mayoral campaign of the merchant Anders Mattson by acquiring votes." The other players receive similar tasks associated with various professions. Some of the players act as henchmen, creating discord and thus adding suspense to the game. The players score points according to their performance on a given mission. The teacher, acting as moderator, can assume the likeness of a bird or a dog in order to move freely in the environment as an observer.

The user interface of the game is simple and straightforward. Movement in the game environment is controlled by the arrow keys on the keyboard and the computer mouse. Exchanging items and other related actions take place using the function keys.

Figure 3: Players exchanging microknowledge via headsets (voice data), characters sporting speech bubbles

Communication within the game is conducted with the aid of headsets. Contact in the virtual game world is established by approaching a character at which time a speech bubble appears and signifies the possibility for communication. Communication via natural speech instead of the usual written chat-form was found to be a major strength of the game. However, this required some special arrangements in the game room as it produced the need to create sound proof areas for the players. The practical solution to this problem was to erect cubicles – like in many language-learning studios – for individual workstations.

A typical session consisted of the following activities:

-demonstrating the basic idea and principles behind the game 15 min
-playing the game 60 min
-feedback and discussion 15 min

2.1.3. Observations

The objective of the project was to investigate the educational use of a 3D gaming environment targeted for students 9 to 16 years old. Given the relatively short amount of time that was available for design and production, the game itself can be considered a success. Despite the fact that before the final field experiments the game had not

been tested on large groups involving more than 10 players, the game environment was found to be stable and reliable.

Over 300 students took part in the ten separate game sessions during the week of the Festival. In addition to oral and written feedback, gameplay was videotaped and recorded on the computers' hard drives. This material is currently under analysis by the research group.

Preliminary findings based on the oral and written feedback suggest that a game-like approach to historical materials is motivating for the students. As with the use of print or following learning material in multimedia form, assuming a character in a virtual world can act as a valuable supplement for the learning process.

New teaching programs often emphasize community, the importance of communication, and media skills. The game showed potential for the realization of precisely such objectives.

This pilot project did not contain the elements required for an in-depth study (such as the use of a control group) and therefore its conclusions must remain tentative. However, the project did produce a wealth of data that can be used to benefit future research.

At present, the environment is freely available for student groups through the Department of Education of the City of Oulu.

2.2. CASE II: VIRTUAL SNELLMAN (1822)

Figure 4: A street scene from Snellman’s period

The positive feedback from Adventure in the Castle of Oulu inspired the team to conceive of a second educational game. Unlike in Adventure in the Castle of Oulu in which gameplay took place in a closed environment coordinated through client programs, the game's follower was designed to function on the Internet and contain the possibility of interfacing with other learning environments and technologies such as mobile devices. The 3D game engine software created for the project was designed with future projects in mind.

This section describes only the designing process and the early stages of production. The finished product will be available for schools in the fall of 2006.

2.2.1. Background

The year 2006 marks the 200th birthday of J. V. Snellman, a legendary Finnish statesman and philosopher who acted in several political roles during his lifetime. The theme of the jubilee is to celebrate the national identity of Finland and this theme is illustrated through the colorful personal history of Snellman himself. All citizens and especially the younger population are encouraged to participate in various events that take place throughout the year.

Virtual Snellman, a virtual learning environment situated in the year 1822, is part of these pursuits. The central idea behind Virtual Snellman is to create a virtual learning environment that contains a wealth of information about Snellman and his contemporaries, and to transport the player into their historical surroundings. The learning environment will also contain exciting game-elements such as various objectives and goals, role-playing and colorful characters, and an exciting plot. Students will be able to develop strategic thinking as well as problem solving and decision making skills. Furthermore, the learning environment will enable the student to be a part of a group and interact with his or her social network.

This Snellman-themed learning environment will be realized as a game in order to attract students. The purpose of the game will be to introduce the students to fascinating historical materials in an exciting way and thus make the learning experience a captivating one.

A game-like environment will offer the player the opportunity to shape the learning experience to suit his or her interests. A game that emphasizes action will make the relationship between the individual player and the information imparted by the game an active process in which interaction and communal goals are raised above the gathering of factual knowledge.

2.2.2. Objectives

The objective of the Snellman project is to construct a virtual learning environment that is inspiring and rich in opportunities. The learning environment contains a wealth of information which is contextualized in the form of a virtual world. Learning in this environment occurs by exploring the virtual space, problem solving, and interacting with others.

