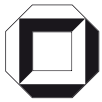
Michael Burmester, Daniela Gerhard,
Frank Thissen (eds.)

Digital Game Based Learning

Proceedings of the 4th International Symposium for Information Design 2nd of June 2005 at Stuttgart Media University



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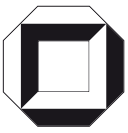

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Editorial

Learning and gaming: does this fit together? Can we use the idea of computer games to make use for learning purposes? Who will benefit from this? Does learner learn better or more motivated, when they play games in order to acquire content? Is it more fun to learn by games? According to Marc Prensky's new book children sitting at their digital learning game would say "Don't Bother Me Mom — I'm Learning!" Will that become true?

The European project SIG-GLUE, the "Special Interest Group for Game-based Learning in Universities and lifElong Learning" (www.sig-glue.net) tries to bring together experts and practitioners in the field of digital game based learning in order to discuss and exchange information concerning the questions mentioned above. The main goal is to promote more and better use of better learning games. Furthermore, the project would like to convince non users of digital games of their educational value, to encourage and support game developers in the creation of better educational games, and to make educators aware of how to use games more effectively in education. On the 2nd of June 2005, the 4th International Symposium for Information Design at the Stuttgart Media University in Stuttgart, Germany, was organised in cooperation with the SIG-GLUE project in order to give experts from research and game design the chance to present their ideas on "Digital Game Based Learning". This book contains the presentations of that Symposium.

The authors of this book present an overview of ongoing research and development projects in the field of digital game based learning. At the beginning of the book we will get an introduction into SIG-GLUE and the SIG-GLUE community. Maja Pivec (coordinator of SIG-GLUE) and Anastasia Sfiri from FH Joanneum Graz, Austria, introduce the SIG-GLUE project, showing the objectives and the possibilities to participate in the SIG-GLUE community. The central platform for information exchange and discussion is the SIG-GLUE web site www.sig-glue.net. Ioannis Antonellis, Christos Bouras, Apostolos Gkamas and Vassilis Poulopoulos from the Research Academic Computer Technology Institute (CTI) from Patras, Greece, describe the intentions and the technical implementation of that communication platform.

A very good **introduction in basic considerations of digital game based learning** is done by the following three contributions. The paper "Categorising and investigating Gender-based Neurocognitive Propensities influencing Gameplay: An Interactions-oriented approach" of Philip Bonanno from the University of Malta describes in very precise ways important foundations of gender-based neuro-cognitive propensities influencing game-play. Boys and girls as well as men and women show significant differences in selecting and using games. Fiona Littleton, Jeff Haywood and Hamish Macleod from the School of Education at the University of Edinburgh in the UK show in their chapter, whether videogame play influence the student's approach to learning. Results of a comprehensive study are presented and discussed on the basis of the relevant research literature. In the healthcare education virtual patients are increasingly used. Michael Begg, Rachel Ellaway, David Dewhurst, Hamish Macleod from the University of Edinburgh show that narrative and game play are an important consideration in making virtual patients useful for students.

Intelligent and creative use of modern information and communication technology in order to facilitate learning experience is a central and very important basis for design of digital game based learning. Ulrike Spierling from University of Applied Sciences Erfurt in Germany describes the potential of digital agents for educational applications. The agents are imbedded in simulations, games, and storytelling. The types of agents used in learning applications are described by showing several project examples. Anja Hoffmann from the Design Service Team of SAP AG in Germany and Ido Iurgel and Felicitas Becker from Computer Graphics Center (ZGDV) in Darmstadt, Germany, describe applications of story-telling for learning purposes. They do it on the basis of several very interesting research projects. The interesting European research project YoungNet is presented by Fabian Kempf from the company VITERO GmbH and Karin Hamann from the Fraunhofer Institute for Industrial Engineering IAO. Both organisations are located in Stuttgart, Germany. The Young Net is a virtual learning community platform for pupils in schools. The pupils can play and learn with other pupils at other schools via the YoungNet platform. But, is digital games based learning possible only on the basis of advanced technology? No, is the answer of Lotte Krisper-Ullyett from the factline.com company in Austria, Johann Ortner, professor at different universities in Austria and Barbara Buchegger from the University of Natural Resources and Applied Life Sciences in Vienna. They show that on the basis of simple internet platforms 1000 "Low Tech Games" can be played for learning purposes.

What is the effect on pupils and students when learning with digital games? Chris Brannigan and Angela Owen from the software company Caspian Learning in Sunderland, UK, present a case study and show how pupils and educators react to game based learning applications. An extensive evaluation study with students at university level is presented by Michael Burmester, Daniela Gerhard and Frank Thissen from the Stuttgart Media University. The used a dramaturgic approach to e-learning in an e-learning course with over 130 participants, and found what is good and what could be better when using drama in story based e-learning.

After having presented theories, foundations, applications and studies concerning digital games based learning it is time to talk about quality standards. Claudio Dondi and Michela Moretti from the research centre and service provider organisation SCIENTER in Bologna, Italy, focus in their contribution on quality in e-learning and quality of digital learning games.

We hope that you gain insight of digital games based learning and that you enjoy the interesting contributions of all the authors. Last but not least we hope to see you in the SIG-GLUE community on www.sig-glue.net. It would be nice to discuss and to exchange interesting information on digital game based learning with you.

Michael Burmester, Daniela Gerhard, Frank Thissen
Stuttgart, May 2006

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First of all, we thank all the authors for providing so brilliant and interesting contributions. In our opinion they enable a broad view into diverse aspects of digital games based learning. Thank you for all your hard work.

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SIG-GLUE: A Special Interest Group for Game-based Learning in Universities and Lifelong Learning

Dr. Maja Pivec and Anastasia Sfiri

Abstract

The SIG-GLUE community has been formed to provide a world wide communication and exchange platform for game-based learning in the field of universities and lifelong learning. The community could be seen as "knowledge pool" i.e. a resource of guidelines and practical examples that can be taken over thus facilitating the application of game-based learning. In the paper we describe formation process, theoretical background, tools, activities and resources of the SIG-GLUE.

Key Words

Game-based learning, special interest group, communities of practice

1. Introduction

Although games are part of children's growing up and formal education, digital game-based learning is a novel approach in the area of Universities and Lifelong learning. In the universities' search for new positioning in the changing setting of lifelong learning, gaming is becoming a new form of interactive content, worthy of exploration.

One of the European Projects, exploring this topic is Minerva project UniGame: Game-based Learning in Universities and Lifelong Learning (UniGame). Goals of the UniGame project were as follows: to promote digital game-based learning in Europe, to test different educational games within different subjects in various European countries and to focus on social game forms that include virtual communities and collaborative learning. More details on research results are sampled in guidelines for game based learning (Pivec et al., 2004).

A follow up project in the area of games for learning is SIG-GLUE (SIG-GLUE). The aim of SIG-GLUE is to foster more and better use of better learning games as well as to strengthen competencies and support practitioners in the application of games for learning.

The aim of SIG-GLUE is establishing structured collaboration and research in the game-based learning area, exchange of knowledge, experience in the game-based learning, monitoring the quality and establishing a quality stamp for game-based learning resources, contributing to innovation of the European and Worldwide institutions and Universities.

Main objectives of the SIG-GLUE project are as follows:

- To research and promote game-based learning and other related novel and innovative approaches to learning in the field of formal and informal education i.e. universities and lifelong learning.
- To foster production of educational games that are based on pedagogical and didactical principles.
- To improve quality of educational game products by defining a clear specification of educational and gaming elements and by establishing a quality stamp.
- To organize events where community members could meet in person and exchange ideas and experiences.
- To organize workshops on educational games application, to disseminate the ideas of game-based learning and show best practices.

The synergy of SIG-GLUE project with UniGame, provides a unique opportunity to continue to focus on game based learning and start with an active promotion of game-based learning approach worldwide. SIG-GLUE is designed to offer trainers, educators, teachers, students, game developers and designers and policy making institutions a technological and a social environment that not only supports and allows interactions among people who belong to a Special Interest Group, but an environment that also encourages the formation, development and sustainability of a virtual community in the future. The SIG-GLUE mission statement, the tools for resources and knowledge sharing among the SIG-GLUE members as well as the strategies for group work and collaboration have been developed with this implicit aim in mind.

2. Formation of the SIG-GLUE

Creation of the community is a process of establishing a theoretical basis for the community, defining possible features and services for the users, defining community committees i.e. scientific committee, defining tools and setting implementation priorities, outlining sustainability issues. Essential parts are outlined in this section.

2.1 Theoretical Background

Wenger's Community of Practice (CoP) model is one of the theoretical models on the notion of learning and professional development within a community. According to this model there are three dimensions which we need to support in order to assist the development of a virtual community. (1) The domain is the area of interest, which creates the common ground and a sense of belonging. (2) The practice is the body of shared knowledge and resources, which enables community members to develop and deal efficiently with the domain and (3) the community dimension is the social frame and arena for the learning and knowledge exchange.

The domain, community and practice dimensions refer to areas, which must be acknowledged in order to create the right "ecology" to encourage CoPs. In the same way that knowledge is emergent and organic so are CoPs. This also means that CoPs cannot be managed in the traditional sense of ordering. Instead one can encourage, cultivate and nurture these three tightly interconnected, dynamic dimensions. Domain, practice and community help identify potential communities and leverage points, which help implement CoP inspired initiatives (Sfiri et al., 2003; Pauschenwein et al., 2003).

2.1.1 Domain

At the building stage of a community it is important to define what the community is going to be about and how it is going to define its role. "Without commitment to the domain, a community is just a group of friends. A shared domain creates a sense of accountability to a body of knowledge and therefore, to the development of a practice." (McDermott et al., 2002).

Although the domain reflects the members' own view of what they think is important, it is not a static dimension of a community. If new problems or more pessing questions arise, perhaps under the pressure of external changes the members of a CoP redefine the domain. Within the SIG-GLUE community of practice the domain question is already well defined in the area of Game-based Learning for Universities and Lifelong Learning. However, what needs to be defined and communicated is the role the community is going to play within this domain. This role, which should correspond to the user requirements, can be expressed in a mission statement, indicating the purpose for the community. This statement will determine who will join; it will influence members' behaviour and the practice.

SIG-GLUE mission statement is "More and better use of better learning games". The steps of achieving the mission as follows:

- Convince non-users of games of their educational value. (here we contact the potential users of games, pointing out innovative approaches for learning and their educational value)
- Encourage and support game developers in the creation of better educational games. (eventually also pointing out curriculum relevant issues that could easily be integrated into the commercial product, or bringing together educators and content developers and enable a fruitful exchange)
- Make educators aware of how to use games more effectively in education. (exchange of good practice worldwide thus making easier to apply new ideas in their own classes)

2.1.2 Practice

Whereas the domain is the area of expertise, which the community focuses on, the practice is the specific knowledge the community shares, develops and maintains (Wenger, 1999; McDermott et al., 2002).

Successful practice development depends on a balance between joint activities, in which members explore ideas together, thus encouraging tacit knowledge types and the production of explicit tools such as documents or Websites. If CoPs do nothing more than discuss current member problems, without documenting the insights they develop, they run the risk of developing "amnesia". This is to say that because they have no record of insights they have already developed, when similar issues arise they

rework ideas, which they have already discussed. In the long run this "déjà vu effect" can be deadly to a community, since it makes participation seem unproductive. Moreover, sharing too much tacit knowledge without documentation excludes non-members from benefiting from the knowledge, which the community has already developed. Tacit knowledge needs to be externalized in a concrete way in order to be a useful resource to more people. On the other hand, too heavy a focus on gathering explicit knowledge and "documentalism" is another danger. It is wrong for a CoP to spend vast amounts of time updating entries in databases rather than concentrating on sharing knowledge. The body of shared knowledge and resources enables the CoP to develop and deal efficiently with its domain.

CoP members are peers in the execution of "real work" and what holds them together is a common sense of purpose and a real need to know what each other knows. Developing the practice also develops members' own communal resources, which include both tacit and explicit aspects of the community knowledge. They range from documents and other objects, which make the practice explicit, to tacit knowledge types such as a common perspective or a certain thinking style. To develop a practice, members of a CoP must learn to talk to one another using words in the same way and communicating with a common vocabulary.

2.1.3 Community

The community element presents the social frame and the arena for the learning processes to take place. It is a very important element since the human relationship is the basis for learning within this social-cultural perspective. A strong community element is essential for a CoP to be effective, because the construction of knowledge as well as the knowledge sharing processes depend on a well-functioning relationship among the learners. It is "people" who drive the whole structure, not best practices or websites. This is also why members need to be aware of how to behave towards one another. A CoP can be seen as a group of people who interact, learn together, build relationships and in the process develop a sense of belonging and mutual commitment. Core members of a CoP need time to learn about one another and discover how to operate as a community.

The challenging work for SIG-GLUE has been the application of the three dimensions in order to encourage the formation of a working virtual community.

2.2 User Analysis

User Analysis is process of identifying all possible stakeholders and grouping them into the user groups. User analysis forms a solid base for further actions i.e. creation of the community, defining IT tools, providing features and services, dissemination plan and activities.

The phase of Special Interest Groups (SIG) user analysis is focused on research for potential SIG members (i.e. practitioners, educational institutions, game developers, researchers, etc.), to be able in further steps to contact potential members and to inform them about the formation of the SIG, publicly announce the SIG along with intention of the SIG and roadmap, get responses from the stakeholders, analyse and classify them according to topic of interests.

Enclosed is the list of questions related to the SIG users that formed the basis for the more detailed user analysis:

- Who are the target groups and what do they do? Collection of information and characterization in relation to Game Based Learning (GBL).
- What is important for them? What are their views and their needs?
- Who provides them with support for their needs?
- What kind of service would they like?
- How can SIG-GLUE provide this to them?
- What can they offer SIG-GLUE?
- How will we approach them?

By providing answers to these questions we also define areas of interest of each particular user and certain user groups and win-win situation and information exchange between SIG-GLUE and users.

To elaborate a user analysis different various creative techniques such as brainstorming i.e. thinking creatively on-demand, user analysis in groups and elaboration of personas were carried out. Brainstorming gave us a list of different kinds of users. We grouped them into two general categories: active and potential users. The project team decided to focus on active users in the first place.

Active SIG-GLUE users can be further classified into categories as follows:

(1) **Super users** i.e. policy makers, organizations that are interested in innovation of educational process and organizations fostering ICT and education
(2) **Students and researchers** and other users of learning games
(3) **Game developers**, educational game developers and digital learning content providers

To build a clear picture of users' needs, questions and expectations from SIG-GLUE, we made a set of personas for each of user categories listed above. The Personas method was first presented by Alan Cooper in his book The Inmates Are Running the Asylum (Cooper et al. 1999). In his book Alan Cooper claims "… Whenever I hear the phrase 'the user', it sounds to me like 'the elastic user'. The elastic user must bend and stretch and adapt to the needs of the moment. However, our goal is to design software that will bend and stretch and adapt to the user's needs. […] In our design process, we never refer to the 'user'. Instead, we refer to a very special individual: a persona." When designing a UI, Alan Cooper suggests defining user personas, i.e. virtual persons who represent typical people belonging to the product's target group(s). This persona will play the user's role in the UI design process. It is for him or her that the User Interface is designed. The reason for using personas in the design process is primarily that the persona only has collective, average properties and need, is always available and after a while will be well-known by the designers and engineers.

Based on detailed user analysis we created personas, i.e. virtual persons with specific needs for different users and user groups. Based on the user analysis and created personas, SIG-GLUE services and tools for specific user groups can be defined.

2.3 Community tools

SIG-GLUE offers a range of community tools for effective communication and information exchange of stakeholders. SIG-GLUE is an open source web-based community, where trainees, educators, game designers and game developers can collaborate in the innovation of learning in terms "make learning fun" and for construction of better educational games. The platform is based on collaborative and community knowledge building paradigms. The following tools are merged within the SIG-GLUE site:

(1) **Dissemination of information**: Announcements, bi-monthly Newsletter, Glossary of game based learning, Libraries (of papers, good practice), Games (list of games for learning, game providers, etc.)
(2) **Synchronous and asynchronous communication and collaboration tools**, such as the forum (public and private, that can be used for closed sessions of working groups), personal messages, polls, comments, e-mail, and similar.

The majority of the SIG-GLUE community contents are open to anyone interested, however to be able to participate in the discussions, moderate discussions, initiate new working groups and access to all libraries, one has to register. As registered user one gets optionally also an automatic e-mail announcement about the new issue of newsletter.

3. SIG-GLUE community

The essential focus of the SIG-GLUE project is to foster exchange of good practice in game-based learning and innovative learning approaches as well as the promotion of game-based learning approach per se. Based on the project goals, theoretical principles and appropriate user analysis, a SIG-GLUE community page was developed. SIG-GLUE community page provides on one hand access to community tools and on the other hand gives information about the project and team of people involved in this project. The main activities of the SIG-GLUE community are as follows:

- **Newsletter** is a regular bi-monthly SIG-GLUE electronic publication to inform community members about ongoing research, discussions, coming events, etc.
- **Discussion** within different moderated working groups (formed by project stakeholders) by means of community tools. Communication and information exchange in the community helps education and lifelong learning practitioners in :
    (i) Getting and contributing information on the pedagogical and didactical issues related to game-based learning,
    (ii) Assessing quality of the games from educational point of view,
    (iii) Utilizing the game and e-learning platforms for playing educational games,
    (iv) Getting support in the selection, development and modification of games for learning.

- **Quality stamp** for the games suitable for learning purposes. Individuals and game producers can submit their game prototypes or fully developed games for the quality review. The review is carried out by a list of independent evaluators following the quality criteria for learning games. More details about quality stamp, submission process and quality criteria are outlined in the community section Games.
- **SIG-GLUE events** on national and international level, fostering the knowledge exchange (in form of symposia, workshops, etc.) and creating possibilities for networking.

Apart from discussions within the working groups, SIG-GLUE offers also other resources, such as e.g. a glossary of game-based learning, where one can look up definitions and examples. There is also a possibility to comment and extend the definition. Another pool of resources is the library, where members can find and/or contribute book reviews, good practice examples, etc. A separate module is focused on games and provides collection of games, game providers, interesting game links, actors in this area, etc.

SIG-GLUE is an open community where everyone is invited and welcome to participate, contribute and organize an activity. Various community areas, benefits and ways of participation for different user groups are presented in more detail on the SIG-GLUE walkthrough DVD that is enclosed in this publication.

4. Conclusions

SIG-GLUE promotes game based learning approach worldwide. However we are aware that there are many practitioners for whom discussion in English could be a barrier. Therefore we created also "SIG-GLUE around the world" discussion, where we invite and support people to establish work groups in their own language e.g. working groups in Spanish, Polish, etc.

SIG-GLUE and related projects contribute to an active promotion of game-based learning approach worldwide and give inspiration and encouragement for the development of innovative learning approaches by practitioners. We hope that game based learning will get more support from policymakers e.g. national ministries for education in the form of including game-based learning into curricula thus supporting directly the work of practitioners. We hope that game based learning will remain a priority of technology enhanced learning foundation programmes, thus improving practice and contributing to educational innovation.

5. Acknowledgements

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6. Authors

Maja Pivec: Her research is focused on game based learning, adaptable e-learning systems, knowledge management, and multimedia knowledge modules. For her research

achievements Maja Pivec received in 2001 the Herta Firnberg Award (Austria) in the field of computer science. She was involved in the international learning standard development carried out within the IEEE LTSC committee.

Anastasia Sfiri: Her work in the area of computer supported learning includes research and development on pedagogical and didactical approaches for eLearning, Computer Supported Collaborative Learning, Communities of Practice and Game-based Learning. Anastasia studied Psychology (BSc) at the University of Wales, Bangor, and graduated the Human Communication and Computing course (MSc) at the University of Bath in Great Britain. Since 2003 she works for the ZML—Innovative Learning Scenarios at the FH Joanneum GmbH in Graz, Austria. She is the project manager and administrator of the SIG-GLUE virtual community.

