COMPUTER GAMES AS HOMEWORK
How to delight and instruct

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Abstract: We are interested in exploring how entertainment in games can be combined with educational goals to make a compelling experience. In this paper we present our design study for the development of a mod game, Antarctic NWN. We first present the background for the game, objectives, and then discuss the gameplay of Antarctic NWN. We then explore issues that influence the design of a gripping game. One important issue is the relation between reality, simulation and game word. Then we focus on enhancing emotional involvement. Emotion is especially relevant to role-play game as it draws players into the story, and supports aesthetic understanding. We also look more specifically at the role of humour in this context. Humour enhances learning as well as providing a more pleasurable experience. In our quest to understand how games can both delight and instruct, we review the environment in which our game might be played, within the classroom *or as family entertainment* and describe different scenarios of use.

Key words: Computer games, education, entertainment, emotions.

1. INTRODUCTION

One of the main uses of computers in the home is for computer games. Computer games are very popular: in their study, Phillips et al. [1] showed that 75% of children played video games, alone or with friends. While there are games with an education focus, the main reason reported for playing games is enjoyment: games are engaging and fun. In this paper we describe the initial stages of our study of modifying a successful entertainment computer game to play an educational role.

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The amount of time that children spend playing computer games at home suggests closer consideration of the role of games. Despite early concern about computer games and the negative effects like violence, addiction or poor school performance, studies have also shown a positive side [2]. Playing computer games can enhance visual processing skills, including visual attention, and the ability to manipulate objects or mental images through space [3]. Players discover strategies for overcoming obstacles, and construct understanding of complex systems through experimentation in natural and unobtrusive ways.

There are countless games where educational objectives are in the foreground, and learning is the explicit goal of the game. There are also games where the educational objectives are more indirect. For example, "Where in the world is Carmen Sandiego" taught simple geography whilst users were playing a mystery game.

We are interested in exploring how games intended primarily for entertainment might also accommodate education. Our current project is to take an existing and popular entertainment game, Neverwinter Nights, and while retaining the entertainment focus, re-purpose it with a new goal of teaching about environmental issues. Our overall objective is to determine how much of the compelling nature of computer games can be combined with educational goals. If this is possible, it could change the role of computer games at home. We thus explore developing a game such as our as a family game. In this paper we focus on basic design issues, reporting on how well we were able to accommodate our educational agenda within the game, and discussing the issues that arise.

The paper is structured as follows. In the next section we outline the background of our project, including our pedagogical strategy, our educational objectives, and the role-playing game we selected to re-purpose. In section 3 we discuss the key elements of our game: environment, characters and the gameplay. In section 4 we examine design issues that are particularly relevant to the design of compelling games: the interplay of fantasy and simulation, and the role of emotional involvement and humour. In section 5 we discuss contextual issues relating to educational setting as well as home and family entertainment. In section 6 we review our experience and present our conclusions.

2. BACKGROUND FOR THE GAME

In this section, we situate the game development within the cybercartography project and discuss the idea and the perspective driving the game design.

2.1 Game Background

Our game study is part of a larger project in cybercartography, a new approach to cartography that "aims at transforming all kinds of cultural, socio-economic and environmental information into interactive representation, allowing users to explore spatial patterns and relationships into new ways" [4]. One goal of this project is a cybercartographic atlas of Antarctica. Some of the content of the atlas is for secondary school students who take part in the Students on Ice (SOI) programme, which features a field trip in the Antarctic. The learning objectives for our game were chosen with these students in mind, and more generally to draw teenagers into the world of Antarctica and environmental issues.

Antarctica is a powerful venue from which to study global warming and its consequences. For instance, ice cores collected from drilling deep into Antarctic ice provide scientists with a wealth of information about past climatic conditions extending over half a million years which help them to understand more recent climate change. The impact of recent global warning has been demonstrated on the Antarctica peninsula [5]. One of the most controversial points remains the potential impact of global warming on sea level. For some this impact is negligible, while for others the sea level could rise up to 80 meters [6]. Beyond this kind of controversy, the risks imposed by global warming on specialised species such penguins are widely acknowledged. These species are highly sensitive to environmental changes and their survival is at stake.