Figure 5: A learning environment containing microcontent

2.2.2.1 The Core Questions of Content Production

In the design stages of the Snellman game, the following central questions have to be addressed before and during production:

1. What does a game have to be like in order to attract and maintain the interest of the target audience?
2. What kind of control mechanism is suitable for the target audience in a 3D environment?
3. How to utilize the enormous amount of historical data in a manner that does not transform the game into a mere reading experience?

2.2.3. Interfacing

One of the important goals of realizing the Snellman game is to make sure the application can be transported to other networks and is able to utilize different learning environments through, for instance, mobile devices. The use of mobile technology raises a number of questions in terms of production. How central a role should mobile devices assume in gameplay? In what way should information acquired via mobile devices mesh with the virtual environment?

How much do the locations of buildings in present-day Oulu differ from the year 1822 and can disparate materials acquired through the use of mobile devices be utilized in the first place? Could one utilize mobile devices in ways other than gathering

information about locations in present-day Oulu? Should this information play a central role or should it remain an added feature?

2.2.4. Requirements

During pre-production, the requirements and demands of the target audience have been carefully mapped. In addition, the design group has compiled a list containing technical requirements for production, content, game design, audiovisual style, and the storyboard.

2.2.4.1. General Properties

The Snellman game was assigned the following properties:

1. A virtual environment where the action takes place
2. Three dimensional, modular, visually impressive
3. Content respectful of the theme
4. Interfacing: mobile devices, other systems

2.2.4.2. Requirements Relating to Gameplay

The following chart illustrates a preliminary list of requirements for a viable game.

Requirement	Arguments and Examples
Replayability	Must not lack in content even if played through a number of times
Expandability	Possibility to expand the environment in the future Sequels, further levels and scenarios
Rich in relevant information	Full of interesting details about Snellman's life Not merely an encyclopedia
Visual appeal and ambiance	Competent audiovisuals attract young gamers Able to convey factual knowledge to the target audience
Educational	Exploration, observation, analysis Not only performance but atmospheric as well
Appealing to young gamers	A genuine game, not a mere application Goals, challenges, and rewards must be clearly visible
Easy to learn	Everyone should be able to play the game Low threshold, but challenging enough

2.2.4.3. Activities in the Environment

The learning environment consists of virtual spaces where the activities take place and information is imparted. A virtual space might be a room, the scene of an historical event, or some other space that contains the necessary selection of tools, characters, and activities.

-creating the space and circumstances
-modeling the events
-setting up the objectives and related activities

-emphasizing interaction

Virtual model of the city center

-an environment the user can explore freely
-information, observations, and materials located in (say) a printing press
-a space where the user can store information

2.2.4.4. Information

The educational objectives of the Snellman game set demands for the historical information present in the game environment. Despite its game-like qualities, information conveyed by the environment takes center stage. However, the objective of the project is not to produce a Snellman databank. The information presented in the game can be viewed as both raw material for gameplay and educational material for students.

1. Information must be based on historical facts
    (a) A critical approach to sources
    (b) Ensuring the authenticity of the material
2. There must be a sufficient amount of information
    (a) Collecting, recording, and transforming the material into a presentable form
    (b) Arranging the material into suitable blocks
3. Information must be accessible
    (a) The material must be placed into the game environment
    (b) Interactivity
4. Information must be presented in an interesting manner
    (a) Game-like qualities
    (b) Choosing perspectives and the manner of presentation

Proper presentation of the information requires that the environment is modeled after Snellman's era; specifically, the year 1822. The objective of designing the learning environment is to create a virtual space that contains all the relevant information. This information is based on historical fact, arranged in a suitable manner to cover relevant topics, easy to approach, and presented in an exciting way.

The game is intended mostly for younger gamers and therefore the information must not be in textbook or encyclopedic form. The user must be able to experiment, explore, and engage the subject matter in a vivid manner. Creating these effects through various activities and experiences can be achieved by faithfully modeling Snellman's era and being true to its historical features.

2.2.4.5. Information Created by the User

Content created by the users themselves is a current topic that has generated lots of interest in gaming and virtual communities. The reason for the popularity of this feature of gaming can be explained by the individual user's desire to star in his or her own storyline and leave a mark on the given environment.

-information is generated collectively
-question and answer wiki
-conversation and interaction with other players

-A user-specific registered character makes it possible for him or her to voice opinions, address questions, to leave signposts for future gamers, and discuss observations about gameplay with others; this makes the information presented in the environment yet more meaningful.