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This paper was presented in part at the ED-MEDIA 05 conference.

Implementing and supporting a game based learning related community

I. Antonellis, C. Bouras, A. Gkamas, V. Poulopoulos

Abstract

A web-based community aims at providing communication and collaboration tools for a special interest group. This paper describes the functionality and architecture issues of a community whose aim is to bring together users who are interested in the field of game based learning and lifelong learning. The members of the community are provided with tools in order to share their knowledge and experience in game based learning through enhanced forums and chats, to read news or receive a newsletter concerning the aforementioned issue, arrange meetings, and make use of shared spaces. All these services are enhanced in order to meet the needs of this special interest group which is unique as it includes the collaboration of game developers, pedagogues and users. Furthermore, we describe a methodology to build a fully functional community with tools for communication and collaboration starting from a simple template and using core content management techniques.

Keywords

Online community, collaboration environment, communication environment, phpnuke, mobile users

1. Introduction

The constant expansion of the web has affected almost any on-line community. People feel the need to communicate, to collaborate, to share their knowledge and express their opinions and thoughts. The growth of on-line communities is great, not only in the number of members but also in the quality of the services they provide. Previous concerns that online communication is hostile, divisive and uninhibited (Kiesler and Sproull) have been overcome over the time. People are very familiar with

the use of devices like personal computers, mobile phones, PDAs etc for their daily communication needs.

This need for communication is one of the most important reasons for the creation of web based communities. The ease of being member of such a community and the simplicity of communication and collaboration between so many people makes communities a must for most internet users.

All the above led to many attempts that try to motivate users to act as groups. The idea is really simple: create a web site which is the base of the community and support this site with web service that can promote communication and collaboration. In order to construct a successful community, "members must be able to fulfil their purpose and accomplish those goals and interact with other members" (Ferguson et al. 2002). Now existing communities have reached outrageous numbers and the services they provide are at least high level. People want to learn about the communities and seek communities that best match their needs.

One community on game based learning is Special Interest Group for Game based Learning in Universities and lifelong learning (SIG-GLUE[1]). Game-Based Learning is an issue that concerns game developers, educators and trainees. Teaching methods based on educational games are expected to be extremely attractive to either University students or people who are involved with Lifelong Learning. In addition, the social and educational aspect of this type of communities (Bouras et al., 2003) is becoming increasingly interesting both from a technological and social perspective. Besides, the Internet's characteristics facilitate the development of unique forms of interpersonal and group interaction. (Oren et al., 2002). Therefore, we intend to create tools for an on-line community where the users can be organized into groups to discuss their ideas and exchange their knowledge.

SIG-GLUE is a web based community for people who are concerned about game based learning in universities and lifelong learning. The primary objective of the community is to inform the public about issues of game based learning. In a second phase the community wants to bring together educators, trainees, game designers and game developers who will collaborate and communicate in order to produce better educational games.

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[1] SIG-GLUE, Special Interest Group for Game based Learning in Universities and lifElong learning, , eLEARNING INITIATIVE, European Union.

After some months of use the community seems to be able to operate in an autonomous way, without the support of the creators. More than 200 people are members of the community and they communicate daily, expressing their thoughts and sharing their knowledge.

This paper is structured as follows. Firstly, we present related work. Secondly, the community of SIG-GLUE design issues is analysed. Afterwards, the basic architecture is explained and the more important issues are indicated. After the architecture, the implementation issues are reported and the changes that can be made in order to enhance the community and provide to the users with more attractive services. In section 6, we present the necessary changes and infrastructure iso that SIG-GLUE can support mobile users. After that in section 7 we present the ideal scenario regarding the functionality community of SIG-GLUE. Finally, some concluding remarks and proposals for future work are provided in section 8 and 9.

2. Related work on game based learning

Many attempts have been made in order to motivate internet users to act as groups. The basic idea is to create a web-based community aiming to bring together Internet users that have similar interests. Many online communities, supporting high-level communication tools, have tried to bring users together but failed owing to negligible participation of the members. “In order to construct a successful community, members must be able to fulfill their purpose and accomplish those goals and interact with other members” (Ferguson et al., 2002). Consequently, the tools used to develop a community are less important than the target group and the common interests of the members of the community. The case of EverQuest, an online role-playing game developed by SONY had huge success when 430,000 subscribers joined the game in 2003 (Rowan, 2003). This means that there is huge interest of people in “collaborative” playing. In our case the interest of the members is focused on the promotion of Game-Based Learning in Universities and Lifelong Learning.

Game-Based Learning is an issue that concerns game developers, educators and trainees. Our main goal is to create a community organized and adopted by the groups listet above aiming to promote the idea of Game-Based Learning. The teaching method based on educational games is expected to be extremely attractive to either University students or people who are involved in Lifelong Learning. In addition, the social

and educational aspects of this type of community (Bouras et al., 2004) is becoming increasingly interesting both from a technological and social perspective. Therefore, we intend to create an on-line community where people, who are involved in the fields mentioned above can be organized in groups in order to discuss their ideas, exchange the knowledge of their own fields and finally participate in a Special Interest Group (SIG) with the intention of constructing better Educational Games.

Many attempts have been made by developers, game providers and pedagogues to create communities or games that can be used for educational aspects. TopSIM (2002) by TERTIA Edusoft provides different business games which have been used in business education and advanced training. With the use of TopSIM someone can simulate different scenarios (Management, Logistic, Banking, etc) and create educational scenarios. For example the management simulation is a model representing a company or functions within the firm. The participants of the simulation take over the management role of a company. They compete in groups against other simulated companies in a simulated market. Through their decisions, the participants influence the success of their company. Thus, they learn about the interrelatedness of a company and about the internal and external factors that affect its economic success. The par-ticipants learn through experience the connections within the organization and the internal and external factors that influence the enterprise's profitability. The target groups are senior and junior managers, administration and authority, employees in technical areas, students of business administration and industrial engineering and trainees. Myzel (2002) is another online community game. The rules of the game are created by the players themselves. The players have to select a role and try to survive in the virtual world of Myzel with its various planets and complex social and political life. Environmental Detectives (2002) was developed by MIT and Microsoft within the Games-to-Teach project. It is a handheld PC game where players play as scientists investigating a rash of health problems in their city stemming from point-source pollution problems. Players learn the science behind contaminants such as source pollution problems. Finally, Unigame (2002) is a project that introduces the concept of game-based learning with a focus on higher education sector and lifelong learning.

All the above, introduce some attempts to bring Internet users together. But none of them, except Unigame (2002) include the collaboration of developers, game providers and pedagogists. These projects focus on specific perspectives, either the technological (developing the games) or the social (pedagogical models). Our intention is to create a

community that will try to bring together Internet users with the intention to exchange ideas, knowledge and experience in order to produce more efficient educational games, and it will be focused on both technological and pedagogical aspects.

3. Design issues

This community will provide users with educational aspects on game-based learning in universities and lifelong learning. It can be therefore seen as a web-based learning tool that can contribute to knowledge acquisition and should respect a number of instructional supporting measures (Cohen, 1994; Slavin, 1996). These measures have been developed to stimulate learning–favourable activities and have been proven as suitable for face-to-face situations as well as have been partially tested in order to promote web-based collaborative education (Hron et al., 2000; Weinberg et al., 2002). The characteristics of each community differ so, it is important to point out the unique characteristics of the SIG-GLUE community and eamine them (A. Hron & H.F. Friedrich, 2003).

The basic needs and requirement for communication and collaboration of the SIG-GLUE community are organized into the following categories (Figure 1):

- need for communication with each other or in groups
- need for collaboration in groups
- need for shared spaces to store and archive information
- need for making available / disseminating information to the public

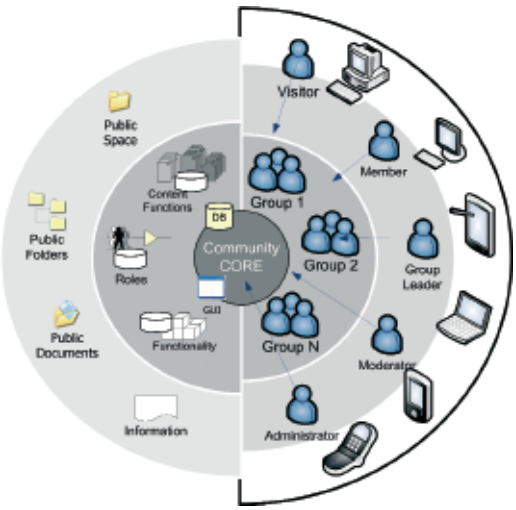

Figure 1: Web community structure.

3.1 Communication tools

SIG-GLUE members need to communicate among themselves in order to exchange opinions, ask questions, offer advice etc. Communication should be both direct and indirect, and both private and public:

- **Direct**: Direct communication requires that all participants participate at the same time and that communication is exchanged instantly (i.e. with no or little perceived delay). Direct communication is required when one needs an immediate personal conversation with a specific person or with a group of people.
- **Indirect**: This type of communication implies that the participants do not have to participate at the same time in a conversation and that the messages may be exchanged with a (possibly large) delay. In this type of communication the time factor is not counted at all and therefore it is used when delay in communication is not crucial.
- **Person to Person and Group Communication**: SIG-GLUE is a community where communication between groups is of great importance. Besides, the community is enhanced with the functionality of person to person communication in order to achieve a greater level of agreement between two sides.
- **Private, Public and Semi-public**: Communication is called private when it includes only the parties that are intended to participate in a communication. It is very important not to reveal any of this information to the public. Private communication is needed for exchanges that are of private nature, or do not concern others and might overload them with useless information. As people within SIG-GLUE work together it is highly probable that they might want to communicate in private for various reasons without sharing with the whole community (or parts of it).

However, taking into consideration that the main purpose of SIG-GLUE is to allow a large number of people interested in Game-based Learning to communicate and exchange results, the most important need is for public communication. All related members—game producers, game developers, content designers and pedagogues need to easily access all communication functionalities and information exchanges within the community and gain the most from this. In addition to its public nature, this type of communication needs to be archived for future reference.

Between private and public communication, there is a need for semi-public communication. Semi-public communication is the one that is revealed to a special group of people, larger than the individuals communicating, but not to everyone.

3.2 Collaboration Environment

Members of the SIG-GLUE community will need tools to support their co-operative work. This is especially true for the SIG-GLUE Working Groups where in each group the members will have a task to execute co-operatively. After the community's expansion the collaboration environment will be converted into a shared working environment for the SIG-GLUE "family". This means that this environment should cover specific requirements in order to provide its members with adequate functionality:

- **Document sharing**: A very common task that all the members will face is the need to produce documents for their work. The documents should be classified and collected into a place in order to create an archive for future needs and reference. Therefore, document sharing is essential for co-operation between the SIG-GLUE members. This makes their work more practical and easier. Access control is also necessary, as there will be situations where only some members of the group could alter the documents while the rest will just read them.
- **Calendar**: A calendar will be useful to keep the members informed about scheduled conferences, online meetings, and other events or milestones. For the Working Groups a calendar can be used for scheduling tasks and monitoring work progress. In addition each member might benefit from a personal calendar. All these various levels of calendars (personal, Working Group (WG)-wide, community-wide) should be mergeable so that one may see in one's calendar the entries one is interested in and/or pertains to one's work within SIG-GLUE.
- **Support for workgroups**: Members of the community must be organized into workgroups. The existence of the workgroups will result in better co-operation, more efficient work and better results. The environment must group members of the same group together, support the super-members and moderators of each workgroup and provide services relevant to the members of the whole workgroup.

3.3 Shared Spaces

As the numbers of SIG-GLUE members increase the use of attachments to exchange information becomes infeasible. In addition forums do not usually support attachments to keep the space requirements down. An alternative is to have one (or more) shared spaces where files can be uploaded and made available to SIG-GLUE members. The shared spaces must include extended functionalities and specific roles for the members because the shared spaces contribute both to communication and collaboration. Depending on the scope of members having access to shared spaces can be public, or private.

- **Public folders**: Public folders will be virtual on-line folders that will contain documents, deliverables and all other information that intend to be available for the public. Availability of these folders may be a specific service of SIG-GLUE or it can be provided as part of each workgroup area (one public folder per workgroup). Access to the data of these folders will be provided without any constraint.
- **Private folders**: Private folders will contain information and documents that will be provided to specific users. These users may be all registered users or specific members of a workgroup (WG). Access to these folders is controlled by access rights management system. A special case of these private shared folders is each WG's shared folder.
- **Databases**: Databases contain structured information of various kinds e.g. an educational games database, a provider's database, a member's database, a links database etc. In these shared databases each member of the community (subject to having rights to do so) can submit, edit, delete and view information.
- **Announcements database**: A special kind of such a database is a news database. As the main purpose of a community is the easy access to news, articles, results and the exchange of knowledge, a well organized news database where every member of the community can submit links and articles of public interest is necessary. The news may be divided into various categories with the possibility that a moderator could add new categories.

4. Architecture

In this paragraph we present the architecture which will accommodate the above mentioned design and functionality issues. First we present the basic platform in which our system is based and after that we present the extensions which we have added to the basic platform.

4.1 Basic platform

In order to build the online community in a manner that would provide all the above communication and collaboration tools in a unique platform and allow efficient administration and customization by the administrator we had to decide on the basic platform to deploy and use. As many available web tools exist for implementing many of the collaboration and communication functions the fundamental issue is to unify all these in a manner that would result in a complete environment with unified look-and-feel as well as functionality.

PhpNuke[2] is an open source content management system for the web that allows the easy creation of web portals that support web-communities. What really makes it suitable for use is the big open source community that supports it by providing additional modules and fixing possible existing bugs in the code. Despite this expanding community PhpNuke is considered to be not a proper choice for a web portal as it lacks security.

Taking these issues into account, we decided only to use the core mechanism of PhpNuke that deals with the "dirty" work of content management and implement new or modify the existing modules so as to provide the required functionality as well as the necessary security. We describe the core mechanism of PhpNuke that we used to construct the web community of SIG-GLUE and later in this paper we give a methodology of using it in order to transform any static web site with communicational needs into a fully functional online community.

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[2] http://phpnuke.org

4.2 Extending the basic platform

The expansion of the web has been enormous and users of the internet have become familiar with the idea of using the World Wide Web almost for every task, simple or not. The use of the Internet by users is changing according to technological habits and current trends. Communities has become a very easy way to bring lots of users together without their physical existence to a specific place or time and without having to accomplish a task or even have to be present when a discussion takes place.

In order to achieve all these, very simple tools and lot of patience are required. Users are now very familiar with web developments and the existing tools do not seem to be enough for them. Most users love trying new methods of communication. They seem to be extremely attracted by communities and web services which are not "conservative", but include an alternative way of doing something, even if it is a simple task.

4.2.1 The hidden power

In a previous section we referred to some reasons why some communities after a period of growth begin to stop functioning, with most of the users being bored. Therefore, we should find some special characteristics that may enhance the community. A way to do this is to meet the hidden or subconscious needs of the members of the community.

One way to enhance a community by attracting its members is by using creativity techniques. Creativity techniques aim of generating ideas within a group of users and promoting the creativity of each group member (Woerndl et. al., 2005). From the ordinary users of a community to the most advanced users and to those who are very keen on using collaboration and communication tools, creativity is always a challenge. Especially when we refer to a community like SIG-GLUE where pedagogues, trainees, game designers and game developers meet creativity seems to be the essential ingredient of success. The creativity techniques can be classified into categories. The two main categories that derive from the classification are the creative method in which ideas are created by spontaneous thinking and the systematic method in which the ideas are created by systematic and analytical ideas. The creative method is supported by areas where the users can write just their ideas or express some kind of knowledge and could

be areas like, announcements, library, games and the forum. The systematic method is supported by areas where one can find feedback from users. This can be mainly the forum where we have lots of discussion on many topics.

The aforementioned issue introduces a hidden technique in order to enhance a community. Another technique is to reassure the members about the stable and unified structure of the community. One should think first of the community as a super organization and as a social system, because many online socio-technical systems function and operate similarly to offline systems, despite differences in implementation (Flor et. al., 2005). This means that the community's members act like they do in their real life. After this, it is easily understood that the members of the community, and therefore of the online society, would like to be treated as unique individuals with different needs and obligations. They would like to feel like they are in their real life and treat the web-based society like the offline society. In addition the role of the administrator must be hidden and he should interfere only in special occasions like the teachers role in a virtual class (Sotillo, 2000). So, it seems to be very important to reassure the members of the community on hidden issues like stability and consistency. This means that the users must be able to see that whenever they visit a different area of the community, their actions remain the same. For the ordinary visitors of the community every area is locked to submissions, while registered members have full access to submit their contribution to the different areas of the community in the same way whatever the module is. This means that members have the power to access every area of the community in the same way they are not distracted and they actually experience the unified framework on which the community is built.

Having a community treated as a super organization and as an offline society means that the members need to follow some rules. But, most web-based communities do not state clearly any rules. This leads us to the result that the community's policies must by implied so that members would be informed about the policies without interfering with their use of the community. Policies are an important component of any virtual community since they represent the foundation upon which the community can actually work. Because policies are crucial for the proper working of a community, techniques must be followed to ensure the security and confidentiality. (Squicciarini et. al., 2005) It is important that the members of the community are reassured about the security of the community, which means correct flow of information, no disclosure of personal information, encryption of private conversations and private groups documents etc. In this way the members will be attracted to use

the community without any doubt or fear. All the above issues concern the "hidden power" of a community's elements. In the next section we will describe more obvious, to the user, issues about enhancing a community.

4.2.2 The power of learning

There is no doubt that we live in a time where information and communication technologies are of high importance. This factor means that more and more people are informed about issues concerning everyone and everywhere in the world. Besides that, the community of the World Wide Web does not only want to be informed. The users are attracted by the learning character that has been given to the internet. More about web-based communities and the information society can be found in (Pyati, 2005, Ahmed and Blustein, 2005, Macher and Pathak, 2005).

Regarding a web community and more specifically the SIG-GLUE community, its power can derive from the needs of people to learn. A web community must be able to foster science and promote a kind of education. This may result in a very limited web community, but we should take into consideration the positive points of this issue. An example of this can be the community of ICTP (International Centre for Theoretical Physics). This community addresses a quite limited audience but it grows and becomes bigger year by year. This derives from the issue that the community has declared and confirmed its scientific and multicultural character (Fonda et. al., 2005) which attracts more and more people. These techniques result in a specific and especially a sophisticated character of the community which enhances it.

Learning through a community is actually an attractive feature, but how can this learning character achieved? This can be achieved through the learning object paradigm. A learning object can be defined as "any digital resource that supports learning" (Wiley, 2002). The learning object paradigm has emerged during the past few years in order to accommodate the need for sharing and exchanging reusable learning resources on the Web (Chatzinotas et. al., 2005). In this way the members of the community will be able to retrieve and offer knowledge through learning objects, knowing that this knowledge is simultaneously converted into experience by the reusability feature of the learning objects.

4.2.3 The power of mobility to the atom

The issues that are discussed in the two previous sections highlight some issues that are actually known to be very attractive for users of the internet and members of a community. Besides all these a community must follow the trends of the technology, and must be flexible enough in order to support all kinds of users.

The latest trend of the technology is “mobility”. It refers to what its name says: provide the users mobile access and functionality. A web-based community is actually build on the internet. No access to the internet means no life for a community. In addition, the members of the online community can interact with each other (communicate and collaborate) only when they are in front of their personal computer and at the same they must be connected to the Web. A large flourishing community will have enthusiastic discussions and will change from hour to hour. This means that if a member of the community has not logged in the last two or three days to the community web site he may become isolated from the other members because he has become out of touch.

Such a community must be enhanced with mobile features. The members of the community should be empowered with the ability to connect to the web-based community through a mobile device like a phone or a PDA. In addition they should be able to participate in most of the features of the community through the mobile devices. This means that firstly the community must support small screen devices, following the open standards, and secondly promote the functionalities in such a way that a mobile user can access and use them with the limited tools (no mouse and no full keyboard) that the mobile device offers. Besides that the users may be also informed about postings in the community via text messages or multimedia messages to their mobile devices.