Based on these different elements we highlighted three major pedagogical goals for the game: (1) help the students to learn about the environment of Antarctica (e.g. geography, climate, wild life), (2) expose them to some issues related to global warming (e.g. facts and developing a critical perspective) and (3) expose them to the scientific processes used to study global warming in Antarctica (e.g. ice core analysis). Based on these objectives we are looking at ways of motivating students by making learning engaging. An important goal of this game is to stimulate interest so as students pursue their quest for learning, for example by consulting the Atlas of Antarctica and changing their world view through the exploration of environmental issues.

2.2 Context of Use: Game as Homework

Teenagers are more likely to use information technology at home than at school and form a more positive attitude towards home computing [7]. Moreover, utilising computers for learning, as it is imposed upon students in traditional class setting, is simply not a fun activity [8]. We are not trying to produce a conventional educational software such as computer-aided learning, but to have high school students play a game to stimulate their interest in environmental issues. We initially envisage that the game would be played at home as homework. Despite being set as homework, it is hoped that the home environment would draw the game toward a more leisurely activity, offsetting the negative affect of school work. Moreover having students play at home has other advantages. The short traditional schedule of class is not compatible with gameplay; at home students can explore the game universe freely, and learn at their own speed. In section 5 we explore in more details different context of use including developing Antartic NWN as digital family entertainment.

2.3 Rationale for the Game

Our aim is to combine the learning objectives within the context of an existing successful game. The approach we take is discovery learning, where learners interact with their environment by exploring and manipulating objects, wrestling with questions and controversies and performing experiments [9]. Discovery learning is particularly relevant to our geographical context, but is also at the heart of learning science through aesthetic experience. According to Girod and co. [10], an aesthetic experience further brings students into the world of science through interactions and explorations and the excitement of meeting cognitive challenges. Rich opportunities to explore, engage, and reflect must thus be provided. An aesthetic experience is also emotional and dramatic, and draws in participants.

There are games that support this approach by providing a platform to develop aesthetic understanding with a compelling nature. Such games stimulate exploration through interaction, for example with characters, plots, action, and fulfilment (e.g. winning) that engage players.

We reviewed many successful games, and decided to work with games that offer controlled situations within a simulated world where cybercartography and environmental issues can be explored. Our aim is to create a powerful drama in which students will get immersed, that will challenge them to think through issues to reach their own conclusion.

2.4 Game Platform

For our project we selected the game "Neverwinter Nights" by Canadian games developer Bioware [11]. Neverwinter Nights (NWN) is widely distributed internationally, available on a range of operating systems, and is both popularly and critically successful. NWN is a role-playing game based on the pen-and-paper game "Dungeons and Dragons". The player takes the role of a character who must explore the simulated world, perform tasks, and fulfil quests, with the collaboration or hindrance of other characters within the game. Like many such games, NWN allows users to extend the basic game by creating new regions and new characters. This feature appeared to offer the opportunity for us to retain the popular character and engaging nature of the game, while allowing us to extend the game to support our learning objectives.

3. ANTARCTIC NWN DESIGN

Our intent is to explore retaining the nature of NWN while using this nature to further our educational goals. In particular, our immediate work was to explore whether this was possible at all: was the nature of NWN sufficiently adaptable? NWN is a role-playing game set on a medieval world. We decided to try and build a version of the game where the player takes on the role of a student doing a field-trip in Antarctica (i.e. like the SOI students). We studied the structure of gameplay in NWN, where one of the primary supported concepts is that of quest fulfilment, and decided to use quests to support our educational goals. Our Antarctic NWN would follow the basic structure of a mystery-adventure game. Players are given a basic enigma "the fate of a small island's inhabitant" which is to be solved through a series of quests. The setting for the quests is an Antarctic research station and surrounding territory. Players meet and interact with both human and animal denizens, and are taken to fictitious spaces, as well as areas based on real world locations. To keep and build on the spirit of NWN gameplay, players are given rewards or "magic tokens" which enable them to gain status or solve more difficult quests.