-The user can submit acquired information to his or her own e-mail account for future use or augment a previous answer given in response to a problem presented by the game at a later date by using (say) an entry code supplied by the game.

Content created by users can also present significant risks. If the content is not controlled in the proper manner, there is a danger that the environment will be filled with inappropriate materials.

3. Utilizing Games for Educational Purposes: A Summary of the Project

The two case projects described in this paper approach the problematic area of educational games with a hands-on mentality. Since an educational game cannot deliver if either the educational content or the game itself fails, there is a need to combine the two domains into a seamless multidisciplinary effort The two-year collaboration between pedagogical experts and game design researchers has provided us with a wealth of information – and critical questions – that can be used in future work.

How to present information to young students in a meaningful and exciting way? How to bring books to life? Snellman, for instance, has been the subject of a biography exceeding a thousands pages and a 24 volume series of books, consisting of 12,000 pages. Young students do not favor written materials of this sort. Is it possible to deliver the same information using games?

The learning process involved in gaming often proceeds in concordance with gameplay. Games require and develop various problem solving faculties and learning strategies. Children associate learning with the classroom situation and thus games offer, as it were, a covert way of delivering information. The idea behind microcontent is to offer the players information that one could acquire from a textbook and present it in small bits, embedded in the virtual environment.

One can teach various useful skills and demonstrate societal values through games. Games involving strategy and simulation have the strength of creating opportunities for experimentation and cultivating a hands-on approach to learning. Games involve learning everyday skills through direct experience, free exploration, and repetition. Furthermore, games evolve language, computer, and media skills and can instruct students in historical facts and values. Modern games can also provide learners an experience in social interaction and alternative methods of learning. The virtual learning environment supports the compounding of knowledge from information collected from the environment and the exchange of relevant facts between fellow players.

Central to the experience is the player's immersion into the world of the game. In digital games, the act of moving through space is of great importance, perhaps as important as the plot of the game and social interaction with others during gameplay. Because of this, these games emphasize exploration and discovery, finding and utilizing various objects and bits of information. It is important that the player feels at home in this virtual space as the experience as a whole is composed to a large extent of the interaction between the player and his or her environment. The game environment acts as a micromedium that amplifies interaction, motivates the player to solve problems presented by the environment, and encourages the player to learn and continue learning.

There is usually an idea of a fictional world behind games, a world where the player can act free from the restrictions of the actual world. Gaming is a multidimensional activity and it is largely dictated by the prerequisites of both game and player. The world that is opened up through games enables the player to perform feats that are simply impossible to execute in the real world. Succeeding in these virtual tasks strengthens the player’s ego and self-esteem. Games are played for the pleasure they produce and the experiences they offer. As the objectives posed by the game are achieved, the goal of educational gaming, microlearning, takes place.

The virtual game and learning environment gives the concept of microlearning a new form and supplies it with fitting content. This tool enables the simulation of real-life situations which can then be tackled inside the safety of virtual reality. The environment integrates familiar Internet applications and working methods, and it enables players to browse through microcontent and accumulate useful information, microknowledge. Traveling through the environment can itself be considered a learning experience. Furthermore, the flexibility of the digital information supplied by the environment enables it to be exported into other applications and platforms, such as mobile devices, in the future. Virtual learning environments demand a fresh conception of information and teaching, but they also supply new possibilities for uniting learning in the real world and learning that occurs with the aid of computer networks.

Games present a difficult situation for teachers and parents. Due to the fast pace of modern culture, teachers and parents find it difficult to keep up with progress. With games, problems such as commercialism and excessive consumption present conflicting scenarios. Games and computer networks can become a problem if they displace social interaction in the real world. Excess violence in games is often, and rightly so, emphasized in the media as well.

Teachers and schools can no longer view themselves simply as distributors of information. The focus of education is shifting towards the task of understanding a computerized digital world that contains great amounts of noisy information. The functions of games and learning environments are converging and more often than not learning in this setting occurs in a less self-conscious manner using modern digital instruments to explore and test the large quantities of information that is available to young students. Active learning such as this produces a learning experience that the student will remember for a very long time. Learning, in this sense, consists to a large extent of adapting and processing information to suit a great variety of different

contexts. Experience has shown that young students are drawn to game-like learning environments and find in them the necessary motivation to undertake the study of a given subject. Retrieving strategically placed bits of information produces a clear picture of the subject as a whole, provides an enjoyable gaming experience, and, most importantly, inspires learning.

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