The mobility seems to be crucial and we think it is an issue that will concern future web communities. The active members of a community really need to be always informed about every action in the community and they actually demand universal access.

5. Implementing issues

In order to provide SIG-GLUE users with the above described services using the platform that PhpNuke offers, we had to develop specific new modules and edit the existing modules to meet our specific needs. What we actually used from PHPNUKE was its core content management mechanism.

5.1 Inside PhpNuke

PhpNuke has a main module that is responsible for the management of the site content. The functional characteristics of such a module depend on the definition of the content that it must manage and its key features as well as the fulfilment of specific goals concerning the administration of the system and its easy expansion. That is why in order to understand how PhpNuke's core works we need to describe these parameters:

- **General page layout**: The system that PhpNuke generates consists of web pages with the wire frame layout shown in Figure 2. Every page consists of five main elements, the header, the footer, the left section of blocks, the right section of blocks and the main module.

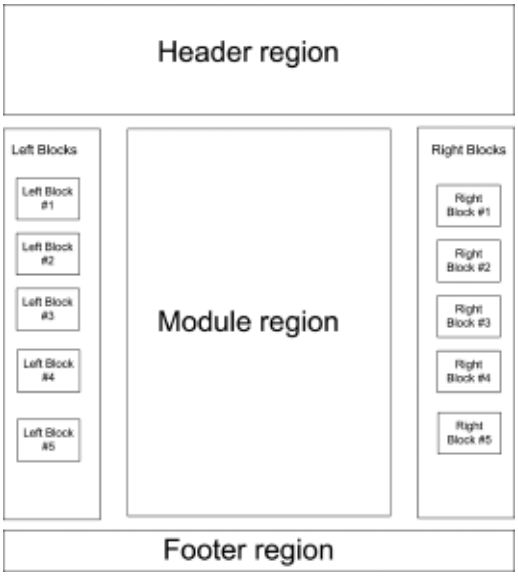

Figure 2: Page Layout.

- **Expansion capability**: The architecture of PhpNuke supports the easy addition of new blocks and modules. The system is responsible for identifying a new contribution and automatically properly initializes all relevant database data. From a developer's point of view, code guidelines are provided in order to successfully integrate an individual web application into a module or a block and it is possible to embody specific PhpNuke's entities (such as registered users or site administrators) into any module using the provided function library. In addition, specific instructions are provided in order to integrate module's administration functions into PhpNuke's administration panel.
- **Site's Administrator Role**: The entire system is administered through an administration panel to which specific users (called site administrators) have access. Administration permits customization of general attributes of the site (name, description etc), specification of the visible blocks and modules, their position and the users groups that have access as well as per-module and per-block administration utilities (defined from each module/block itself).

5.2 SIG-GLUE services and implementation

The SIG-GLUE final platform that we implemented started from a simple template and through a specific procedure (Figure 3) resulted in the creation of the services. It is clearly shown that any menu-driven web template can easily be converted into a full functional web community. Implemented modules supply services for Forums, Chats, (communication tools), Calendars and on-line libraries (Collaboration Tools), news database and public-private folder (shared spaces).

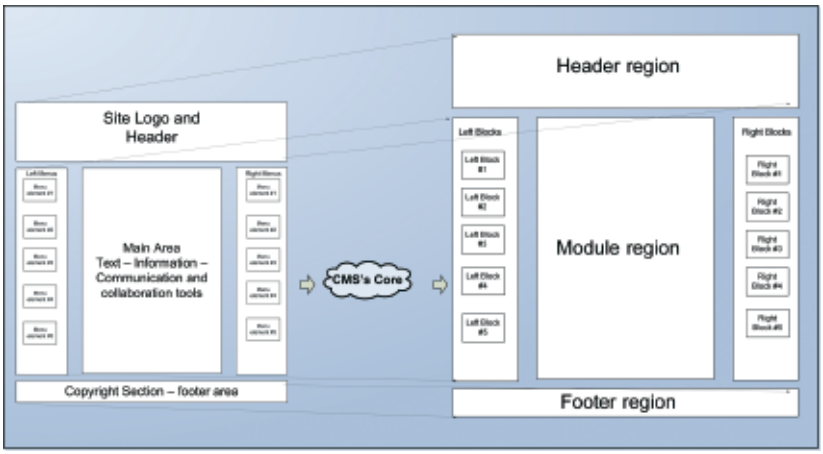

Figure 3: Basic Platform.

5.3 Hiding the power into the architecture

What is to be discussed in this paragraph is the hidden power that should be included in the architecture. Talking about hidden power, we refer to the techniques that should be hidden in such a way that it will not interfere with the users of the community's interface.

The architecture should support personalization and unification of the modules of the community. The community should have a stable and unified graphic user interface with integrity of information and security. What we did in order to enhance the community's integrity and security issues was to omit any unused functions, and modify all the functions that may contain any malicious code. We changed the interface in order to achieve unified and stable layout and concluded with the layout that is shown in figure 4.

Figure 4: Screenshot from the main page of the community.

As we can see from figure 4 we moved the right hand menu of the PhpNuke platform to the top of the page in order to achieve a unified layout throughout the different modules of the community, because we faced occasions where modules covered the right hand menu. The menu to the left is the first level menu with the second level menu coming right after the title of the page as we can see from figure 5.

Figure 5: Announcements module with submenu right after title: "Announcements".

After making the layout unified we had to change the module functionality in order to give life to our super-organization to act as a standalone system. The community became an "open community" where the moderators were not needed to vet the content from members. The members are free to use any functionality of the community apart from these that could harm the content or the integrity of information. On the other hand special attention was given to the "private" spaces of the community in order to reassure members about the high security level. In these ways we empowered the community's core system.

5.4 Promoting the "learning" characteristic

SIG-GLUE is a community that aims to bring together people who are concerned about game based leaning (GBL) in universities and lifelong learning. Considering who might be in this group of people, we concluded that they are mostly people who are concerned about science and research, so it could be useful for the growth of the community to give a more sophisticated atmosphere to the community. Scientists and Researchers need to work in a sophisticated environment.

Firstly, we created places where one can learn about the community, in order to convince people who are aware of GBL that the community's goals include GBL. In addition we created means of synchronous and asynchronous communication in order to begin the discussion groups for the people who want to learn through the community. You can see a means of communication in figure 6. Besides that it was essential to create databases and shared spaces in order to store the learning objects and convert them into experience and references.

Figure 6: Discussion Area-Forum.

The expansion capability of PhpNuke helped us creating the appropriate tools for promoting the learning characteristic. The Glossary, the useful Links, the Good Practices that can be found in the community imply a place of knowledge spread and transfer more and more people.

The community is separated into places that can be classified from the access that the users have and from the type of content. Creating something that can be compared to a real library, the library of the community of SIG-GLUE includes almost everything that can be useful for someone who wants to be fully informed about GBL in universities and lifelong learning.

6. Supporting mobile users

The next step to be taken is to support mobile users. An easy way to inform users about the change of the community and the support of mobile devices is information through mobile devices. The members of the community will be informed through SMS or MMS about news of the community, new discussions in the forum, new forum posts that possibly concern them, upcoming events etc. This first step seems to be crucial and will stimulate a debate. From the results of this "debate" we will understand whether the users will be attracted by the community's mobile character or not.

If the results are positive, a redesigning of the community will begin. The redesigning will concern only the code of the community because it will have to be changed in order to be supported by small screen devices. This means that either the html pages will be converted into a language supported by all the mobile devices or that the most crucial parts of the code will be rewritten in order to become visible and fully functional on a small device.

Most of the functionality must be changed because the mobile devices are not easy to handle when browsing the internet. This means that one can post a reply to the forum by sending a voice message, or synchronizing the calendar of his/her PDA with the calendar of the community, downloading the events that may concern him/her.

6.1 Transforming the Community

In trrying to investigate how all these needs of traditional Internet users can be transformed into requirements of mobile users we meet two main types of obstacles. Firstly, the interface of the communication tools should be changed so as to take into account small screen restrictions. Moreover, community services, that is communication and collaboration tools, as well as shared spaces must be revised in order to permit easy access through mobile networks, utilizing more efficient techniques in order to meet low bandwidth restrictions.

As SIG-GLUE's main aim is to inform its members about current trends in game design, we can easily apply transformation techniques derived from mechanisms

to push news into mobile devices. Such mechanisms take into consideration both restrictions and extra capabilities of the mobile interface and the mobile network resulting in an optimum use of the community tools. Moreover, these techniques have also designed in order to exploit mobility behaviour of mobile users (Albert and Kim, 2000; Sharples, 2000).

6.2 Characteristics of mobile device's interface

Mobile devices introduce a very different interface for their user. Small screen size, slow text input facilities, small storage capacity, limited battery life, low bandwidth network capabilities and slow CPU speed are main characteristics of such modern devices. In particular, screen size limitations directly affect the user's behaviour. Recent studies (Kawachiya and Ishikawa, 1999; Buyukkoten et al., 2000) on the effect of screen size on completing task related with browsing, show that mobile users tend to follow links less frequently than traditional Internet users. This behaviour comes from the more conservative link exploration trend of small screen users. This implies that we must provide user with information within the first two or three links he visits in order not to lose him.

In addition, as many different small devices exist equipped with web browsers that support different content types (HTML, xHTML, wml, multipart, mixed), it is also important to be able to identify the user agent that a mobile device users and provide it with the corresponding edition of the community pages.

6.3 Content Transformation Techniques and Mobile Services

Mobile edition of the aforementioned communication tools should take into account special requirements of mobile devices as well as the expected change of mobile users' behavior while browsing through community services. It is clear that both structural design of the community and community's services must be transformed in order to meet very different needs.

The major challenge of displaying community pages into small screen devices such as PDAs or smart mobile phones is the content transformation into an appropriate layout that will enable users to access it easily. Standard transformation techniques

have been widely studied (Alberts, 2000a; Alberts, 2000b; Bickmore, 1997; Buyukkokten et al., 2000; Buyukkokten et al., 2001a; Buyukkokten et al., 2001b; Danielson, 2002; Dyson and Haselgrove, 2001; Jones and Marsden, 1997; Jones et al., 1999; Feiner, 1998) and include direct migration methods, data modification techniques as well as data suppression migration methods.

Direct migration does not require human or system intervention as there are no transformations made to the original web page. It does require more effort to navigate the pages by users as only a small part of the page is visible at one time (Alberts and Kim, 2000a; Dyson and Haselgrove, 2001; Jameson et al., 1998)

Data modification techniques involve the creation at source of duplicate Web pages that are intended for use on the small screen by reducing image's size or summarizing text. Data suppression methods remove data to make small-screen versions display only skeleton information of the source data resulting in simplified navigation and reduced disorientation.

The selected transformation technique is very similar to the Gateway methodology (MacKay, 2003). According to this method, whenever users visit a web page, they construct a mental model about the structure and the content of it. What is critical while transforming the content is to minimize the adaptation of the existing mental model when migrating between devices so as to reduce volatility. Characteristic factors that form this mental model include page layout, scrolling attributes, distance to information (path of links that must be followed), graphical interface and information density (Danielson, 2002; Spence, 2001).

What Gateway tries to do is display the page designed for a large screen on the small screen by reducing the web page in scale to fit the screen. The same 'look and feel' is replicated using same layout and design. However, blocks of information are identified so as to allow users navigate included information as they would on the large screen (Figure 7).

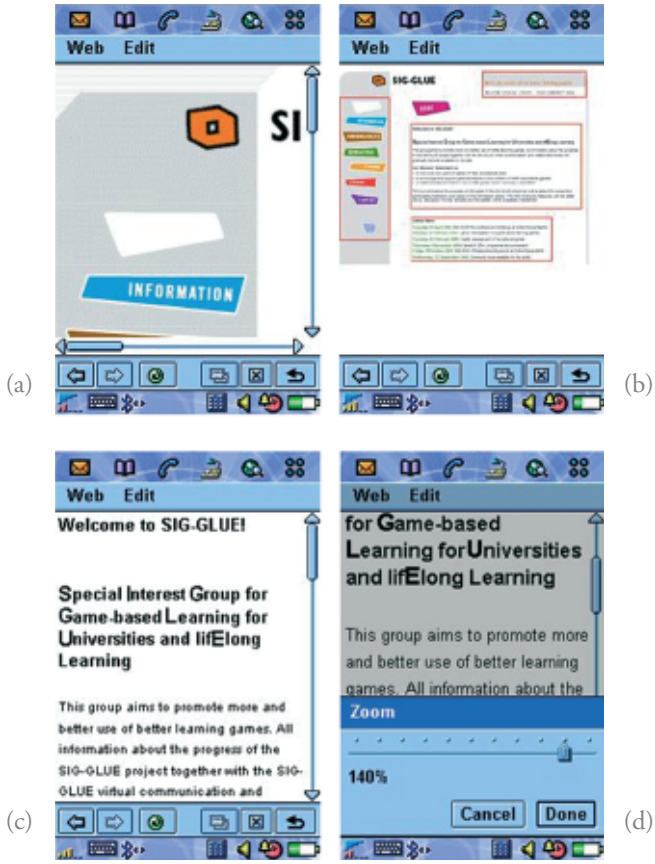

Figure 7: SIG-GLUE community seen from the Symbian Opera browser of the smart phone Sony Ericsson P800. (a) without any transformation, (b) after transformation according to the Visual Gateway schema. Figures (c) and (d) show the corresponding content of a visual block of the main page with and without zoom.

The transformation mechanism of SIG-GLUE's community interface can be summarized as shown on Figure 8.

- Specific interface blocks are decided (e.g. left menu, top menu, advertisments block, main content block)
- HTML pages are transformed 'on-the fly' into enchanced images that include visualization of different blocks
- Mobile User Agent is identified using HTTP Header information of the browser request
- If agent implies a mobile browser the response includes the corresponding image to fit the mobile screen (using a database of known mobile devices)
- Visualized blocks link to 'text-only' pages that contain only text (so as zoom is allowed)

Figure 8: Content transformation mechanism.

7. Functionalities—The "ideal scenario"

7.1 Community functionality

Concerning the functionalities of the web-based community it is important to analyze and address the interactive features. Advanced features and innovative services attract members of the community to participate and collaborate. The collaboration of more members has another positive point. The more people are concerned about the issue of Game-Based Learning; the more people express their ideas, opinions and experience.

An important issue of an on-line community is the Graphic User Interface. It should be simple enough so as not to confuse the users but also intelligent enough in order to guide the users through the advanced features and consequently encourage them to use the tools which promote communication and collaboration.

SIG-GLUE is a web-based community aiming to bring together people whose interests are focused on game based learning. Consequently, the graphic user interface should be game like. This means that it should be colourful and cheerful, without transcending the limits of the formality of its educational goal. The interface should have an unequivocal hierarchy to help the users navigate the community. As a result of all the above, the community has menu based navigation, with main menus, some of which have a submenu.

The Home button leads the user to the first page of the community. Some extra information can be found in the second section which is the Information about SIG-GLUE. Following is the Announcements. In this section the users will be directed to news concerning the community and technological advances in their field of interest. Besides, there is the Newsletter of the community. Interaction is focused on the articles of the news or the newsletter, as the members can submit their own articles. The Forum button leads to the interactive communication. There are the forums of the community which are separated into the general discussion forums and the work-groups' forums. After this section there is the library. It contains a submenu, which has a link to the shared space, to the glossary and the link "Links" which leads members to some useful links concerning game-based learning in Universities and Lifelong Learning. Its red color indicates the power of interaction which is produced by uploading and downloading files. The library area is followed by the games are. In this area one can find useful information about Games that are related to game based

learning, the "actors" of the field, and game developers. The contact button is at the end of the main menu of the community website and has contact details for the community administrators. Figure 9 shows the left menu which includes all the above links

Some extra areas that are not shown in figure 9, but are very useful for the community, are the "Who's Who" and "private messages" area. The "Who's Who" area includes a full list of the members of the community where people can get to know each other better by viewing each other's profile. In the private messages area the users can send each other private messages in order to communicate in a "private" manner about a specific issue.

Figure 9: Left menu of the SIG-GLUE community

In the following paragraphs we will describe the interaction of each group of users with the community web-site. Firstly, we should consider the types of users that will be members of the community. There are three types of users: anonymous users, registered users (members), and the administrators. This hierarchy of community users implies the level of participation of each user group that will be using the community web-site.

Anonymous users have access only to information which refers to community itself. In addition they have limited access to sections of the community that are interactive, such as the forum. The community is aiming at to encourage anonymous users to become members of the community.

An anonymous user can become member of the community by registering at the community web-site. Little information is required for the registration such as the

name and a valid mail of the user. After submission of the registration form the user becomes automatically a member of the SIG-GLUE community. This membership allows user to interact with the collaboration and communication tools. From the "Forum" section a member has access to the forum. A member is able to view all the conversations in the forum and post his answer to any topic. Entering the "Newsletter" section, a member can view all the news and newsletters of the community. Members become subscribers of the community newsletter after submitting the registration form. Moreover, they may send their own articles for publication to the news section, or to the newsletter. The community library gives members their own shared space where they can upload files concerning game-based learning and lifelong learning and download other users' files.

The administrators of the site are actually special members, who supervise the whole community. There are also some administrators who are responsible for specific sections of the community. An administrator is responsible for the preservation of the consistency of the community's sections. He/She has special access to any service without any restriction and in addition to the administrator section of the site which is an extended version of the administration section of PhPNuke. From these pages the administrator can manage the content of the community, the services and the members. The administrator is also responsible for the shared spaces. The security of the shared space is advanced but the administrator should vet every file added.

The hierarchy of the users is an extremely important issue for the development of the community. The users can interact with the system without exceeding the limits and restrictions which are necessary for any type of community. The users should act as they do in their real life where they have obligations and rights, which are implied through the restrictions to the services of the community. In this way, it is expected that the on-line community will flourish.

7.2 The "ideal scenario"

After discussing issues on how to enhance the community it is the right time to explain the "ideal scenario" of the empowered community. The functionality issues and the first scenario of the community can be found in (Antonellis et. al., 2005). The scenario that will be described contains a user and more specific a game designer but in general

the user could be an educator, a trainee, a game designer or a game developer and the scenario would be still the same.

The dissemination of information of the SIG-GLUE community through MMS advertisements leads a game designer to visit the community. She is attracted by the way she learned about the community (via MMS), reads the information about the SIG-GLUE community and decides that it is a good idea to become a member of this community in order to share their experience and acquire knowledge.

She registers for the community and creates her personal information and interests. An email is sent to the game designer welcoming her to the community and is followed by some information on what could be useful for her in the community according to the interests she submitted earlier. After browsing the pages of the community that were suggested automatically she decides to become a member of the game designers group. She creates a group membership account and the group moderator gives the game designer full access to the semi-public functionality of the group.

The game designer can be now become an active member of the community. She submits events to the calendar, takes part to the events and remains synchronized with the SIG-GLUE calendar by synchronizing her mobile device. She takes part in events of her group and post replies to the discussions. If, for any reason, she is away from a computer she is able to take part in events, discussions, brainstorming by using the features that are designed for her mobile device. In addition she uses the "library" of the community in order to upload content and she downloads any useful content acquiring knowledge and gaining experience.

After a short period of time, and many hours spent in the community, she has a prototype idea on how to create a better educational game. She feels secure enough to share her idea with the members of the community. A new section in the discussions section of her workgroup begins and opinions from all members are heard. A small survey begins on the different ideas that derived from the discussion. The members of the group are called to vote for the best idea either through their personal computer or mobile device (SMS, MMS). The results are posted to the community and the ideas are presented to the other working groups. The presentations can be found in the public sections of the community.

A considerable number of people discuss the idea, trying to enhance it and support it by evidence which is uploaded to the community's shared spaces. The idea is widely disseminated amongst the community. Many papers and practices on the idea are written and a universal survey and discussion begins in the community in order to finalize the idea. The results are posted and the final version of the idea becomes a complete proposal. The company of the game designer will design the game. Companies from the members of the groups will deal with the rest (practices, scenario, game developing, testing and production).