3.1 The Game Environment

Our model world is centred around an Antarctic scientific research station "Mac Town", which is modelled after the real American base, MacMurdo Station. It features buildings such as dorms, pubs, science labs, etc. We have modelled the type of existing buildings and the layout of the station, but not

quite its appearance (see figure 1a for NWN MacTown). We are retaining the medieval look of the buildings until we have more experience with the game and are ready to invest in 3D modelling necessary for more realistic buildings.

The game also contains frozen landscapes, including underwater representations: these are not really accurate representations of Antarctic landscapes, but close enough to postpone more faithful 3D modelling. The larger structure of the territory does not follow Antarctica faithfully either, and it is unlikely it will: the terrain modelling in NWN is too primitive, and the true scale of Antarctica would be difficult to accommodate in a game. Simulating a realistic environment is not necessary the design solution as discussed in section 4.1.

The game is populated with characters such as students, scientists, support personnel and appropriate fauna (e.g. penguins); in some cases the appearance of the characters is suitable, but we may eventually need to invest time in 3D design to model Antarctic clothing. The actions of non-player characters are governed by scripts, and the NWN system allows us to make scripts so that these characters can behave like students, scientists, and so on, and also communicate and interact with the player in a limited way.

Our experience so far is generally positive: NWN allows us to do what is necessary. The problems of the inappropriate look can be resolved with more modelling, and the faithful representation of the larger terrain scale would make gameplay difficult anyway. The layout of MacTown being modelled after McMurdo Station clearly seems to lead to incidental learning: while playing gamers, rapidly became familiar with the layout of the base, and the roles of the different buildings.

3.2 The Quests

Quests are the core of the game. In the original NWN, they serve to present the player with puzzles and tactical decisions, and both facilitate guidance and document progress. We hoped to use these structures to aid our educational work. We have developed two main types of quests, active quests, which are essentially task-based, and rhetorical quests based on conversation. Active quests are constructed around the process of scientific exploration, from primary data collection, to making inferences and conclusions based on analysis of the data. Rhetorical quests are more experimental, and we discuss them further later in the paper.

One action quest explores the process of ice core drilling, for determining the climatic state of Antarctica at different periods. The player needs first to collect ice core samples, then to bring the sample back to the station for analysis, and lastly to make inferences on the climate of Antarctica. Quests

are structured into sub-quests and plots. Plots are constructed around scientist actions or actions to be taken by players.

Resulting climate changes are illustrated by dramatic and humorous visualisations depicting melting ice and rising sea-levels. The climate changes are illustrated through visits to a small island, which goes from a frozen landscape, to a tropical landscape, to finally being submerged under meters of water. Multi-sensory modalities, such as sound and images, can be combined to evoke powerful emotional images that are remembered.

Another example of an active quest is the "the penguins krill quest" (see figure 1b). In this quest, we want students to understand the impact of global warming on a specialized species, but we want to accomplish this within the framework of enjoyable gameplay. For this quest, we first require that players transform into penguin, as only a penguin can talk to another penguin: we can allow this via scripting. Seeing problems through the eyes of the penguin adds emphasis and makes the quest more personal and humorous.

Conversations between characters, and between characters and players have an important function in our game. Mediation through language is critical to learning [12]. We are designing specific rhetorical quests and plots based on conversation, using different narrative modes and techniques such as humour, to communicate information, challenge students and foster social emotions. Rhetorical plots have an important phatic role in our game, they play a similar role to film transition, they initiate quest and *move* players from one quest to another. To keep players interested, plots need to be designed creatively using different narrative modes. We are also exploring conversation as an alternative to fighting, which featured strongly in the original game.