The "idea" of the game designer has become an educational game and many Universities use the game because they learned about it through the community's dissemination features. The game designer could have created the game alone with her company, but through the aforementioned procedure a learning game was designed with the collaboration of trainees, educators, game designers and game developers.

The exampled that was described introduces the ideal scenario of the community and seems to be a chimera, but it should be noted that the community does support all the aforementioned functionality and if one wants to follow this scenario he/she will be able to do it.

8. Conclusions

This paper presented the technological functionality and architectural issues of a web-based collaborative environment enhanced to support Game Based Learning. The features of this environment include Shared Spaces, Communication tools and Collaboration tools. These features are implemented by creating an extended platform based on PhpNuke. PhpNuke and generally the use of PHP-MySQL technology was chosen because we believe its open source style harmonizes with the style and tone of the open web-based community we intend to create. This platform includes all the necessary tools that are needed by the members of a community. In addition to the standard tools, some integration is necessary to produce adequate features for the members. Besides the basic tools, many more modules and blocks were created in order to provide static pages or features that are not implemented in PhpNuke. We analysed the demands of the community and specified the needs of communication and collaboration of the members. Together with the above we described the role model of the members in the community thoroughly, because we believe that the

success of a community is based on the cognition of the target group rather than the use of advanced and perfect features. This means that firstly we focused on establishing the target group and its special needs and after that modified the basic architecture. In addition, this paper presented techno-logical functionality and architectural issues concerning game based learning for mobile users. The mobile specific edition of a web community with communication and collaboration tools as well as shared spaces was presented and mobile specific services were analysed. Web content transformation techniques for mobile devices although useful need to be altered in order to adapt to mobile specific services. Enabling mobile game designers to access such a community extends will contribute to easier access to the services.

9. Future Work

In the future we will focus on the needs that will arise through the use of the community, trying to cover the needs of the members in communication and collaboration issues. In addition, following new technology architectures we could upgrade all the features and the services aiming to faster communication system and more productive collaboration features. Features, concerning video conferencing, voice conferencing, application sharing and smart notes tools could be added as advanced modules of our platform or as stand alone sections which will use the same database with the platform. In conclusion it is essential that a web-based community should follow new technology issues in order to become, not only a huge community in terms of numbers of members, but also to promote the collaboration and the remote communication of Internet users in an optimum way. Moreover, we will focus on the needs that will arise through the use of these services. It will be given more emphasis on content personalizing techniques, that will conserve bandwidth by providing mobile users only with content close to their interests. Construction of the user profile will exploit implicit information about the mobile device as well as user-defined interests.

10. Authors




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Gender-based Neurocognitive Propensities influencing Gameplay: An Interactions-oriented approach

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Research interests

Educational Technology; Instructional Psychology; Cognitive Neuroscience; Differentiated and Flexible Learning; Metacognition; Science Education.

Based on 'work-in-progress' investigating interactions during solitary and collaborative gaming.

Abstract:

This paper reviews the literature on gender-based propensities in the use of ICT. It also outlines the methodology and preliminary results obtained by the author investigating interactions in collaborative gaming.

Using recently published reports and a wide spectrum of research, gender-based neurocognitive propensities are identified and categorised. These include gender-based differences in psychomotor skills, neurocognitive abilities and social skills. Their manifestation and role in determining typology and frequency of interactions in group-based cooperative gaming contexts are identified through a taxonomic model that classifies interactions along three dimensions (Domain, Technology and Community) and across three pedagogical levels (Acquisition, Participatory and Contributory). Each dimension has a receptive cognitive component and a reactive meta-learning one. This model underpins the experimental methodology for a number of investigations carried out with college students organised in small study groups according to personal data obtained from preliminary surveys. Results include gender-related interaction profiles demonstrating underlying neurocognitive

propensities employed during solitary and collaborative gaming. A concluding section discusses the pedagogical implications of such profiles.

Keywords

Game-based learning, Cognitive Neuroscience, Pedagogy, Process-oriented approaches, Gender-related issues, Technology-intensive collaborative learning environments, Group dynamics.

1. Introduction: Gender Differences in the use of Information and Communication Technology (ICT).

This paper reviews the literature related to research about gender-based propensities in the use of ICT. It also outlines the methodology and preliminary results obtained by the author investigating interactions in collaborative gaming.
Research with different age groups and ICT applications consistently point to differences in the behaviour of males and females when using ICT. The Eurydice report (October 2005) "How boys and girls in Europe are finding their way with information and communication technology", points to a number of gender-related differences. There is no difference between boys and girls regarding communication and word processing but significant differences in the case of games and programming. In all countries, boys use more graphics programs and the internet (for collaboration or downloading) more frequently. In all countries, boys say that they have mainly learnt how to use computers with friends or on their own, whereas girls report that they have mainly done so at school or with their family. The same observation applies to use of the Internet although the differences are less marked. Boys claim to be more competent when performing complex activities. Differences between girls and boys become more clear-cut in the case of complex activities grouped together under the heading file management. Boys show a higher degree of facility in activities such as plotting graphs using spreadsheets or creating presentations using programs such as PowerPoint.

The fact that these trends are apparent in all countries shows that neither culture nor the level of school computerization appears to influence such gender-based patterns. Eurydice concludes that "Whatever the country or level of school computerisation, the attitudes of girls and boys vis-à-vis the use of ICT seem to differ in the same way: boys are more attracted to ICT and use it more freely", (Pg. 8).

Colley (2003) confirms that boys obtain greater experience with computers at home than girls quoting Comber et al. (1997) and Shashaani (1994) and asserts that much of this experience is acquired with computer games, which boys play to a far greater extent than girls, quoting Van Schie & Wiegman (1997), Yelland & Lloyd (2001) and Bonanno & Kommers (2005). Besides providing entertainment Colley points to a number of effects of using computers and computer games. Such interactions encourage familiarity in using computer hardware and software. Quoting Gailey (1993), Colley claims that such activity promotes learning of the programming skills necessary for particular games, thus providing transferable expertise in the types of logic and operations used by many types of software. Boys develop positive computer attitudes, Kirkman (1993) and Levine & Donitsa-Schmidt (1998) and higher levels of confidence, Brosnan (1998), Comber et al. (1997) and Todman & Dick (1993).

Such exposure to ICT tools promotes a different approach to computers. Through playing games, boys learn to regard computers as toys (Gailey 1993) or as technology to be mastered and thus interact with software in a more playful and exploratory manner, (Giacquinta et al. 1993). Girls approach computers differently and tend to use them as tools to assist them in producing work having a preference for using routines they know. These different approaches are also present among adults—women use the Internet as a tool rather than as technology for play or mastery, (Singh, 2001).

Woman made more tool-like references than experienced men, who made more personal references indicating their greater sense of control, (Hall & Cooper 1991). Gender-related perceived control give rise to stylistic tendencies when interacting with computers. Turkle (1984) describes boys as “hard masters”, exercising control with analytical rigor giving them an advantage in programming. She categorizes girls as “soft masters” who take a more concrete approach. They tend to treat computers as entities with which to negotiate in order to create a product such as when using modern software and the Internet for exploration and creativity.

These trends in childhood and adolescent years evolve into characteristic gender-based interaction patterns and approaches with ICT in adulthood. The Pew Internet Project (2005) reports that, while roughly the same percentage of men and women in the US are serious internet users, they differ in fundamental aspects. Men value the net for

the freedom it gives them to try new ways of doing things and for obtaining all kinds of information ranging from sports results, job offers and taking part in online fantasy sports leagues. By contrast women like the opportunities the net gives them to make and maintain human connections and for gathering information about health, map directions and religious material. Gender-related differences are also reported in the use email. While men using it as a way to maintain links with organisations rather than individuals, females make greater use of e-mail for exchanges with individuals and support groups.

The differences between male and female approaches and interactions with computers are highly relevant to understanding how boys and girls use computers in all settings, including education and gaming, whether solitary or collaborative. A review of the literature points to a number of physical, cognitive and social gender-related differences that clearly show the evolution of biological underlying mechanisms determining individual and collective interactions within specific socio-cultural environments. This paper categorises these gender-related differences and extends their implications to the psycho-social climate within collaborative gaming contexts.

2. Theoretical background: Research in Gender-related Neurocognitive Propensities

Evolutionary pressures in humans led to gender differences in physical adaptations, neurocognitive processing tendencies and social comportment. Frost (1998; 2002) argues that sexual division of labour resulted in the emergence of sexually differentiated skills. Through the riskier, hunting activity man evolved better navigational abilities as a consequence of travelling over a wide territory with much solitary scouting and reconnoitering. Females taking care of food gathering developed superior social and linguistic skills as gathering necessitate continual social interaction among individuals concentrated within a smaller area. Geary (1998; 2004) attributes evolutionary differentiation to male-to-male competition for fertile females. Besides enhanced navigational skills, males evolved to be superior in the use of projectile (e.g., spears), blunt force (e.g., clubs), tracking and dodging thrown objects. Such biologically determined primary abilities are eloquently manifested and exploited during action and fighting games showing this highly evolved “aggression management” mechanism in males.

Cognitive gender-related differences include visuo-spatial (mathematical) abilities, linguistic propensities and information processing in working memory. Most games capitalise on visuo-spatial skills like orientation, manipulation of three-dimensional objects, target following, localisation, maze following and navigation. Geary (1998) uses the principles of sexual selection as an organizing framework for interpreting cross-national patterns of sex differences in biologically-primary cognitive abilities (those that have been directly shaped by evolutionary pressures i.e. by means of either natural or sexual selection). Primary abilities, such as language and mathematical abilities are found pan culturally and are supported by neurobiological architectures designed to process domain-specific information and develop in natural contexts, that is, during children's play or social activities (Geary 1995; Pinker & Bloom 1990; Witelson 1987).

Cross-national studies suggest that there are no sex differences in biologically primary language abilities including phonological, semantic, language-generation and articulatory mechanisms. Together with mathematical abilities, these show moderate heritability estimates and are found in all cultures as well as in nonhuman primates. Sex differences in several biologically secondary linguistic and mathematical domains, such as those related to reading, writing and computation emerge primarily in school or in ICT-intensive environments, are found throughout the industrialized world. In particular, males consistently outperform females in the solving of mathematical word problems and geometry as a result of greater elaboration in males than in females of the neuro-cognitive systems that support navigation in three-dimensional space.

Research shows that males and females differ systematically on tests of spatial cognition (Halpern 1992; Kimura 1996; Voyer, & Bryden 1995). On average men have an advantage in tasks of spatial cognition such as the Viewfinding Task, (Watson & Kimura, 1991), localisation and orientation (Gordon & Lee, 1986), and mental rotation, (Gouchie & Kimura, 1991; Moffat & Hampson, 1996). Men also have an advantage in tasks that require both target-directed motor skills such as finger dexterity and spatial cognition involving three dimensional object rotation, such as catching an object, (Watson & Kimura, 1991), and guiding or intercepting projectiles such as throwing darts, (Watson & Kimura, 1989, 1991). These cognitive and psycho-motor skills are strongly influenced by early and current hormonal levels, (Margolis & Fisher, 2002). Gazzaniga et al (1998) discusses hormonal influence on spatial learning tasks in both human and rodents. High levels of oestrogen in females are associated with poorer performance, while high levels of testosterone optimize spatial abilities in

males. Janowsky et al. (1994) show how increased levels of testosterone from testosterone supplement through scrotal patches, to regulate bone and mineral metabolism, resulted in increased ability in spatial manipulation of objects but not in motor dexterity, verbal memory and cognitive flexibility.

One of the largest between-sex cognitive differences favouring males, that is extensively exploited by digital games, concerns visuospatial tasks that require transformations in visuospatial working memory, (Krikorian, Bartok, & Gay, 1996). Males have an advantage in visuospatial reasoning being more adept at performing disembedding and internal spatial transformations required by a task such as mental rotation of shapes, shape recall, geometry, maze learning and map reading, (Gazzaniga et al., 1998; Halpern, 1986; Wilson et al., 1975; Coren et al., 1994). The differences hold up whether one is dealing with simple or complex patterns (Bryden & George, 1990). Males are either faster or more accurate when completing such tasks. Males also differ in increased aggression and greater risk taking. The male advantage in spatial reasoning may be one reason why they score higher on maths tests, why most chess masters are men and why males use computers more as a medium for entertainment, learning, communication and personal expression than females.

On average, women have an advantage on tasks requiring perceptual speed and fine motor skills, such as identification of pictures, (Watson & Kimura, 1991) or sequenced hand movements, (Nicholson & Kimura, 1996). Numerous studies, (Inglis & Lawson, 1982; MacCoby & Jacklin, 1974) consistently found gender differences in language and visuospatial skills. On average, girls begin to acquire language about one month prior to boys, and by age 11, they consistently perform better on tests of verbal abilities, with the gender gap growing at least until adulthood. Female superiority is seen on tests of both receptive and productive language, and on more complex tasks such as making analogies and creative writing. The gender difference is not large, showing extensive overlap between the two groups, but it is consistent. In general, women are reported to be more verbally fluent than men, (Stumpf, 1995), although mixed results have also been obtained. For instance, studies have shown a female advantage for quickly producing words from a particular semantic category (e.g., foods), (Gordon & Lee, 1986). Girls are much better than boys at generating sentences when given the initial letter of each word but there is no sex difference for rapidly producing words beginning with a particular letter, (Gordon & Lee, 1986), for either type of fluency measure (e.g., (Moffat & Hampson, 1996)) or task of rapid articulation, (Gouchie & Kimura, 1991). This explains the observed preference by

females for word puzzle games (Bonanno & Kommers, 2005). Girls also show better interpretation of emotion cues, and a higher tendency to comply with parents and peers.

Baenninger and Newcombe (1995) make a significant suggestion very relevant to competence in the use of digital media. They claim that many gender differences may be decreasing in recent years, citing a number of meta-analyses that have shown this pattern. Crawford et al. (1995) also stress a decline in gender differences in spatial visualization skills in the past 40 years. Stumpf (1995) acknowledges the reduction in some gender differences with time but points out that gender differences across a number of cognitive dimensions are still quite robust despite the reduction over time. Such studies point out the importance of psychosocial factors on sex differences in cognitive abilities. Finally, current models, (Casey, 1996; Halpern & Tan, 2001) propose that the interaction between life experience and inherited biological propensities builds sex difference in spatial cognition. Sherry et al. (2002) points to the importance of game playing in developing such skills quoting Subrahmanyam & Greenfield (1994) who argue that children learn cognitive skills, such as how to orient things in space, by playing electronic games and that these skills differ between girls and boys because of differential exposure to electronic games.

It is clear that different genres of games such as First/third person shooters, Fighting and Sports games capitalize on these biologically primary psychomotor skills that are an intimate component of the male neurocognitive constitution and that are pan culturally distributed. Interaction with artefacts within a given cultural context, such as digital games, gives rise to biologically secondary psychomotor skills such as increased perceptual acuity, eye-to-hand co-ordination, reaction speed, parallel processing and quicker information processing that characterize highly competent gamers.

Gender-based propensities in Social Skills.

Sexual division of labour, mainly hunting for males and food gathering and child rearing for females, together with competition for mates, resulted in the emergence of sexually differentiated social skills. Over time, these differing task requirements led to the emergence in men of better navigational abilities, aggressive behaviours and defensive skills. On the other hand evolutionary pressures equipped women with superior social and linguistic skills (Geary, 1998).

Geary also elaborates on the survival value of coalition-based competition. Play appears to provide the practice necessary to develop the capacities needed for survival and reproduction in adulthood (Fagen, 1981). The pattern of human sex differences in play activities is consistent with the hypothesis that coalition-based male-male competition was an important feature of human evolution. Sex differences in rough-and-tumble play, or play fighting, are especially evident in species where conflict in adulthood is often resolved through physical aggression (Smith 1982). In polygynous primates, males engage in play fighting more frequently and more vigorously than conspecific females, a sex difference that is related, at least in part, to prenatal exposure to androgens (Collaer & Hines, 1995; Wallen, 1996). Although boys sometimes engage in play hunting, studies of the spontaneous play behaviour of children reveal that boys more frequently organize themselves into groups and compete against groups of other boys and engage in this form of play three times more frequently than do same-age girls (e.g., (Lever, 1978)). More often, boys compete as members of teams and must simultaneously coordinate their actions with those of their team mates while taking into account the action and strategies of their opponents. Boys interviewed expressed finding gratification in acting as a representative of a collectivity; the approval or disapproval of one's team mates accentuates the importance of contributing to a group victory. (Lever, 1978, p. 478).

Most of these competitive games require many of the same physical, social, and cognitive capacities that are involved in coalition-based warfare (Geary 1995) characterized by in-groups and out-groups formations, the strategic coordination of the activities of in-group members as related to competition with the out-group, the throwing of projectiles at specific targets, and the tracking and reacting to the movement of these projectiles. These activities can be exemplified by team-based sports games and by the game of Throw at Each Other with Mud, played by Sioux Indians 200 years ago (Hassrick, 1964), among many other athletic games.

Contiguous and virtual collaborative or competitive gaming contexts are the most recent, eloquent manifestation of these coalition-based interactions where males tend to dominate. Multiplayer LAN parties and massive multiplayer on-line games are exclusively male domains as are international gaming competitions like the Cyber X Games and the World Cyber Games. 'The imbalance between men and women was clear to see in the Cyber X Games with almost 50 male teams taking part, compared with just seven female squads. And as in the world of sport, there were separate com-

petitions for each gender. On-line games are overwhelmingly male (Counter-Strike is 99% male) so females that do come into this world feel overpowered or that they are not welcomed,' (Hermida, 2004).

Conclusion

This paper elaborates on individual neuro-cognitive processes identified above and extends their implications to the psycho-social dimension within collaborative gaming scenarios. The typologies, frequency and directionality of task and person-oriented interactions will be quantified and discussed in relation to the above mentioned gender-related neuro-cognitive mechanisms and propensities.

3. Methodology

3.1 An Interactions approach

An interactions model that classifies interactions along three dimensions (Domain, Technology and Community) and across three pedagogical levels (Acquisition, Participatory and Contributory) is being proposed. Each dimension has a receptive cognitive and a reactive, meta-learning component. The proposed interactions-oriented approach is organized around an elaborated version of Gilroy's (2001) model:
Valued Learning Experience = F [Pedagogy; Content; Community; Metacognition]
The domain/content dimension involves interactions leading to the acquisition of relevant knowledge and skills. The social dimension captures the socio-emotional climate and ensuing interpersonal interactions within a group that lead to the formation of bonds, relationships and roles. Interactions also occur at the technological level showing increased knowledge and refined skills in the use of digital tools. Through metacognitive activity, participants organize and control individual and collective learning along these dimensions.

A more detailed discussion of this model may be found in Bonanno (2005), where it is applied to identify learning profiles of participants in Web-based communities.

3.2 Experimental Methodology

3.2.1 Subjects

This investigation was carried out with college students enrolled for a course in Biology at advanced level. The gender distribution was 35.1% male and 64.9 % female. This was the mean for different student samples involved in various investigations.

3.2.2 Procedure

The investigation involved two stages. First, data about participating students were analysed to determine the prevalence of Neurocognitive propensities in Solitary Gaming. The second stage involved investigating the effect of Gender-based Neurocognitive propensities on interactions in Collaborative gaming.

Allocation of Subjects to Study Groups and Data Collection
This stage of the investigation involved a group of students interacting co-operatively using one computer on which games were run. The procedure included the following steps:

I. Administering questionnaire to collect data about participants' gaming tendencies.
II. Setting up study groups with different composition and experimental conditions.
III. Recording gaming sessions.
IV. Analysing recorded student and game-play videos for type and intensity of interactions.
V. Computing typologies of interactions on to data sheets.
VI. Entering and analysing data into SPSS, according to research questions.

3.2.3 Recording Gaming sessions

Separate recordings captured: (i) students interacting and (ii) corresponding simultaneous game-play as seen on computer monitor. The game was played on a Laptop PC connected through a converter card to a VCR. The VCR was connected to a TV so that students could follow game play both from the Laptop monitor and from

the TV. At the same time a camcorder fitted on a tripod was placed in front of the students to record group activity. After a study session, the group recordings were transferred from the camcorder cassette to a VHS cassette to be used for analysis.

3.2.4 Games Used

Different game genres were used to create diverse interactive scenarios and hence experimental conditions. Sid Meier's **Alpha Centauri** (AC) was used as a strategy game based on science and technology. **Empire Earth** (EE), **Age of Empires** and **Rise of Nations** have a historical orientation with an attractive intermix between narrative and game play. **Mind Maze** (MM), from Microsoft's Encarta package, was used as a language-based puzzle game. **SIMS Deluxe** was used for its emphasis on the dynamics of human relationships. **Need for Speed** was used as an action/sports game.

4. Results

4.1 Neurocognitive Propensities in Solitary Gaming

Results obtained in this investigation are discussed in more detail (Bonanno & Kommers, 2005). From this analysis it is very evident that games offer the context for gender-related behaviour patterns arising from underlying neurocognitive tendencies. This investigation about the use of digital games within a Maltese context is in line with findings from similar investigations. Though the Computer is the most popular gaming device in use, the tendency in females to play puzzle games leads to a wider use of the mobile phone. Maltese male college students spend more time playing games than females. The pattern for average time (hours per week) obtained for Maltese males (M= 6.712), for females (M=2.492) and for the total group (M=3.941) is comparable to that obtained in other studies—sample mean (M= 5.00) for British Columbia teens (Media Lab Analysis report, 1988) and (Shelly et al., 2002) College males (M = 13.77), females (M =4.65). The lower values can be attributed to a number of factors. The lower mean for the whole group is a consequence of the limited time available for playing digital games (and in fact for all other leisure activities), because Maltese students are enrolled in a very intensive two-year course that compels students to dedicate most of their time to study. The overt resistance to or anxiety about playing digital games from a good percentage of female students confirms this. Predominant gender scripts in relation to this medium amplify this trend.

The above analysis of gaming tendencies discloses a number of underlying cognitive and motivational gender-related trends. The high percentage of females opting for the Puzzle, Adventure, Fighting and Managerial games confirms Shelley's et al. (2002) findings that females' top reasons for playing include challenge and arousal. Males' preference for First Person Shooters, Role Playing games, Sport and Strategy games indicates gratification of different needs—challenge and social interaction. These tendencies can also be seen as a process of accommodation to different underlying gender-related neurocognitive processes. The indicated preferred games by females capitalize on their natural propensities and skills such as perceptual speed, fine motor skills and sequenced hand movements, (Watson & Kimura, 1991). Games preferred by males demand a higher visuospatial ability involving localization, orientation, mental rotation, target-directed motor skills, greater reaction speed, increased aggression and greater risk taking. This confirms Halpern & Wright (1996) and Casey (1996) claim that males excel at tasks requiring maintenance and manipulation of information in working memory, while females excel at tasks which require rapid access and retrieval of information from stored memory. While males excel at tasks that benefit from combining new strategies, such as mental rotation ability, females tend to draw on memory of past algorithms or knowledge such as verbal fluency, rather than inventing new approaches. These underlying neurocognitive processes manifest themselves externally as gender-related processing styles. Referring to Turkle and Papert, Rommes (2002) claims that males prefer command structure approaches in computers, as they want to 'feel in control' and they are not afraid of taking risks in learning how to use a computer, thus preferring a 'learning by doing' approach. Females favour a more concrete, contextualized, intimate 'bricolage' approach and they do not like to take risks while learning (Turkle, 1988; Turkle and Papert, 1991). Game genre preference is yet another context where these tendencies are expressed.

4.2 Influence of Neurocognitive propensities in collaborative gaming.

4.2.1 Identifying Factors determining Interactions.

Experiments conducted to understand the mechanisms for efficient collaboration include approaches that decomposed 'work alone' as a dependent variable into several other measures of performance, such as the improvement of monitoring and regulation

skills (Brown & Palincsar, 1989; Blaye & Chambres, 1991). Dillenbourg et al. (1996) conclude that collaboration is in itself neither efficient nor inefficient. Collaboration works under some conditions, and it is the aim of research to determine the conditions under which collaboration is efficient. For this purpose one has to vary these conditions systematically along two dimensions, both dependent (work alone / collaborative learning) and independent variables (the composition of the group, the features of the task, the context of collaboration and the medium available for communication). The composition of the group covers several other independent variables such as the number of members, their gender and the differences between participants. These significant research conclusions are being integrated with results from the first stage of this investigation to quantify gender-related neurocognitive and social propensities. These will be analyzed through the following independent variables: **Preferred social context** for gaming; separate **Task-oriented interactions** (TOI: Focused reception, Interacting with Game, Imitating Game actions, Referring to gaming Biography, Asking for help, Giving help, Responding, Sharing, Providing feedback, Confirming, Suggesting); separate **Person-oriented interactions** (POI: Pleased look, Neutral look, Disagree / Rejection, Jubilant Expression, Approving gestures, Disapproving, Disengaged, Hostile, Recommends game, Censures game).

4.2.2 Results for effect of neurocognitive propensities in collaborative gaming.

A highly significant difference regarding the preferred gaming environment was obtained: Pearson Chi Square $p < 0.001$. 69.2% of the males prefer solitary gaming compared to 30.8% who prefer playing games in company with others. The reverse tendency applies for girls who prefer gaming with others (57%) to playing games alone (43%).

Different games utilize different gender-related neurocognitive processes that manifest themselves through characteristic types and frequencies of interactions. Preliminary analysis of data about interactions in various gaming contexts shows different gender-related interactions profiles. For the science and technology-oriented, real time strategy (RTS) game, **Alpha Centauri**, males and females show different interaction repertoires. At the beginning of the game males show high levels of cognitive activity manifested through higher 'Interaction with game', 'Focused Reception', 'Sharing' and 'Providing Feedback'. As the game proceeds it establishes a repetitive game-play pattern inhibiting male exploratory or risk-taking activities.

This de-motivates males who start 'Censuring the game'. Female rejection of such game play is manifested through lack of interaction. Throughout the gaming session, females show reduced cognitive activity regarding 'Interaction with Game', Task-oriented interactions (including 'Sharing' and 'Providing feedback') and reduced interpersonal communication.

For the game **Empire Earth** females show a higher level of cognitive activity manifested through longer periods of 'Focused Reception', show higher level of response and positive reactions. Males show a greater tendency to be 'Disengaged' thus showing that most males are not intellectually stimulated by rehearsal-oriented RTS games. Still, when asked for help, males contributed by 'Giving Help' mainly to females who show a higher level of 'Responding' due to their more reactive rather than proactive approach. This manifests a clear distinction in attitude to games between males and females. Males assume a superior competence status considering themselves as a reference point when females find themselves in difficulty. On the other hand females tend to accept a subordinate competence status. Tacitly males consider RTS games as 'chicken feed' for them. Their opinion is that true gaming challenge is only found in Action, Shooting, Racing and Sports games, but these types of games exploit their highly developed visuo-spatial skills. Male disengagement is actually their reaction to the rehearsing strategy demanded by RTS games which happens to match female neurocognitive propensities. When faced with difficulty females prefer to ask assistance to males, perceived as more competent in solving game related problems. This contrasts with the approach adopted by males when faced with difficulty. Males adopt a tinkering approach, not afraid of taking risks, rather than asking for help from their colleagues.

For the Puzzle game **Mindmaze** there is no overall gender-related significant effect. The game seems to be appealing to both sexes but in different ways. Males are stimulated by practicing their navigational skills while manoeuvring through the labyrinth of passages and doorways in the virtual medieval castle. Females exploit their linguistic abilities being enthused by recalling and corroborating information when prompted by quiz questions. This clearly demonstrates that males and females adapt to gaming contexts that use their natural strategic propensities, obtaining gratification if this matches their gender-related neuro-cognitive propensities.

An investigation was also carried to explore possible female preference for socially supportive, intimate gaming contexts through analysis of interactions at the socio-

emotional level assuming that increased interactivity is an expression of preferred socio-emotional context. Females tend to show higher cognitive and emotional interactivity in groups composed solely of female participants rather then in mixed-gender groups. In the presence of males, females tend to be more restrained in expressing themselves thus contributing much less in building a positive socio-emotional atmosphere.

4.2.3 Conclusion: Pedagogical Implications

Analysing different aspects of collaborative gaming contexts from an interactions perspective is a rich and valuable research experience that can provide insight into potential pedagogical applications and possibly a paradigm shift in the conception of designing technology intensive collaborative learning environments. The proposed interactions approach, involving the technology (game and gaming hardware), the subject or domain and the community dimensions, is a more systematic approach in developing a pedagogy for digital game-based learning. Instead of designing learning solely based on content and task analysis, it is a more valid approach to identify and promote interactions both at a cognitive and metacognitive level within the identified dimensions. A process-oriented approach also fosters an innovative methodology for evaluating the instructional and educational potential of games. The use of games in identified learning or training situations should be determined by the type of neuro-cognitive processes that are employed by user/s. Different game genres utilize and develop different neurocognitive skills. Hence it is the job of teachers, instructors and game designers to identify and exploit these in instruction or game design.

Design activities should be sensitive to gender-based neurocognitive propensities. Both when designing games or game-based learning, such propensities should be respected, exploited and challenged. Male and female learners should be made aware of their natural tendencies in the use (or avoidance of use) of digital games or game-based learning. Relevant pedagogical support should accompany such activities, pointing to congenial tendencies both in patterns of games used in solitary contexts but also in collaborative scenarios. Patterns of use based on uncongenial neurocognitive processing, stereotypes or evaded group roles during gaming should be challenged to develop the necessary compensatory skills.

This interactions model can also be applied in the evaluation of the various gaming contexts—PC based gaming, console-based, mobile gaming, solitary, cooperative or competitive gaming. The instructional or educational potential of such contexts can only be holistically assessed through the use of interaction metrics and not content-oriented approaches. Educational games and game-based learning should be analysed for the degree of domain oriented interaction—how much and in what ways does a particular game promote knowledge, skills, insight and reflection about the domain in question. It should also be assessed for its potential in developing gaming and technology related skills (gaming gestalts) and knowledge (awareness of surface and deep game structure), together with corresponding attitudinal change. The pedagogical value of games and gaming contexts should also be evaluated through the level of participation and contribution that the experience triggers in users.

5. Author

In 1982 graduated from the University of Malta (UOM) with a bachelors in Education specializing in Science Education. Between 1982–1995, taught science and biology in Secondary state schools. In 2001 graduated with a Master of Philosophy by research from the Centre for Communication Technologies, UOM, specializing in Individual Differences in Learning and Instruction. Presently reading for a PhD in Instructional Psychology and Technology at University of Joensuu, Finland. Lectures in Biology at a pre-university college, and in Flexible Learning at the UOM. Currently involved in various EU projects involving Educational Technology.

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Influence of videogame play on a student's approach to learning?

Fiona Littleton, Jeff Haywood and Hamish Macleod

Keywords

learning, higher education, student, videogames

1. Abstract

From over thirty years ago when a Pong prototype was first switched on in Andy Capp's bar in California, computer, arcade and videogames (from here on referred to collectively as videogames) have made a significant cultural, social, economic, political, and technological impact on society (Newman, 2004). Since the launch of Pong in the 1970s, computer and videogames have grown into a $30 billion worldwide industry. Between 2000 and 2004, the UK's consumption of videogame products and activities grew by over £15 billion, with the recent successful UK and US launches of Microsoft's Xbox 360 and Sony's PlayStation Portable (PSP) not yet included in those figures. In recent years there has been an upsurge in the number of researchers studying gaming. Topics have included investigations of the reasons why people play videogames, the potential of games in educational settings, and the effects which these games, and the culture which surrounds them, may be having on society. As videogame playing becomes more widespread, and increasing numbers of videogame playing students enter higher education, educational research into the impact of extensive videogame playing on student approaches to learning and attitudes towards higher education is vital. The chapter begins by presenting an introduction to the culture of videogames and continues with a discussion on the relevant literature in this research area. An overview of our research project currently being carried out in the School of Education at the University of Edinburgh in the UK will be provided. The project is seeking to explore the experience of videogame play among students in higher education, and to identify the differences which might exist between gamers and non-gamers in their approaches to learning and study, and in their attitudes towards higher edu-

cation. Finally, key results of our project will be presented and discussed in the context of current research.

2. "Everything bad is good…"

Videogames represent the fastest-growing sector of the global media and entertainment industry and dominate much of young people's leisure time. Presently, the videogame industry's revenue surpasses that of the movie industry. In 2004, the average amount of time eight to eighteen year olds spent playing games per day on a computer, console or handheld was 49 minutes, up from an average of 26 minutes per day in 1999. Of the 2000 children surveyed, 22% played videogames for more than an hour per day (Kaiser Family Foundation Report, 2005). By the age of twenty-one the average American has played 10,000 hours of videogames compared to 3,000 hours of book reading (Prensky, 2001a).

From their launch, videogames have attracted widely disparate responses from media, educators, parents, academic researchers, and even religious groups and politicians.

> *"In America in the early 1980s President Ronal Reagan extolled the virtues of videogames to create a generation of highly skilled cold war warriors, while at he same time the US Surgeon General C. Everett Koop proclaimed videogames among the top health risks facing Americans. To be sure, such extreme cultural reactions to technological and cultural innovations are hardly new; mid twentieth-century critics feared that television watchers would become addicted to television, never leaving their homes, and critics before them feared that film would pervert viewers"*
> (Squire, 2002).

Koop claimed that the sole objective of most videogames seemed to be kill, destroy and eliminate the enemy and that they contained nothing constructive. Koop eventually explained that he was not basing his opinion on any scientific evidence and that it was merely personal opinion, yet the debate continues even today. In the summer of 2005, following the Grand Theft Auto 'Hot Coffee' controversy, in which hidden code within the videogames' programme could be unlocked to reveal pornographic scenes, Senator Hillary Clinton called on the US Federal Trade Commission to instigate a 90 million dollar study on the effects of videogames on children. Steven Johnson, author of Everything bad is good for you: how popular culture is making us smarter,

responded with an open letter in the Los Angeles Times addressed to Senator Clinton, refuting the claim that popular culture is dumbing-down our society. Johnson (2005a) states that on the contrary "popular culture has been growing increasingly complex over the past few decades, exercising our minds in powerful new ways" (p13) and highlights videogames as "the best example of brain-boosting media" (Johnson, 2005b). Here in the UK, Prime Minister Tony Blair, under intense pressure from politicians and parents in 2004 following an enormous media frenzy surrounding the content of the videogame 'Manhunt', commissioned a new research study into a possible connection between videogames and violence, which is due for publication in 2006.

With his influential book, What video games have to teach us about learning and literacy, James Paul Gee (2003a) finally gave intellectual respectability to academic reflection on videogame studies. He points out that "the phenomenon of the videogame as an agent of mental training is largely unstudied: more often, games are denigrated for being violent or they're just plain ignored" (Gee, 2003b). He describes videogames as media that require deep thinking and complex problem solving skills and which are fun, immersive, and spectacularly successful at engaging players. In his research, Seymour Papert (1996) claims "what is best about the best games is that they draw kids into some very hard learning" (p88). He writes about children using the term 'hard fun' to describe videogames, and he immediately explains, "[the kids] don't mean [the videogame] is fun in spite of being hard, they mean it is fun because it is hard" (ibid: p88). Therefore, videogames are played because they are essentially difficult and challenging. As any successful games designer knows, if videogames are too simple and easy they will not be played, and if they are too hard and complicated they will also be avoided. Gee (2003b) states that "each level [of a successful game] dances around the outer limits of the player's abilities, seeking at every point to be challenging enough to be hard but doable", never moving so far beyond a player's comfort zone that they will give up. This he says "is referred to in cognitive science, as the regime of competence principle, which results in a feeling of simultaneous pleasure and frustration" (Gee, 2003b). He believes that "learning works best when challenges are pleasantly frustrating" (ibid). He does not appear to be advocating the implementation of videogames in classrooms, but identifies the key design principles within some of the most popular videogames and presents these as learning principles that should be applied and integrated into educational curricula. Gee's current research would seem to be foreshadowed by the work of Tom Malone in the 1980s, who argued that the education community had much to learn from videogames, and from the enthusiastic engagement that they motivate in people (Malone, 1981).

3. The changing nature of students

Educating our students is a primary goal of colleges and universities. Reaching that goal, however, depends on understanding our learners, which is an essential component in facilitating learning. Gaining an understanding of our students' behaviours, attitudes and expectations gives us more options for engaging students in the learning process (Oblinger, 2003).

In parallel with the observations of authors such as Johnson, there exists a burgeoning interest in the changing nature of students in higher education, with many researchers attributing this change to the impact of new media (internet, videogames, mobile phones) on students. Students who are engaged with these types of media were born in the 1980s or later and are often referred to as the 'Net Generation' or 'Net Gen' (Oblinger, 2003). Today's students are accustomed to the ubiquitous presence of digital technology in their lives, for example, computers, videogames, video cameras, mobile phones and digital music players, all of which demand 'new media literacy'. The students currently in higher education are different from their predecessors in many ways, but particularly because they are the first generation to grow up surrounded by digital media. The rate of change between generations is perceived as accelerating, with technology at the heart of that acceleration. Marshall McLuhan (1964) coined the term 'electric speed' to describe this phenomenon. Johnson (2005a) explains that

> *"[technology] introduces new platforms and genres at an accelerating rate. We had thirty years to adapt to the new storytelling possibilities of cinema; then another twenty for radio; then twenty years of present-tense television [...] five years to acclimate to the VCR and video games; then e-mail, online chats, DVDs, [...] the Web—all becoming staples of the pop culture diet in the space of a decade"* (p175).

Authors are beginning to claim that as a result of this ubiquitous digital environment, the minds of the students in this generation have literally been altered ('rewired' is a popular term often used). Marc Prensky (2001a) claims "people who undergo different inputs from the media and culture that surround them can, and do, think differently" (p43). He describes all students as "native speakers of the digital language of computers, games and the Internet" (Prensky, 2001b, p1), and he uses the term 'digital native' to describe these students collectively. He believes that inputs such as computer games, television and mobile phones change the way digital natives think and behave. They make decisions faster, at so-called 'twitch speed', and can easily parallel process (the

art of taking in information from several sources at once) and multi-task. He refers to those who were not born into and did not grow up in a digital world, as 'digital immigrants', those with a foot in the past, and an 'accent' they will never lose, which is constantly visible and identifiable through their behaviours, such as going to the internet second rather than first in search of information and the printing of their email. He claims that digital natives, who are empowered in their personal lives by and immersed in interactive technology, find old teaching methods 'horribly boring' and have to 'power down' at school. Prensky maintains that the "single biggest problem facing educators today is that our digital immigrant instructors, who speak an out-dated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language" (Prensky, 2001b, p1). He believes that the best way to ignite this missing 'spark' of learning is to bring computer games into classrooms.

In contrast, Squire (2002) writes "some advocates of digital game based learning imply that developing educational games is a moral imperative, as kids of the 'videogame generation' do not respond to traditional instruction" and he continues by "cautioning against overexuberance about the potential of digital games to transform education" (Squire, 2002). He believes that "games are very particular kinds of experiences and that playing games does not appeal to everyone, and certainly no one game (or more appropriately game experience) appeals to everyone" (Squire, 2005). It follows that even if students have been exposed and had access to various new types of media, one cannot presume, that these students will have chosen or choose to be game players (past or present). The dichotomous metaphor of 'digital natives, digital immigrants' seems to imply a presumption that all young people make up a homogeneous group, a group who are immersed in the culture of digital technology and videogames, and that therefore, all young people can be classified collectively as 'digital natives', a presumption that we are challenging through our research. The variance that exists within this generation (i.e. 'net generation') needs to be acknowledged and understood.