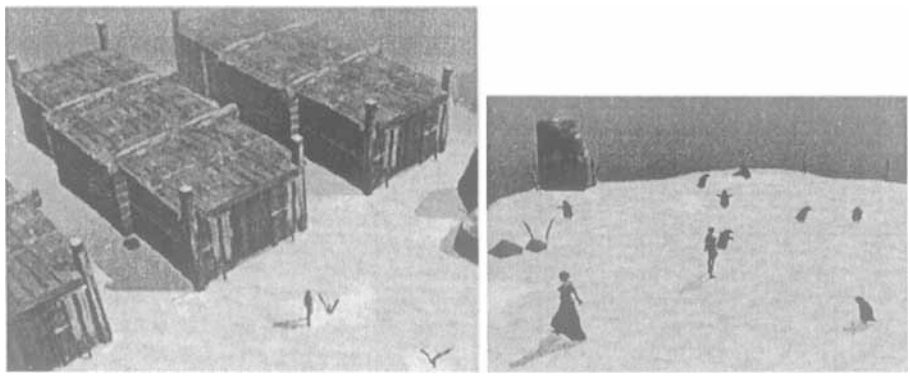

Figure 1. a, b: screen shots of Antarctic NWN, Mc Town and Penguin quest.

Specific argumentative quests can also be developed following the old Greco tradition, to debate issues, challenge an opponent or raise questions. Reflexivity and dissonance can create powerful learning opportunities for players as they struggle with multiple viewpoints and diverse value perspectives presented by the characters [13]. This can be done seamlessly within gameplay, also enriching the sense of immersion. The support for inspecting quest progress also facilitates reflection and planning.

Our experience so far with the quest structure has been very positive: quests are well supported by the game and critical to gameplay, enable us to further our educational objectives, and allow us to work with affective techniques to integrate the gameplay with the educational strategy.

4. DESIGNING A COMPELLING GAME

Our initial emphasis has been to explore in order to determine whether NWN can support education, so we are in the early stages of the game development. In this section, we want to present a number of design issues like imaginary simulation, emotion and humour, which are particularly relevant to the design of an enthralling game such as Antarctic NWN.

As we have stated, emotion is particularly important in our approach, as emotional energy both drives and holds together the development of the game experience [14]. Engagement arises from the participation of students with the environment as they become involved in a drama. Thus, narrative and emotional elements should be revised to insure the player emotional involvement.

We developed our game from an existing game featuring adventure quests, based on fast actions and vanquishing villains. By contrast our game is more contemplative, still based on role-play, but solving scientific enigma, and resolving conflicts. There are several implications, and we must find different innovative design solutions to maintain engagement.

The issues at stake here are the relation between reality, simulation and game word; and between engagement and learning. If we are to succeed, we have to realise the fun and compelling aspect of games but also to support aesthetic understanding.

4.1 Imaginary Simulation

The fundamental design basis for our game is imaginary stimulation. Antarctic NWN is neither the fictive world of Neverwinter Nights, nor a

simulation of McMurdo Station and life in Antarctica. There are important distinctions between a simulation and a game.

Games can be completely imaginary and fictive worlds, but games might also be an artistic representation of a simplified reality such as SIM city [15], which directs and immerses the player in the game. Simulations are based on an accurate model of reality that designers have streamlined to accommodate users' cognitive abilities or to overcome technical limitations. Our design challenge is between fantasy and simulation or, combining vividness and imaginativeness. Vividness allows players to feel the reality of a game while imaginativeness relates to the fantastic aspects [16].

Another game mod based on NWN is *Revolution,* where the setting is the American Revolution [17]. In this game, designers used a historically accurate model of a town and characters' costumes. Although we are initially using the medieval look and feel of NWN for practical reasons, it is by no mean obvious that we should model a more realistic description of Antarctica. Simulating a more "realistic" Antarctica might not necessarily be the best design solution.