While research into the ways in which new media affects a young person's cognitive development is ongoing, it seems less clear how differences based on previous game experience might impact on students in higher education. John Beck and Mitchell Wade (2004) looked to young adults within the game generation to observe the impact of new media (videogames) on their orientation towards business. They point out that the prevalence of games has shaped how younger adults and children, both males and females, think and learn (Beck and Wade, 2004). The authors report that people who have intense experiences with digital media, in this case videogames, in

their formative years, will be "a different kind of future employee—people who are confident with risk and surprise, who regard simulation and fantasy as a useful tool not a distraction, and who see themselves as the heroes of their own narratives" (Beck and Wade, 2004).

4. Videogame Research in Higher Education

It is against this background and in parallel with Beck and Wade's research that we are conducting our research at the University of Edinburgh. We are investigating the gaming experiences of student childhoods to explore whether there is a relationship between a student's past experiences of (i.e. engagement with) videogames and their current approaches to learning and study and their attitudes towards specific aspects of higher education (e.g. feedback and collaboration). From the research discussed earlier in this chapter further investigation is needed into the connection between the two elements. In the context of our research we have defined videogames to be 'all types of electronic, handheld, console and computer video games'. Our research question is:

> *What impact or influence does extensive videogame play in pre-university years have on the attitudes of students to education and specifically does it appear to influence their learning styles?*

The method used in the first step of the project's data collection was a survey, which sampled over 1200 full time undergraduate students from a wide range of disciplines (e.g. Archaeology, Nursing, Divinity, Electronics) across every year of their degree (bachelor) courses. An option of online survey or paper-based survey was offered to students in an effort to ensure high completion rates. It was vital to our research that all students in our data analysis were of a certain age category so that they would have had potentially similar media backgrounds; therefore, only young adults between the age of 17 and 24 years old were included in the analysis of the data. For the purposes of our analysis, rather than grouping the students by subject area, of which there were a very large number, we grouped them into four broad cognate areas which we have found useful in the past (i.e. Medicine and Veterinary Medicine, Humanities, Science and Engineering and Social Science).

The survey was designed to gather data from each student on three major themes:

- Attitudes towards higher education
- Approaches to learning and study
- Videogame play experience.

It was clearly not possible to completely capture the rich diversity of students' approaches to learning and study and their attitudes towards higher education within a simple survey and so we focussed on some key elements to provide a baseline so that any differences between student groups could be highlighted based on their previous video game engagement. Emerging themes from the analysis of the survey (discussed in the results section) could then be analysed further using qualitative methods. These key elements likely to have an influence on students' approaches to learning and study and attitudes towards various aspects of higher education were identified from previous research (Marton et al, 1997). The majority of responses were elicited using a 5-point Likert scale. The students were asked to rate their general approaches to learning and study, rather than for specific approaches used towards one course or course module.

Please indicate your level of agreement with each of the following statements on a scale of strong agreement to strong disagreement.					
For the most part, I manage to hold my concentration when I attend lectures	≤	≤	≤	≤	≤
I concentrate on learning just the information I need to know to pass	≤	≤	≤	≤	≤
In general, I prefer to study on my own rather than with other students	≤	≤	≤	≤	≤
On the whole, I am quite systematic and organised in my study	≤	≤	≤	≤	≤

Figure 1: Sample of survey questions

Data were gathered on previous videogame play experiences of each student. Judging that it would be difficult for students to recall their exact age when they first played videogames, which for some students could be almost twenty years ago, we asked students to recall at which stage in their childhood they played videogames. Students were also asked to recall how often they played videogames at each of these stages.

Can you recall the period(s) in your life during which you played a video game? How frequently did you play?					
	Every Day	Most Days	Most Weeks	Relatively Infrequently	Never
During Primary School (Elementary School)	≤	≤	≤	≤	≤
Early Years of Secondary School (Junior High School)	≤	≤	≤	≤	≤
Late Years of Secondary School (Senior High School)	≤	≤	≤	≤	≤
In University	≤	≤	≤	≤	≤

Figure 2: Sample survey question on videogame play experience

Questions were included that focussed on other aspects of videogame play experiences, such as how frequently students participated in online gaming communities, how frequently students purchased videogame-related materials and what type of videogame they played most often (e.g. adventure, strategy or sports). To allow for potential constraints of time, parental control and/or monetary issues in relation to the frequency of a student's videogame play, we also asked the students if they could recall ever having the desire to play videogames more frequently than opportunities (e.g. parents/guardian/teacher or time) allowed. We believe that data gathered on these other aspects of videogame play might play an important role in future research analysis.

5. Emerging Themes

The sample analysed included 1239 full time, undergraduate University of Edinburgh students aged between 17 and 24 years old. The majority of respondents (64%) were female, and over 60% of all students completed the paper-based survey. Almost half the respondents (46%) were from Science and Engineering, with 14% from Medicine and Veterinary, 24% from Social Science and the remainder from Humanities. Around 40% of students were entry-level undergraduate students and over 35% of students were in the second year of their course.

	All Students	Male	Female
Ever Played Videogames	95%	99%	94%
Currently Play Videogames	39%	69%	22%

Table 1: Videogame play (by percentage of gender)

Students were asked had they ever played a videogame and 1182 students (95%) said yes, with an almost even distribution between the percentage of males and the percentage of females (see table 1). However, when asked if they currently played videogames only 39% of all students said yes, with 69% of all males surveyed currently playing videogames but only a mere 22% of females a fact which requires further investigating using qualitative methods.

One of the key steps for this research is to produce empirically derived definitions of 'formative years' and 'intense engagement with videogames' that can be used to observe the influence of previous videogame play on students' approaches to learning and study and their attitudes towards higher education. Drawing on the work of Jean Piaget in the 1950s and through our data analysis, we produced the following definitions. We define formative years as 'the childhood period up to and including the age of 14 or 15 years old, i.e. the end of a child's early secondary school period (junior high school)' and we define a person who has an intense engagement with videogames as someone who 'played videogames every day or most days at some stage within their formative years (as defined)'. The definitions are, however, still being refined. Using these definitions we assigned each student to one of two videogame player categories: High Gamer or Low Gamer.

- High gamer includes all students who at some stage in their formative years (either in primary or early secondary or both) had an intense engagement (played every day or most days) with videogames.
- Low gamer includes all students who never played videogames in their formative years and students who played videogames relatively infrequently or most weeks at some stage in their formative years.

	Total Number	Total Percent	Male	Female
Low Gamer	753	61%	156	597
High Gamer	486	39%	294	192
Total	1239		450	789

Table 2: Videogame player categories (by gender)

Thirty-nine percent of all students surveyed were classified as high gamers, of which 60% were male. The majority of male students were high gamers (65% of all males surveyed were high gamers) and the majority of female students were low gamers (76% of all females surveyed were low gamers). As detailed earlier, we also recorded data on various other aspects of their videogame play experiences that might prove influential in future research. When asked if they could recall ever having the desire to play videogames more frequently than opportunities allowed, over 69% of high gamers recalled having a desire to play more often, as compared to 28% of low gamers and 19% of high gamers recalled having this desire frequently, as compared to a mere 3% of low gamers. Over 25% of high gamers reported having participated in online videogame communities, but less than 6% participated on a frequent basis. Over 50% of high gamers recalled taking part in videogame-related activities (i.e. purchasing videogame magazines and visiting videogame-related websites) with less than 10% of high gamers participating on a frequent basis.

Some of the specific questions used in the survey were detailed earlier in this chapter. During our analysis each question on approaches to learning and study and attitudes towards higher education was ranked with a score between 1 and 5. The higher the student scored the stronger they agreed with the statement given. Through detailed data analysis, key components which focussed on student approaches to learning and study and attitudes towards aspects of higher education emerged: organised approach to study, studying for understanding (relating ideas while studying), exerting minimal effort to pass, attitude towards collaboration (group work), difficulty concentrating in lectures and attitude towards qualitative feedback.

So for example in relation to the component 'organised approaches to study', the higher a student scored, the more organised they reported themselves to be in their approaches to study.

During our analysis we compared the means of low gamers and high gamers (using the statistical t-test) in relation to the key elements detailed earlier. We also carried out tests of independence asking 'is there a relationship between previous videogame play (each videogame category) and each key finding?' If the test was found to be statistically significant ($p \pounds 0.05$) then there exists strong evidence to imply that a relationship may exist between the two. As our project is still ongoing it is only possible at this stage to present key findings from the survey analysis, all of which require further investigating using qualitative methods.

	Low Gamer N = 753 (Mean)	High Gamer N = 486 (Mean)	Difference +/-	% Difference (Low gamer to High gamer)	Tests of Independence (p)
Organised approaches to study	2.98	2.79	-.19	-6.37	P<0.0005
Exerting minimal effort to pass	3.07	3.25	.18	+5.86	P<0.0005
Difficulty concentrating in lectures	3.28	3.09	.19	-5.79	P=0.002
Willingness to collaborate	3.22	3.22	.00	0.00	Not Sig

Table 3: Some Key Findings from our survey analysis

Low gamers scored higher when reporting how organised they were in their study, which implies that low gamers are more organised in their study, as compared to high gamers. The percentage difference between low gamers and high gamers is 6.37, and the test of independence (detailed earlier) is found to be highly significant ($p < 0.0005$), which gives strong implications that a relationship may exist between the two elements and therefore we can state that students who had low engagement with videogames in their formative years are currently more organised in their study, as compared to students who had intense engagement with videogames in their formative years.

The second finding highlighted in Table 3, refers to another aspect of the student's approach to study, which we named 'exerting minimal effort to pass'. The higher a student scores on this factor the more inclined they are to do the least amount of study possible while still passing. When comparing the means of each group, high gamers scored higher than low gamers, with a percentage difference of 5.86. This was also found to be highly significant ($p < 0.0005$) and therefore we can conclude that students who had intense engagement with videogames in their formative years exert the least amount of effort in their study, as compared to students who had low engagement with videogames in their formative years.

When asked if they find it difficult to concentrate in lectures low gamers scored higher than high gamers, with a percentage difference of 5.79. This finding was also found to be statistically significant ($p = 0.002$) and therefore we can conclude that students who had low engagement with videogames in their formative years reported finding it more difficult to concentrate in lectures, as compared to students who had intense engagement with videogames in their formative years, a key finding that would seem contrary to the US based research that was discussed earlier.

Finally, in relation to a student's willingness to collaborate with their fellow students, no difference, significant or otherwise, was found between the low gamers and high gamers. Both high gamers and low gamers would prefer to work alone than with other students. Essentially it should be noted that students who had high engagement with videogames in their formative years are no more likely to be willing to work collaboratively than students who had low engagement with videogames in their formative years.

During the course of our analysis we also worked with other videogame player categories which we referred to as 'Hardcore Gamer' and 'Non-Gamer'. Hardcore gamer includes all students who at some stage in their formative years played videogames every day. Non-gamer includes all students who had never ever played videogames in their formative years. Assigning students to the categories of hardcore gamer and non-gamer decreased our sample size by over half, with over 700 students not belonging to either category. However when we tested these exclusionary gaming categories against the key elements of the survey (highlighted in table 3) the exact same findings emerged. The percentage difference between the two groups (non-gamer to hardcore gamer) did increase (as compared to the percentage difference between low gamer to high gamer), but the direction of the difference and the significance of each was the exact same. We feel that finding differences between groups that are closer on the videogame player spectrum (i.e. high gamer and low gamer) is more important for the purposes of our research than finding differences between such extreme groups as hardcore gamers and non gamers, where differences might be expected to occur.

6. Future Directions

It is important to bear in mind that the research project is still ongoing and that the findings highlighted above are an element in a larger research project. It is possible that larger differences do exist between aspects of approaches to learning and study and attitudes towards higher education that have not been highlighted here. Interviews and focus groups with high gamers and low gamers will constitute the next stage of this research, with the aim of further exploring the survey findings.

7. Authors



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Virtual Patients: considerations of narrative and game play

Michael Begg, Rachel Ellaway, David Dewhurst and Hamish Macleod

1. Introduction

Virtual patients (VP) and virtual cases (one or more virtual patients or other participants in a contextualised setting or scenario) are increasingly common tools in healthcare education. Intended to be used as a proxy of a real patient a VP represents those aspects of the patient that are relevant to the educational context in which it is used. Thus two uses of the same VP may use significantly different data or involve the VP in very different ways (Ellaway, 2004).

Although the increasing use of web technologies in healthcare education is one driver for their use, a more important one is that opportunities for medical students to access real patients are rapidly decreasing since the trend in healthcare is for patients to spend less time in hospital and for many procedures to be carried out entirely on an outpatient basis. This has meant that viable alternatives are urgently required to maintain the quality and efficacy of the medical education process. It also suggests that the primary role for the use of VPs is one of prosthesis; providing an imitation of the real thing. This, it will be suggested in this chapter, need not necessarily be the best approach to considering the development and use of VPs.

While VPs simulate aspects of individual processes and procedures, it may be argued that they presently offer little in the way of extending this simulation to the complex decision making challenges that are an essential part of professional clinical practice.

The literature has indicated how successful gameplay and experiential learning opportunities share common aspects (Gee, 2003). It would seem that in the paradigm of the clinical case, in which there may be a degree of contextual role play (interactions which carry consequences for the scenario, or narrative engagement with the learner), the VP offers an opportunity for 'game informed learning' (Begg, Dewhurst et al., 2005).

Currently, most VPs are linear constructs that are developed around single scenarios and linear decision paths with limited scope for immersive engagement for the student. Choices are largely constrained and student's choices do not substantially affect the predetermined outcomes. In this chapter it is suggested that by adopting the idea of the 'virtual as potential' as an alternative to the 'virtual as prosthesis' this may suggest a means of developing VP activities that have requisite complexity (Greif, 1991), more meaningful engagement for learners, and that more effectively promote the development of professional decision making skills. This approach, it is also suggested, is also more conceptually in keeping with the underlying architectural principals of VP data structure—that is, abstracted, object classes that remain open to a multiplicity of possible contexts and forms of manipulation.

In order to do this the idea of the virtual and how it presently relates to contemporary healthcare education will be examined. The importance of the opportunities presented to healthcare education through the use of VPs—principally the increasing emphasis placed on experiential and situated learning and the need for the development of decision making skills will be highlighted. The chapter will also examine the potential benefits of realigning our appreciation of the virtual from prosthesis to potential and how this may influence and encourage learning applications that are not only more rewarding in terms of complexity and engagement than those currently in use, but are also more closely aligned to the flexibility of choice and multiplicity of contexts encouraged by emerging VP interoperability and modelling standards and specifications.

While it remains outside the scope of this work to develop a taxonomy of game-informed elements for inclusion in VP data frameworks, it is anticipated that a case can be made for a more substantive consideration of game and narrative influences within the essentially fictive construct of the VP case.

2. The Virtual

Given the popularity of the word virtual in our culture, it will serve us well to equip ourselves with an awareness of the origins of the term. It may be very well to have a virtual learning environment, populated with VP cases that we discuss in virtual chat rooms with virtual friends represented by virtual avatars, but the simple fact of the term's ubiquity in the contemporary academic vocabulary does not teach us about the essence of the term.

Through the evolution of our understanding or interpretation of what the virtual is, many artists have borne witness to the complexity of the concept. From the tantalisingly tangible yet resolutely flat trickery of trompe l'oeil painting to the richly textured journeys into memory within Proust's A la recherche du temps perdu, from Borges's Labyrinths, to Nicholson Baker's involved adventures in frozen moments of time, whether it be explicitly concerned with space or time, the virtual has—and continues to—inspire, entrance, captivate, engage and enlighten.

The concept of the virtual has been with us for many centuries. The word itself has its origins in the latin virtus, meaning strength or power and evolved to virtualis signifying something or someone of outstanding quality: the virtual person being what we would now commonly understand as the virtuous person (Shields, 2003). More recently, Baudrillard suggested that as a culture we have become so involved with representations, simulations and signs of the real, that the real has been to all intents and purposes lost (Baudrillard, 1995).

An alternative approach, however, (arising largely from Deleuze), considers the virtual to be somewhat more than merely a prosthetic for a missing reality.

The suggestion is that it would be a mistake to consider the virtual as in any way opposed to the real. Pierre Levy's Becoming Virtual offers this:

> *"The virtual, strictly defined, has little relationship to that which is false, illusory or imaginary. The virtual is by no means the opposite of the real. On the contrary, it is a fecund and powerful mode of being that expands the process of creation, opens up the future, injects a core of meaning beneath the platitude of immediate physical presence (Levy, 1998)"*

Ryan observed that the relationship between the actual and the virtual is a one-to-many relationship. The virtual has the potential to be realised in any number of ways depending on the individual context of use. From an educational point of view this squares conveniently with learning technologists' appreciation that a primary strength of online learning is its capacity to support individual learning styles within a single system. Anyone with a passing familiarity with the contemporary drive within learning technology for reusable, multi-contextual components and aggregates cannot help but be drawn in as Ryan continues:

"The concept of virtualisation is an extremely powerful one. It involves any mental operation that leads from the here and now, the singular, the usable for once-and-for-all, and the solidly embodies to the timeless, abstract, general, multiple, versatile, repeatable, ubiquitous, immaterial, and morphologically fluid… It is through the consideration of the virtual as potential that the mind puts together representations that can act upon the world (Ryan, 2001)."

3. Narrative, videogames and the Virtual

The near ubiquity of personal computers in more recent years has brought forward a further multiplicity of contexts—in the home, in the work place, in education—for the term virtual. We can play a part in virtual societies and become active in virtual communities that promise to help to counter the alienating, fractured nature of our post-modern lives (Rheingold, 1994). Equally, we can make use of virtual reality to learn how to fly aeroplanes, develop virtual characters and engage in social and gaming behaviour with other virtual characters, earn spare cash in virtual action rooms, and lose all these earnings in virtual casinos and shopping malls.

Computers are in essence virtual machines. Internally they do little more than respond to binary instructions. However, when given a set of instructions within a specific context of use and using appropriate interfaces they become much more complex phenomena; metaphorical representations, simulations, a prosthetic, perhaps even, as Turkle has suggested, a part of our selves (Turkle, 1984; Turkle, 1997).

Emergent narrative, as described by Murray (1997) suggests a new form of narrative, one that is constructed directly through interaction rather than entirely predefined. Video game developers realised that their developments—and consequently the experience of players -was enriched by making the play personal. No two players should have the same experience of a single game world. A single player should have a different game experience depending on how they approach the game. As far back as the early 1980s Malone identified dynamic feedback as being a significant factor in a game's ability to engage a player (Malone, 1981). If feedback is not instantaneous, and is completely irrelevant to the move the player has made, then engagement is in danger of being lost. Consequential agency—the feeling that a player can have a real substantive effect upon the game world would also seem to be central to the success of these environments. Bruckman has reported on how players react negatively when

they feel unfairly or unrealistically constrained by a game—they try to break out of that environment! (Bruckman, 1992). The game or emerging narrative must respond appropriately and believably then to the player's interactions. The game narrative is, as it were, a world which the player inhabits and should not begin to consider leaving.

Emotional simulation—a condition that, in narrative contexts, calls upon the empathy of the reader for the character, and the emotional performance that this empathy encourages, is another factor suggested by Ryan as being significant in being able to successfully bring about prolonged engagement with the narrative (Ryan, 2001).

So far, in this chapter, a number of issues surrounding the essence of the virtual, particularly within a cultural framework in which computer mediation of contexts of work and play is increasingly commonplace have been addressed. It will now turn specifically towards healthcare education and the use of VPs.

4. The virtual in healthcare education

The increasingly widespread use of integrated educational support systems such as virtual learning environments (VLEs) has marked a significant growth in our dependence on new technologies to support and structure our learning frameworks (Browne and Jenkins, 2003). At the same time the imperative for the healthcare services is to reduce the amount of time patients stay in hospital. With fewer patients spending less time in hospitals and clinics, opportunities for building learning activities around real patients have decreased and various forms of representative simulation have become an increasingly common alternative in healthcare education. However, such virtual interventions commonly address single, linear challenges or processes; very little is currently on offer to account for the loss of opportunity to pick up the tacit knowledge of clinical practice that arises from the experience of actual involvement in a real clinical scenario.