In a scientific quest such as the ice core quest, we might want to use a more accurate version of scientific instruments to facilitate learning. The barbaric look of some of the characters could also prove distracting. However, keeping a fantasy look and feel to the game led us to design the king of the penguin quest, which would look odd in a more modern setting. The more fantastic and imaginative aspects of the game also allow for a more creative gameplay. One design challenge that we are facing is how to orient the game between fantasy and simulation.

One important question is thus how much we want to convey of the Antarctic reality and how can we express it within the game. We can for instance further embed specific elements of Antarctic reality in the game that are relevant to some of our target population (i.e. SOI). Antarctic weather is a hazard, so to emphasise the importance of Antarctic clothing and gear, characters should always dress up before going out. We expect that such basic facts about Antarctica can be learned incidentally from playing the game. Moreover, adding danger elements such as extreme cold, generators breaking down, or ice shattering will emphasise hazards, but they can also be used within the strategy of the gameplay as obstacles to overcome or random surprise elements that have to be addressed at once to keep players engaged.

The creation of an imaginary simulation demands that we carefully chose Antarctic issues and elements that we want players to explore and contemplate, and find how to communicate them through innovative design solutions that support the gameplay and maintain engagement.

4.2 Designing with Humour

In this game, we are exploring the uses of humour to make the game engaging. Besides, there are a number of ways that humour enhances learning. Humour can help to manage learners' well-being, emotions and mood, for example, and help prevent frustration, or reduce anxiety. Humour has motivating effects on attention, retention and comprehension of information [18]. And of course using humour also provides a more pleasurable experience.

In the game, the choice of characters' names has often a comical flavour. We see humour as relevant to dialogues to encourage players to read conversations. It has been claimed that humour makes the interaction between characters seem more natural and enjoyable, and humour can play a role remarkably similar to small talk [19]. Humour greases the wheel of dialogue, serves a transitional function, and provides a ritualised way for people to move in conversation.

Puns and other forms of verbal joke can enliven conversation. Humour is used in our penguin quests to relate an anecdote about penguins: the king penguin is the ultimate winner of the game "king of the hill". Irony can also play a role, as this rhetorical device has the ability to evoke a closer relationship based on a shared experience. An important function of humour is to create a link with the audience.

Characters can also be personalised using humour. The study of physical comedies shows that exaggerations of body postures create a comical effect. In one of our argumentative rhetorical quests, the character debates in a very forceful way, and characters can be given very distinctive and contrasting body types (such as in the old comedies) to increase the slapstick effect. Building on the strengths of humour, representations can be exaggerated or transformed to have a comical effect. Building on visual comedies might provide alternatives to fighting villains, and enhance the fun and emotional involvement of players.

4.3 Making Characters Cry

As we have discussed emotional involvement is an important part of designing for aesthetic understanding. Emotion can augment engagement and enhance the pleasure of learning. It has been argued that the chief impediment and motivator to learning is not cognition but emotion [13]. Emotion is especially relevant in a role-play game as it draws players in the story, and makes for richer characters, as well as providing information.

Emotions in games are evoked, for example, by failure and achievement, by obstacles overcome and by success in quests. Emotionally rich environments can be created by carefully choosing lighting, colour, music, sound, objects, symbols and character's conversations and actions. We can darken interiors to represent a heavy atmosphere, and costumes can also indicate variations in moods etc. The sounds of Antarctica, diesel generators at the station, wind, penguin or seal colony noises, these will be added to the game to enhance vividness. We want to accentuate the aesthetic and romantic feel of the game to reflect the fascination for adventurers and explorers like Scott and Shackleton. Characters, actions, dialogues and props all should function to provoke a compelling experience.

In NWN, conversations between characters take place in a chat window or in the game environment. Characters' emotions can be emphasised through typographic variations, and the inner feelings of a character can be represented by using specific symbols, as is the tradition in comics.

Human beings are experts at interpreting facial expressions and body language, and they are profoundly susceptible to emotions, moods and actions of others [20]. Visual persuasion has shown how the use of happy people makes us more cheerful, or how showing excited groups arouse viewers' curiosity [21]. Empathy with film characters keeps a viewer engaged in the film world; similarly empathy with game characters can engage players in the game world. Players would project their own values and desires into the virtual characters.

It could be thus quite important for a role-play game, to develop a strong pallet of basic emotions. Crying can be conveyed by sound effects and by showing the character with his head hanging down and shoulders crouched. We plan to strengthen the characters' facial expressions through simple conventions, e.g. a character turning very white (fear) or red (anger). Facial expressions are not usually shown in great detail in NWN, so it may prove difficult to evoke with precision. However, it is believed that characters' emotional value should be studied in this context and examined in relation with the believability and engagement of the game.

5. CONTEXT OF ANTARCTIC NWN

In our quest to understand how games can both delight and instruct we need to consider in depth the environment in which Antarctic NWN is played. We envisaged that the game would be played at home as school homework however we also want to explore the use of game in a different context, as family entertainment. From the basic game, we discuss some of the design issues related to the context of use.

5.1 Education and Antarctic NWN

Bridging the educative and ludic world might not be simple. From the educational point of view, Kurt Square [22] suggests creating instructional resources around any game, to push students to think about their game-playing more deeply. However, we should be careful when using computer games with an educational purpose not to offset the gameplay and the learning dynamics against each other.

When using Antarctic NWN as homework, we need to support students in their learning process. An interesting component of NWN is the role of henchmen. Henchmen are characters that a player can recruit throughout the course of the game to help them in their quests. A henchman is thus specifically designed in our module as a guide, to provide additional explanations when required and to help students. Learning to play a game is not always straightforward especially for non-gamers. Teachers can play the role of "Dungeon Master" as in the Dungeons and Dragons games. In this way, they can motivate and support students playing at home, for example via a chat window. Role playing games also typically a number of associated manuals (frequently third-party) that are used to assist in role playing and are well suited to educational purposes. In these manuals, we can include additional materials such as references to related websites, or point to classroom related activities. For example, in one of the quests scientists would start to argue about the role of CO2 emissions in global warming. Students could then be asked to research and review the concepts surrounding global warming to prepare for a political debate on this subject in the classroom. Participating actively in debates should enhance the learning experience.

Another more challenging possibility is to give students the opportunity to develop their own stories, and to design and implement their own quests. It could be an important extension activity, and might provide motivated teenagers significant opportunities for knowledge-creation and co-authoring of their own educational game environment.

We have presented some of the issues pertaining to the use of Antarctic NWN as school homework centred on supporting education. Different game elements such as the henchman guide or scientific quests will be tested in relation to their educational content but also in relation to the compelling nature of the gameplay. Learning involves both individual and social processes; learning is stimulated by peer interaction [23]. For more advance versions of Antarctic NWN, we envisage transforming the single player game into a multi-player game.

5.2 Antarctica NWN as family entertainment

The family is not a natural unit that simply exists, but one that is defined by action. Most games are played with friends or family, and video games are no exception. Mitchell gave Atari 2600 consoles to twenty families and found that most families used the game systems as a shared play activity; video games were found to be a positive force on family interactions [24]. Moreover, the interest for computer gaming is changing: around 40 % regular computer game players are adults over thirty and two-thirds of the 'gaming demographic' are female [25]. Thus it is quite possible that an entire family play computer game.

The objective of this version is to explore the potential developing family based educational games. It enables us to look at a different relation between learning and entertainment, and learn more on how to design for a family game in this context.