Even after graduation medical students will undertake many years of further training before they may call themselves a full professional. This postgraduate training is undertaken mostly in real clinical contexts, where knowledge, skills and understanding are acquired through the experience itself. It would seem, therefore, that much of the education of healthcare professionals depends upon the learning opportunities offered through the actual practicing of skills in context.

As has already been suggested, VPs are increasing in popularity partly as a result of the reduction in opportunities for this practical engagement with clinical practice and so it would perhaps seem appropriate to suggest that we attempt to introduce as much of the essence of real clinical scenarios as possible into VP structures.

5. Virtual Patients

Healthcare students are no strangers to VPs and they are encountered in a variety of contexts: actors performing the role of patients in clinical examinations; mannequin dummies in activities relating to, for instance, anaesthesiology and resuscitation; web-based computer assisted learning (CAL) packages, in which students can interact with case based self assessment exercises online, to name just a few.

These clinical simulations, simulated patients, CAL sequences, and so on already exhibit certain characteristics that could be considered analogous to many of the factors outlined above. For instance;

- Students may be encouraged, often indirectly, to adopt a character role through which they can engage with the activity—most commonly that of a professional clinical practitioner.
- Students are presented with situations that require them to interact directly with them (from answering multiple choice questions in a CAL sequence to responding to changes in physiological status in clinical simulations)
- The patients are often presented as characters, with names, personal and social histories, in essence a story
- Student responses are often assessed and feedback given, enabling personal reflection on how well they have performed.

It is also perhaps true to say, however, that the narratives that accompany many current VP scenarios are simplistic and linear. The underlying frameworks supporting patient data and associated resources are largely directed towards the convenience of teachers and those creating the scenarios. The efforts being made to promote multiple contexts for VP elements is a largely administration driven process. There would appear to be comparatively little effort being made at using such initiatives to address the individual experience of the learner.

At the University of Edinburgh there is an ever-growing range of web based VPs that deal directly with numerous curriculum topics. The following are two brief illustrations of VPs currently used by undergraduate medical students:

- **George** is a VP in his mid fifties who medical undergraduates encounter first in year one. Throughout the subsequent five years of their undergraduate programme they will encounter George numerous times as his condition grows ever more complex thereby matching their current levels of study. George offers real time engagement and is a valuable platform for integrating learning tasks that had previously been taught in isolation, such as social and cultural factors of health, communication skills
- **Hannah** is another VP developed to provide learning aids in reproductive health. The student is invited to learn more about Hannah on her journey from discovering she is pregnant to the birth of her child. Students are quizzed on a variety of associated topics and are offered numerous resources such as scans, lab reports, case notes, etc to enhance the learning experience.

These applications, and others of their kind are popular with students. They offer elements of a realistic context in which the students can interact with a variety of data and resource types. However, as outlined above, they are currently tightly constrained in how much reality they can represent. If a student offers an inappropriate response to a question, say, regarding George's prescription medication, there is no consequence to that, merely feedback to indicate that their answer is wrong, an indication of what the correct answer should have been and a prompt to move on to the next page. The same would be true of Hannah, and other web based VPs.

It has been suggested that there is already much in VP cases that are analogous to other narrative driven applications—videogames in particular. It is appropriate tp highlight possible factors where a more considered application of narrative/game informed elements could actively enhance the learner experience of interacting with VPs:

6. The learner as consequential agent

How might the environment allow the learner to feel that their interactions have real consequence? Three possibly influential factors might be;

- Emergent narrative: Murray's (1997) description of emergent narrative suggests that it is a form defined by interaction. The progress of the story is—as much as possible—defined by the choices that the interactor makes. How might we enrich the possible navigational pathways in VP applications to allow the learner to feel that it is their own choices that are driving the progression through the case?
- The responsive environment: The learner will reasonably expect the environment to respond to his/her input. These expectations should not necessarily be limited to one right path and a few alternatives that lead quickly to a dead end. If a learner can take an individual path through a case, which allows for reasonable deviations, and that does not result in a termination point, the environment will likely prove to be more engaging, more responsive, and may even allow for further knowledge assimilation through information picked up on the individual's choice of path. How might we approach accounting for these diversions within VP applications?
- The psycho-social moratorium: Gee (2003) has illustrated how games allow for the making of poor choices without any detrimental effect upon the richness of engagement. The player—and for our purposes the learner—having failed to meet a core objective, can (and does) return to try again. Successive attempts can be made to attain the core objective—each attempt increasingly informed by knowledge that has been successfully acquired through previous attempts. Once successful, it is not unusual, in gaming contexts, for the player to return purely in order to improve their performance. How might we structure our VP case architectures to accommodate appropriate break points that would: allow learners to make repeated attempts at core tasks; allow for a dynamic grading of performance; encourage learners to try repeatedly to find their optimum path to the desired outcome?

7. Labyrinth

'Labyrinth' is a new development initiative within the College of Medicine and Veterinary Medicine's Learning Technology Section at the University of Edinburgh. The Labyrinth application is a content authoring and delivery platform for learning activities such as VP case scenarios. Like the examples offered above, the application can present fictive cases in which characters are introduced and a variety of tasks are offered to the student, who will also be identified with a consequential role within the application—commonly that of the health professional. Unlike the previous examples,

however, the emphasis within Labyrinth is on decision-making. The decisions made by the student directly influence how the material and subsequent options emerge.

For example, in a module concerned with clinical admissions the student may enter into a scenario in which they are contextualised as an agent in charge of an admissions unit at the start of a nightshift. The student will read a basic introduction text then be asked to make a decision as to what to do next: consult with registrar; establish what resources are available; approach a patient; or make a cup of tea. Clearly, some choices from this array would be more appropriate than others. The critical point is that no matter what choice the student makes, the narrative continues unbroken. Electing 'to make a cup of tea' will result in a text message indicating that your attitude may appear questionable and that the registrar seems to be giving you a disapproving look. Choices will then be made asking you whether you would now like to: consult with the registrar; approach a patient; or establish what resources are available. Similarly, in another scenario in which the student performs as a community GP on call, a situation is presented in which the GP receives a telephone call at 8.30 in the evening from the mother of a baby, concerned that her child is not settling and has a persistent cough. You are asked to decide whether to: go and see the child immediately; instruct the mother to administer Calpol and phone the surgery in the morning; or call an ambulance. Again, each choice comes with its own consequences and these consequences inform the subsequent narrative chain of events.

By logging all interactions it is possible to track an individuals progress through a case and, if appropriate, map their choices against optimum pathways suggested by the case authors. As well as the dynamic instant feedback received by students as they progress through the case, they may also be presented with summary reports that indicate where their interactions have differed from those which the author has established as good, or even best practice.

This brief illustration offers an indication of how factors associated with successful gameplay have been introduced to the basic VP activity: specifically, presenting an environment that reacts dynamically and plausibly to the student's interactions and the emergence of a narrative that arises directly as a consequence of the student's decisions.

8. Discussion

Medical students do need to interact with real patients—this is what they are being trained to do. It is apparent that the opportunities for such interaction are becoming fewer. The use of VPs has grown in popularity as a means of presenting learning opportunities that have the potential to situate learning within realistic contexts and employ a range of data and resource types.

However, the present structuring of VPs limits interaction to a single structured pathway, where the way in which the student responds to questions posed has no impact upon the unfolding of the scenario.

The perceived function of present VP applications would seem to be largely prosthetic; filling in the gaps left by the unavailability of human subjects. However, as we have described, the realism of these situated cases is greatly limited by the lack of consequential decision making opportunities.

It is suggested here that the essence of the VP should perhaps be more concerned with potentiality than prosthesis. A deeper embedding within VP meta frameworks of procedural aspects of narrative may impact positively upon the learner experience of VPs—just as they have been shown to be a contributing factor to the success of videogames.

The impact may be just as profound upon teaching practices, in particular content authoring. It would seem more appropriate to create several potential pathways through a clinical scenario producing a learning activity which will prove more challenging than that of a single path. Authoring interfaces may be able to help alleviate some of the challenges here, but there may be further potential in multiple authorship and the interleaving of cases (bad decisions made by a student in treating, say, a pharmacology case could result in a straying into a case addressing overdose, or critical resuscitation skills, for example).

It is almost ironic to observe, however, that the kind of content structures that would allow for multiple pathways to be taken through case based procedures are conceptually in keeping with the imperative to maintain flexibility in the meta structures of VPs to allow them to be used in part or in whole across multiple contexts (this sentence does not make a whole lot of sense to me).

Making narratively rich, game informed decisions about how to present what information and when to present it in the unfolding of the narrative may lead to the development of compelling applications in which the learner feels driven to compete, to succeed, to know—who feels caught up in a rich environment where there are critical choices to be made—and where those choices have real consequence. While it seems likely that the sense of engagement would be enhanced by the kinds of measures outlined in this chapter another important new question is opened: is there any correlation between learners sense of engagement with a computer mediated learning application and the pedagogical impact of that application?

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Learning with Digital Agents—Integration of Simulations, Games, and Storytelling

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Keywords

Game-based Learning, Interactive Digital Storytelling, Storytelling Agents, Gaming Simulation

Abstract

Digital agent technologies provide extensive opportunities for learning applications. Special emphasis in this article is on a critical review of the chances, limitations and risks associated with the use of anthropomorphic avatars and digital agent representations. Depending on the different conceptual models and connected metaphors, various interactive experiences can be shaped, as illustrated by several examples. Different content types and different learning effects are discussed that can be realized by a varying mixture of storytelling, gaming simulation and interface design aspects. The main argument made is that the metaphor of a help agent, appearing in a superior role towards a human user, is counterproductive to wide acceptance, and that other applications of the agent, such as in a role of a digital companion, are more likely to be successfully established. Finally, scenarios are provided that show how distinct forms can be used in diverse learning situations dealing with social skills, and in a constructive approach to learning.

1. Introduction: Digital agents in the context of learning

A "Digital Agent" is a concept that has been raising increasing interest over the last 15 years. In general terms, a digital agent is software, working on behalf of a user or several users, and is sometimes also referred to as "software agent technology". Commonly, the field of software agent technology also includes the specification of agent-oriented

software architectures and programming languages, where an agent works on behalf of other software components. The defining attributes of software agents, in contrast to conventional objects or programs, are described in terms of their behaviour, such as autonomy, intelligence, or reaction to the environment (Franklin and Graesser, 1996). More specifically, these are models of human-like features similar to mental states, for example beliefs, desires, and intentions, as well as internal world representations, formed by ontological descriptions. In this article, the focus is on applications that make use of the humanoid properties of digital agents for their interaction with users, supporting specific conceptual models, metaphors and associated expectations. The user types under consideration here are end-users of learning applications (learners), as well as teachers or learning content authors.

1.1 Visions and motivation

In Human-Computer Interaction (HCI), the employment of digital agents in a graphical interface follows the primary vision to achieve a bridging between the communication styles of people and of computer technology. Instead of forcing the user to learn and adapt to the vocabulary and styles of machines, the familiar symbol sets that are used for human-to-human communication are used by the machine. This includes natural language as well as nonverbal signs that are not used consciously by people, such as facial expressions, gestures, voice pitch, and presence. The vision resulted in the modelling of the "avatar"[1] as an anthropomorphic approximation of the computer to a human being. Avatars are perceivable embodiments of "software agents"—in a sense applying the metaphorical division of "body" and "mind" to software. "Embodied Conversational Agents" (ECA's) form a current research topic addressing the definition of their parameter sets, markup languages, and user evaluations (Cassell, Sullivan, Prevost and Churchill, 2000). In summary, user interface agents and their visible avatars serve as a conceptual bridge. The initial goal has been to make technology more comprehensible and also to enhance it through new emotional qualities—information technology obtains a human face. However, anthropomorphism in the interface has also met criticism from the outset, for example see a discussion of Don, Brennan, Laurel and Shneiderman (1992), and will be discussed in section 2.

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[1] Avatar: (Sanskrit source: Embodiment, Incarnation) Originally, an avatar is the manifestation of a Hindu Deity (especially Vishnu) in a human, superhuman or animal form. Today the term has been introduced in the context of computing to either refer to a visual representation of a user in a multi-user environment, or, as in this article, of an intelligent software component for human-like communication with users.

Beyond their application as a proxy appearance for "the computer program", avatars as well as software agents have been applied in the storytelling and gaming industry for years. Through Computer Graphics, animated characters have been brought to life on the virtual stage, at first to tell linear stories[2]. In contrast to pre-produced imagery in movies, virtual figures that appear to respond to a user's actions in a video game have to actually be rendered in "real time", with the help of underlying "behaviour" controllers. These are software agents, managing their avatar's movements, depending on user inputs, context information and internal world representations. As a joint effort in Computer Graphics and Artificial Intelligence, mental states such as personality traits, emotions, as well as conversational knowledge are added to build "Virtual Humans". Assuming that these agents are additionally equipped with more sophisticated models of mimetic competence and plot coherence, I refer to them as "Interactive Storytelling Agents"—a breed of digital agents that are capable of responding in a meaningful way to a user's request while retaining an overall story or action plan defined by an author of a story.

The topic of "Interactive Digital Storytelling" is also a new interdisciplinary research field, gaining interest from the media and games industries as well as computer scientists dealing with agent technology. More than merely enabling human-like interactions with ECA's, dedicated story agents provide a digital presentation with narrative coherence of content and dramatic tension, while it responds to users' inputs. There are various and contradictory definitions of Interactive Storytelling, depending on the starting point from which the approach is made. For example, according to game designer Chris Crawford (2004), Interactive Storytelling is a "new kind of computer gaming" through adding story complexity to a game, whereas Andrew Glassner (2004) as a writer refers to it as "responsive narrative". In either case, it constitutes a hybrid form, containing elements of games, simulated humanoid agents and storytelling. General conceptual issues of Interactive Digital Storytelling applications are discussed in (Spierling, 2005a).

Finally, a class of applications have been conceived and developed from a computer science perspective, which form the category of "Pedagogical Agent" technologies. As a special case of ECA's, these agents are semi-autonomous animated virtual figures,

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[2] A quick overview of the history can be found in Wikipedia's "Timeline of CGI in movies—Pioneering uses of computer-generated imagery in film and television", http://en.wikipedia.org/wiki/Timeline_of_CGI_in_film_and_television

capable of showing and telling by using gestures and language. They are designed "to teach", namely to be able to demonstrate complex tasks within a tutorial-like communication, and to motivate by conveying emotional responses. A survey of these approaches to technology, which are still very much in their infancy, is provided by Johnson, Rickel and Lester (2000).

1.2 Hypotheses

Games and storytelling can both be of major help in teaching situations and are widely used for learning, with or without a computer. E-learning applications in general should be easy to use, to let the learner focus on the content matter instead of struggling with the interface. Therefore, the first hypothesis raised here claims that digital agents with avatars can be used as entertaining and useful sparring partners for learning in an E-learning application, while satisfying several learner/user interests simultaneously: enhancing the human-computer interface, introducing actors that can tell a story and present a learning topic, and that constitute believable game characters.

However, against the background of visions that once led to their development, and regarding recently occuring concrete artefacts, the assignment of agents and avatars also raises acceptance problems. On the one hand, this is due to a current state of technology that is not yet mature enough to enable the desirable and necessary performance. On the other hand, the thesis made here is that users often develop misleading conceptual models of assumed virtual humans that hamper the establishment of feasible and sustainable associations and expectations. For example, the predominant existing role model for virtual agents has been their conceived occurrence as digital "guide", "teacher", or "adviser". Any metaphor of an "intelligent help agent" implies a human-agent relationship of the agent in a way outmatching a human user. In a learning application, such an artefact is likely to be criticized immediately, as soon as its behaviour is not satisfactory—independent of its effective functionality. Therefore, the major argument made in this article stresses the importance of designing a suitable conceptual model, which should always place human users into the "driving seat". The most useful digital agents then appear to be digital companions acting as pawns in a game, or in other words, acting as digital operators with limited tasks in strictly defined scenarios.

In order to illustrate several application possibilities, examples and content types are presented first. Then, their promises and provoked expectations for learning are

explored, while also discussing conceptual aspects of storytelling and simulations involved in digital agents. Finally, learning scenarios with digital agents, beyond their function as virtual guides, are outlined.

2. Examples of conceptual models and applications of digital agents

The term "conceptual model" is well established within HCI, constituting a metaphor or mental image of a known concept such as an activity or a physical entity, leading to certain expectations of users. It is explained as "a set of integrated ideas […] about what it should do, behave and look like, that will be understandable by the users in the manner intended" (Preece, Rogers and Sharp, 2002, p.40). Donald Norman (1988) pointed out the distinction between the design of a conceptual model (the "designer's model") and a user's understanding of it (the "user's model"). The characteristic problems discussed arise when a software designer develops a certain conceptual model of a tool to build, but the resulting appearance of the artefact, together with contextual conditions, provoke a different one in the imagination of a user. The following is at first a discussion of general conceptual models that can be observed with the use of virtual characters, followed by specific example applications.

2.1 Different conceptual models of digital agents

User interface help elements

One of the most familiar examples of a help agent is the Microsoft paper clip, "offering" help while using a tool-like office application. While its conceived purpose is beneficial, and there are a lot of similarities to the first "guiding" avatars designed for learning, user sympathy is ambivalent, and it rather often meets with criticism. Reasons have been researched for example by Swartz (2003). For the context of this paper, two characteristics shall be pointed out:

1. The agent occurs proactively on top of the work, without being asked for help, setting the input focus to its widget, forcing the user to interact with it. The designer's conceptual model actually underlying this behaviour is that of a User Interface element, particularly a dialog box. Unfortunately, it doesn't look like a dialog box—its appearance rather supports a mental model of an agent.
2. The visualization suggests the possibility to perform free text input of natural language, presenting the verbal invitation to "ask questions". In fact the number

of questions that the system can answer is very limited. It only can refer to indexes in a catalogue of simple keywords. It looks similar to a chatbot's interface, but without a chatbot's functionality.

As a conclusion, one major reason for the unpopularity of the paper clip could be that there is an inapt mixture of different possible ways to frame its concept. Basically, in its role model of a "helper", it appears as if it is not smart enough in its behaviour, although the mere knowledge it has in its database should be satisfactory. It is just not able to do small talk, which is what people would expect in reaction to its appearance.

Chatbots as virtual beings

Chatbots, in fact, are another example worth investigating. The term "chatbot" (also: "chatterbot") refers to a software robot program which attempts to maintain a textual conversation with a person. The most important challenge that is faced by developers is to create entertaining small talk in order to keep the conversation going as long as possible. Technically, chatbots use simplest pattern matching of written user input to find suitable answer patterns in a database, also called "knowledge base". In addition to prepared answer sentences completely written by a human author (the "botmaster"), the chatbot can generate sentences using the typical techniques of "Eliza", Weizenbaum's famous program from 1966 (Weizenbaum, 1966). Eliza is able to turn a user's input sentence into a counterquestion, by replacing sentence parts such as "I am" with "Why are you" and reflecting the rest of the sentence back to the interlocutor. This behaviour has proved to tempt people to believe that Eliza "understands" them, and they judge it as intelligent behaviour—at least as long as they don't become aware of its rule-based and stereotypical nature. By annual competitions, such as the Loebner Prize [3] and the Chatterbox Challenge[4], chatbots are compared and tested with a method introduced by Alan Turing in 1950 as the "imitation game" (Turing, 1950). Criteria for winning the original "Turing Test" were simply that the program could pass as a human. The current competition awards the best achieved indistinguishability to a human interlocutor, while conversations between bots and real humans are compared by a jury and the bots have to be detected by the judges. The remaining typical problem with pure chatbot conversations is the lack of a coherent storyline or conversational plan to be achieved, since sentence-based pattern matching is all there is.