We can establish our game within a family network, as a multi-player game for family members. Each family member would play a different roles that matches the characters already developed in the game such as scientists, students, the penguin king, and so on. However, in such a family version we would need to more strongly support the social dynamics. Each person would be part of a scenario in which tasks cannot be completed that without the participation of another family member. To enhance the gameplay, we can populate the game with clues about the characters' inner lives, family situations and history. For example, we can introduce the journal of the great-great grandfather explorer, describing Antarctica in his time, and reminiscencing about family history. The character cast needs to be modified to relate to family members and personalities. Studies have suggested that older siblings can play an important role in the introduction of home technology, especially for girls [26]. We can also introduce older helpers in the cast whose mission is to help younger players to solve quests. A grand-fatherly henchman could be introduced to help younger players still. A family of penguins could be developed with a much younger cute but annoying little penguin. In other words, we can use a variety of devices familiar from stories, plays, and films, to assist identification and to allow engagement from several perspectives in a family. For this game version, we also probably need to customise quests and to make them easier for younger siblings and more challenging for older family members.

To tailor the basic Antarctic NWN game as a family entertainment we need to consider a number of issues like game issues such as character cast and quests, as above, but also informal learning and engagement. In our design, we consider that learning will happen incidentally when playing the game, in the way word games support literacy and card games numeracy.

Making the gameplay appealing to all family members might prove more difficult. We plan to use Antarctic NWN as a means to help study the potential for family computer learning games in more depth.

6. CONCLUSIONS

In this paper we described our initial work on re-purposing a computer game with an entertainment focus to also support educational objectives. We worked with the game Neverwinter Nights to address a geography education topic on global warming by developing our game Antarctic NWN. We focused in this paper on fundamental a design issue: how to integrate learning objectives while maintaining the compelling nature of a game. We described how we looked to the structure of the game to find support for our educational objectives. We found sufficient support in the way the game is oriented around a setting and scriptable non-player characters; this allowed us to build and populate a world suitable for learning about global warming.

The game does not easily support realistic terrain modelling or scale, but it does allow us to model layout and character roles to support incidental learning. The game also revolves around quests, and we found the narrative structure of quests in particular quite valuable. We described how we use various action quests to give guidance and support learning about processes. We are also using rhetorical quests to guide collaboration and competition between the player and non-player characters. This also allows us to explore alternatives to fighting which features strongly in the original NWN game.

One of the main objectives of our project is to create an engaging educational game. We focus on imaginary and simulated aspects of the game and how they can affect the aesthetic and educational aspects of the game. The role-play in the game means that character and role identification can be leveraged, thus we more specifically discuss the design of emotional characters. Supporting emotional involvement is an important aspect of the game, thus we emphasise the role of humour, to make the game fun, the character more believable, and encourage learning. We found that the game does allow us to represent emotion by character interaction and posture, but it was more difficult to show details using facial expressions.

In the last part of our paper we looked at the game context of use and how it influences the design of our game. A question that has to be investigated concerns the contextual effect of the classroom, and of the game being homework. This setting could negatively affect engagement, i.e. the game being less fun because it was homework, but it could affect positively learning, by providing a fun and stimulating experience. To explore

differences in learning and engagement, and the role of context, we discussed the design of Antarctic NWN as a family digital game.

Our experience suggests that it is indeed possible to support education within the game framework we chose. We are continuing to develop the game iteratively and incrementally, attempting to match the game support structure with our pedagogical objectives, and working with students to evaluate the experience. In particular, we will pay closer attention to differences in gender and between gamers and non-gamers. There are acknowledged differences in what kind of computer games girls and boys like, or what they like in computer games. This could also influence the design of future iterations with the creation of different characters and quests adapted to each gender.

We hope to develop a sufficient understanding to inform the development of compelling educational applications with mod games, and establish a model of the game design process, with guidelines to help future designers.

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REFERENCES

[1] C. Phillips, S. Rolls, A. Rouse, M. Griffiths: Home video game playing in schoolchildren: a study of incidence and patterns of play. Journal of adolescence, 18, 1995, pp. 687-691.

[2] D. Gentile, P. Lynch, J. Linder, D. Walsh: The effects of violent video game habits on adolescent hostility, aggressive behaviors, and school performance. Journal of adolescence, 27(1), 2004, pp. 5-22

[3] Young, J. R. Upitis The microworld of Phoenix quest: social and cognitive considerations. Education and Information Technologies 4(4), 1999 pp. 391-408.

[4] F. Taylor: The Concept of cybercartography, in Peterson, M. (ed) Maps and the Internet, Amsterdam: Elsevier, 26, 2003, pp. 405-420.

[5] British Antarctic Survey, 2004, http://www.antarctica.ac.uk/About_Antarctica /FAQs/faq_02.html

[6] D.McGonigal, L. Woordworth: The complete encyclopaedia: Antarctica and the Arctic. Firefly Books, Willowdale: Ontario, 2001.

[7] S. Mumtaz: Children's enjoyment and perception of computer use in the home and the school. Computer & education 36, 2001, pp. 347-362.
[8] S. Egenfeldt-Nielsen: Practical barriers in using educational computer games. On the horizon, 1, 2004, pp. 18-21.
[9] J. Meredith, R. Fortner, G. Mullins: Model of affective learning for Non-formal Science education facilities. Journal of research in science teaching, 34, 8, 2004, pp. 805-818.
[10] M. Girod, C. Rau, A. Schepige: Appreciating the beauty of science ideas: teaching for aesthetic understanding, Science education, 87(4), 2003, pp. 574 - 587.
[11] Bioware, 2003, Neverwinter Nights, http://nwn.bioware.com/
[12] L. Vygotsky: Thinking and speech. In the collected works of L.S. Vygotsky. Plenum press: New York 1, 1978, pp. 121-166.
[13] A. Pedretti: Perspectives on learning through research on critical issues-based science center exhibition, (2004).
[14] D. Wong, and K. Pugh: Learning Science: a Deweyan perspective, Journal of research in science teaching 38, 3, 2001, pp. 317-336.
[15] SIM City, 2004, http://simcity.ea.com/
[16] D. Choi., H. Kim, and J. Kim: Toward the construction of fun computer games: differences in the views of developers and players. Personal technologies, 3, 1999, pp. 92-104
[17] Revolution, the game prototype, 2004 http://www.educationarcade.org
[18] N. Kher, S. Molstad, and R. Donahue: Using humour in the College classroom to enhance teaching effectiveness in 'dread' courses. College student journal, 33(3), 1999, pp. 400-407.
[19] A. Nijholt: Embodied agents: a new impetus to humour research. In Proceedings of the 12th Twente workshop on language technology in computational humour, April 15-16, Italy, 2002, pp. 101-112.
[20] G. Dyer Advertising as communication. Routledge: London, 1992.
[21] F. Caudle: Communication and arousal of emotion: some implications of facial expression research for magazine advertisements. In emotion in advertising eds S. Agres, J. Edell and T. Dubtsky. Quorum books: London, 1990, pp. 127-159.
[22] Squire K. Reframing the cultural space of computer and video game, 2003. http://cms.mit.edu/games/education/research-vision.html
[23] J.P. Gee: What video games have to teach us about learning and literacy. MacMillan: New York, 2003.
[24] E. Mitchell: The dynamics of family interaction around home video games. Special Issue: Personal computers and the family. Marriage and Family Review 8(1-2), 1985, pp. 121-135.
[25] J. Dyck,, D. Pinelle, B. Brown and C. Gutwin: Learning from Games: HCI
Design Innovations in Entertainment Software. Proceedings of Graphics Interface 2003, 2003.
[26] J. Fromme: Game studies: computer games as part of children's culture. Game Studies, 3 (1), http://www.gamestudies.org/0101/juul-review/