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[3] http://www.loebner.net/Prizef/loebner-prize.html
[4] http://www.chatterboxchallenge.com/

Chatbot technology recently finds an increasing interest in commercial websites for advertising, or as a pre-sorting mechanism, answering first questions within an online call center for customer service. Very often in this context, people take chatbots as virtual beings that pretend to be human and immediately join in a testing mode similar to the imitation game. Chatbots experience being asked very personal questions that completely stretch the boundaries of their task and purpose and entertain comments considered annoying for a human. For the purpose of entertainment, most bots are designed to answer these questions up to a certain point. It is remarkable, that users typically seem to develop a conceptual model of having a "being" as a counterpart, but not as a fellow human being they would respect and encounter using the usual rules of politeness. At the end of the day, humans clearly commit themselves to a social interaction with the agents, assigning their perceived behaviour to apparent character traits.

Virtual actors, puppets and dolls

In animated movies, puppet theatre and recently also in video games, virtual characters are used as actors to play a drama on the virtual stage. The underlying conceptual model is clearly not comparable to the function of autonomous agents, but rather of agents serving as a medium, which is used to convey a story on behalf of an author. The undeceived audience should be aware of the "fake" authenticity of the apparition. However, in mass media, especially in TV series with introduced characters, "parasocial" behaviour of the audience towards the fictional figures can be recognized (for example, identification with the fictional character, or a one-sided affective relationship). In stories, the goal is not to create for the mastery of an imitation game, but rather for the "willing suspension of disbelief" of the audience, a term coined by the poet S. T. Coleridge. Interestingly, the attributes that lead to success are less the photo-realistic visualization of the virtual actor than, again, its behaviour, especially in the perceivable coherence of actions. This is typically obtained and supported by a compelling story, with a clearly modelled goal and character of the actors. The parasocial interaction is different from real social interaction, which has been identified for interactive media and computers (Nass and Sundar, 1994).

Video games are a special case for the function of virtual actors. In a sense, they resemble aspects of each of the last two mentioned metaphors (a "being" or an "actor"), depending on the game genre that applies best. In the case of a simulation game, the suitable metaphor rather is a "doll" than an actor, but with additional

mimetic talent compared to physical dolls. The main difference is that control of a doll is completely up to the player instead of the author. An example game is the best selling computer game "The SIMS"[5], which allows players to simulate social life while influencing parameters of single virtual dolls—including the possibility to abuse them, treat them badly and make weird experiments, just like with real dolls. The simulator will calculate their fate, based on the states of their parameter set. In simulation games, there is no storytelling author controlling the coherence of events. The only storytelling, if any, happens at the beginning, in order to explain a mission or an outset. Actually, this is done partially by the players, who in fact are in charge of creating their own stories with their dolls.

Virtual Human

The first attempts at building Artificial Intelligence (AI) entities to converse with, as in the ones mentioned in the context of chatbots, provoked the vision and fostered research into the possibility of making a machine "really understand", to build machines with consciousness. The philosophical debate between the notions of "strong AI" and "weak AI" on whether or not this is possible will not be covered further[6]. Instead, the practicality of the metaphor of a "virtual human" shall be critically investigated, as it is a very likely conceptual model activated through a pedagogical agent appearing as a surrogate teacher — even more so, since current research in computer graphics and speech technologies also strives to perfect this vision. The idea of a fully-fledged virtual human is a controversial concept as alarmed reactions of teachers have shown in this context (Spierling, 2005b), fearing a substitution by automation. Additionaly, expectations have been raised so high that the results are very likely to be a disappointment, last but not least because of a phenomenon called the "uncanny valley"[7]. This valley occurs as a drop in the plotted curve of empathic emotional responses to increasing anthropomorphism in a robot, just when the "almost-human" stage is reached, resulting in negative feelings such as weirdness. Bickmore and Picard (2004) have reported insightful research results that show how especially designed agents can influence the perception—or rather the illusion—of "caring", perceived even by

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5 The SIMS 2, produced by Electronic Arts, http://thesims2.ea.com/

6 In AI philosophy, this debate is still alive and goes back to John Searle's argument that true consciousness can not be achieved by formal logic systems, as illustrated in (Searle, 1980) by the "Chinese Room Argument".

7 The term "Uncanny Valley" was coined by the robotics researcher Masahiro Mori in 1970, compare http://en.wikipedia.org/wiki/Uncanny_Valley

computer-savvy persons who know that machines don't experience genuine caring, and pointed out the possible undesirable implications. As a result of these findings, and especially as machine consciousness is far from reality, a user's conceptual model is preferable that raises lower technical expectations, as well as gives control and comprehension to the user.

2.2 Example applications

Pedagogical Agents and instructional storytelling

The current state of the art in animated Pedagogical Agents aims at a new paradigm for learning systems (Johnson, Rickel and Lester, 2000). In principle, the emphasis is on face-to-face interactions between an agent and a student in a virtual, interactive learning environment. Some classic examples are the applications Steve (University of Southern California, CARTE Institute), Cosmo (North Carolina State University) and PPP Persona (DFKI, German Research Center for Artificial Intelligence)[8]. Steve has been applied to naval training tasks such as instructions for engine operating. Students share a virtual environment with Steve by 3D stereoscopic vision and audio. The Steve 3D-model is able to perform gaze directions and pointing gestures while talking with an electronic voice. The model is visualized as an upper body floating through virtual space to reach locations to point at or talk about. A similar approach of combined gesture, locomotion and speech, referring to objects in the environment while delivering problem-solving advice, is followed with Cosmo. While students use the learning system about network topology as a construction game to solve tasks and learn actively about network routing mechanisms, Cosmo's task is to help, offer advice and to explain factual knowledge. Its visualization is a similar functional abstraction such as for Steve, however less anthropomorphic. PPP Persona guides a learner through web-based material, by combining text with abstract 2D pointing visualizations. The presentation is pre-planned but can be adapted and repositioned dynamically according to the user's actions. The user is mainly busy performing a task with the mouse and keyboard.

All mentioned examples are supplementary to the performed task and produce deictic references to particular objects that are part of the virtual world, together with textual information, such as speech. They can be used for:

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[8] All three examples are explained in (Johnson, Rickel and Lester, 2000)

- Demonstrating physical tasks interactively by animation
- Navigational guidance, problem solving guidance
- Nonverbal signals for conversational control and emotional feedback
- Conversational interface to the computer, conversational assistance

Comparative evaluation studies have shown that the agents contribute to the learning effect at least through a higher form of engagement and motivation of a learner (Johnson, Rickel and Lester, 2000). Another study for conversational assistance through avatars showed a neutral effect concerning the comprehension of instructions, but a combined higher degree of entertainment and positive acceptance (Krämer and Bente, 2004). However, the results concerning the preferences for a certain visual appearance were highly diverse, depending on personal biases. Furthermore, all mentioned examples were tested in research environments, and a similar broad reality check as with the paper clip example (see above: Swartz, 2003) is still outstanding. The resulting perceived conceptual model might vary, depending on the concrete application, between a help element and a performing actor.

Simulations

Simulation games have been discussed as ideal learning tools for the comprehension of system dynamics, such as in SimCity[9] (Bos, 2001), or Mobility[10]. Particularly in the context of planning and construction, as well as for the control of machines, computer simulations are wide-spread. The basis of each simulation game is an abstract model of the system that underlies the learning subject. The application of simulations on the base of abstract models in the domain of human or social systems is rather in its infancy. Two examples shall be emphasized: The best-selling computer game "The SIMS"[11] for play and entertainment, and the learning tool "Virtual Leader"[12]. In "The SIMS", each virtual doll has an extensive set of parameters describing its properties (e.g. needs: hunger, comfort, social, etc.) and behaviour (e.g. skills: cooking, creativity, charisma, etc.). The complex interface of many buttons and sliders allows players to invest resources and make detailed day-to-day decisions. There are no objectives for the player, it is rather a household or family simulation which

9 The first version of SimCity was produced by Maxis in 1989. The current official website is http://simcity.ea.com/
10 http://www.mobility-online.de
11 http://thesims2.ea.com/
12 Virtual Leader has been produced by Simulearn, http://www.simulearn.net/

can be shaped freely, and the player organizes the life of the agents so that they achieve personal goals. There is no winning or loosing, and it has no educational purpose.

In contrast to "The SIMS", "Virtual Leader" is an early example of an application of digital agents in a simulation game as a dedicated learning tool. It is a leadership training simulation, giving the learner exercises in different scenarios of a business meeting with virtual employees, where biases of employee ideas, financial performance and customer satisfaction are at stake. The user interacts with the mouse and slider-like graphical tools, rating persons as well as their upcoming ideas during the conversation. Depending on the decisions of the learner, the system gives feedback on three different aspects of leadership performance: power, tension, and ideas.

The function of the digital agents in the case of the simulations are:

- Demonstration of communication behaviour (verbal and nonverbal) of a counterpart in a conversation, and representing the virtual population of the scenario
- Improving the immersion and "suspension of disbelief" in the scenario by rendering the avatars as believable entities
- Apart from their rendered appearance, the most important function of the digital agents is to "be" the abstract computational model of humans with assigned variables and calculated states, in order to provide awareness and cognition about a social system

The creator Clark Aldrich (2003) admits that a major problem is due to the fact that these simulations are not at all realistic in every aspect. There is a general recognition issue with simulations that is similar to any of the other problems of digital agents: where the necessary abstraction in a simulation model of a city or a traffic system does not lead to acceptance problems—when human concerns are at stake, things are different. This does not only concern the appreciation by the target group. The phenomenon is even debated in philosophy and sociology, asking if quantitative methods from natural sciences and mathematics can be applied to cultural and social issues. For successful functioning of the agents' state machine generating the simulation, quantifications are indeed a pre-requisite, resulting in the impact on (and expression of) emotions, personality and skills of the agents by mere calculation and computer logic. There is the argument that "binding" causal explanations would additionally have to take into account at least the temporal metric of the physical world (likewise,

extensively complex parameter sets) in order to do justice to real-world cognitive processes.[13]

Interactive Digital Storytelling

Beyond the face-to-face interaction of a single pedagogical agent and a learner, there have been recent research experiments in the context of "Interactive Digital Storytelling", building the foundation for most of the findings in this article. While simulations add an underlying world model to the concept of digital agents, here, particular structures from storytelling domains are added. In general, this is any representation of a plot, optionally further divided into narrative sub-structures such as acts and scenes. Most important is a dramatic character constellation, giving each character a clear goal in the context of the told story. Stories and simulations show some resemblances at their starting points, since character constellations can also be modelled as parameter sets. Their differences are revealed during the unfolding of the plot. Put simply, the power of a told story is to explain the cause for an effect and its special circumstances. Therefore, a specific ending along with specific major turning points is most important, especially when the end is surprising, since it is often the motivation to tell this particular story at all. In contrast, pure simulations are open-ended—if at all, they can be considered to be "what-if"-stories. After having run the simulation, "cause-and-effect"- stories can be told about it. However, some simulated endings might be completely uninteresting to tell later. In Interactive Digital Storytelling, there is the notion of "emergent narrative", pointing out the open-endedness of such a plot that only comes into being through interactions of users, and therefore cannot be completely predefined by an author. Formulating general acceptance criteria and design rules to maintain dramatic tension is still an open research issue, as the whole field hasn't yet produced mainstream products.

The following investigations have been performed in edutainment projects, which employ digital conversations of a user/player with virtual characters on a stage to convey information and to entertain. Within the game design community, a similar integration of simulation and storytelling was used in the project "Façade" by Mateas and Stern (2003), however, not for educational purposes. In Façade, two virtual characters perform a conversation along a plot outline, in a situation of a couple having a severe argument. The resulting role play assigns a role to the player as a

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[13] This argument on using simulations is discussed in a comprehensive way, from an epistemological point of view, in (Peschl and Scheutz, 2001).

friend stopping by their apartment and getting involved in the quarrel—either to calm things down or to witness their breakup, by typing contributions to their conversation on a keyboard.

With the edutainment projects, various approaches were explored to combine similar plot-based interactive storytelling with character-based emergent conversations. They differ in their user interfaces and in their bias on either more storytelling or more simulation—resulting in the degree of user activity, versus pre-authored plot played out by the agents. In all examples, several animated characters converse digitally with each other and with one or more users, who either type text with the keyboard, or apply choices, for example, with special hardware interfaces (compare Figure 1, right).

"Geist"[14] (Kretschmer et. al., 2001) is a scenario in a real world setting explored with a mobile Augmented Reality (AR) platform and GPS location tracking. User interaction occurs by walking through the historic site of the Heidelberg castle, provided with the "magic equipment": a mobile computer. The goal is to track down virtual ghosts, visible through magic binoculars, who live at real places and ask the tourist for help (see Figure 1, left). Each of them tells a part of a story about the past. The tracking system provides information about the location and the line of vision of users. In effect, tourists cannot alter the story outcome; but they can change the order of scenes slightly, depending on the route they choose. The main effect here of the agents for learning is the motivating adventure of having a live experience with ghost characters attached to a real historical site.

Figure 1: Applying choices through special interfaces. Left: Geist—in the Mobile-AR scenario, interaction occurs through finding ghosts by walking in real locations. Right: art-E-fact—video-tracked pointing gestures select parts of a painting, while special props define the meaning of the interaction.

[14] The term "Geist" is German for "ghost"

In the project “art-E-fact”, the employment of digital agents has a similar motivation, they entertain and provide people in a museum with initial interest in the topic of art history (Spierling and Iurgel, 2003). Two characters perform a conversation, taking different roles, starting for example an argument about the question if a Madonna-and-Child topic of the Renaissance can be considered “kitsch” or not, or a detective challenge. Each actor explains different facts in the context of the painting, for example about comparative art history or particular painting techniques, and they can involve the visitor into the discussion and ask him for arbitration in their quarrel. For specific interaction with the painting in the museum, for example closer inspection or painting exercises, toy-like props have been developed as interaction devices for pointing, such as a magnifying glass or a brush. The learning topic is on the details of the painting style, and the agents deliver a suspenseful story framing the content to generate greater motivation.

The function of the digital agents in the edutainment scenarios are:

- Enhancing motivation and interest by introducing a compelling story or fictional scenario
- Playing out a conversation, story or conflict among the agents, while representing character roles as an initiation of a role play to join in later
- Prompting the learner for interaction with direct manipulation devices

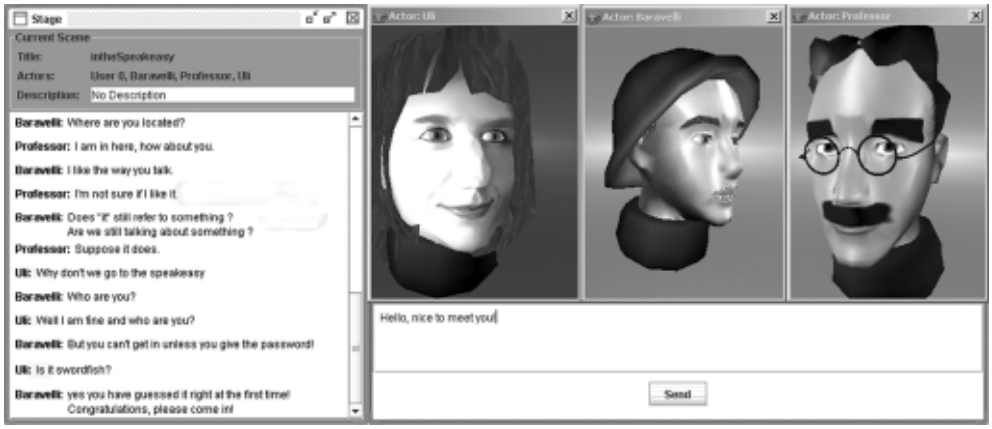

Figure 2: Example screen with text interaction: Scenejo—Emerging small talk between several virtual agents and one user.

Finally, the experimental platform "Scenejo" (Müller, Spierling and Weiß, 2005) offers an almost free chat with several virtual agents and users (compare Figure 2). While users type text on a keyboard to contribute to the conversation, the 3d-modelled talking heads pronounce the answer text through a speech synthesizer, lip-synchronized with their facial animation. A future task would be the integration of a speech recognition system for spoken text input. The dialogues between the actors are pre-modelled by a chat knowledge base, which primarily contains a huge amount of text patterns that a user or an agent can potentially express, along with associated lines for the bots to answer. The result is an emerging dialogue that is partially but not completely predefined by an author, and which can have surprising turns, in contrast to the aforementioned pedagogical or storytelling agents.

The two projects art-E-fact and Scenejo have similar goals while they approach a middle ground of narrative presentation and the interactive conversation based on user input. In Scenejo, the emphasis of activity is more on the user's side. As a platform, this enables the integration of simulation-like structures. As shown later in chapter 4, Scenejo is used as a technical base for an interactive conversation, which combines the general underlying idea of the "Virtual Leader" simulation with free verbal conversations. It offers several levels of conditional states, processed by a drama manager, for example changing abstract parameters such as emotions, planning of dialogue acts and specific wording. For the description of the verbal knowledge base, the mark-up language AIML of the Open Source project A.L.I.C.E. is used[15]. Figure 3 shows a sketch of Scenejo's design levels and an interface screenshot of the authoring view on the plot graph through a transition network.

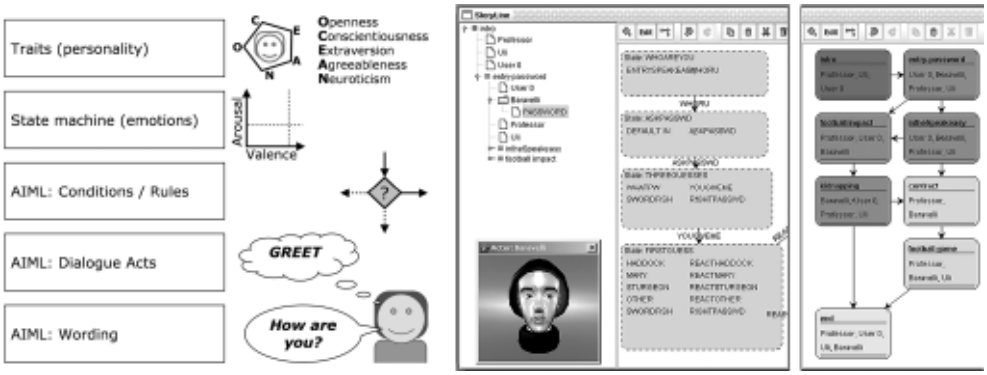

Figure 3: Scenejo (Drama manager & Authoring tool). Left: sketch of the parameters on several abstract levels, processed by the drama manager, Right: screenshot of a modelled plot graph

[15] http://www.alicebot.org

3. Expectations for Learning

The second section briefly discussed selected existing examples and applications of digital agents to illustrate the hypotheses made in the introduction. To a large extent, alongside with most recent discussions about the topic of digital agents for learning, a pedagogical agent obtains the role of a "help agent", or the role of a guide, a teacher, or simply provokes an expectation that implies a superior relationship towards a human user. This expectation is similar to the yet unfulfilled dream that a chatbot could counsel a human client in a meaningful way. Up to now this has only led to partially satisfactory results. The main technical as well as conceptual challenge is not to let the agent tell something, but to make the agent listen to a human user carefully.

The interactive scenarios presented show different ways of letting a user interact with a digital agent. For example, a user can walk through a site and explore places where she listens to pieces of a story presented by an actor—or the user might be actively occupied typing sentences in a rapid interchange with the chat agent—or the interface provides buttons and switches that let a user unhurriedly and deliberately control the states of a complex parameter set in a simulation. While virtual actors playing out content are widespread, there is little discussion about how the user's interaction is part of the learning process.

3.1 Three aspects of learning content

In the following, three learning aspects of the created media are discussed, which are all present at the same time—however possibly with changing relevance (see Figure 4). The aspects apply to any medium that can be used for learning, for example to paper and pencil, as well as to digital agents, and have been discussed in (Spierling, 2005b). Clark Aldrich (2003) noticed three "primary colours in the palette of educational material" (linear, cyclic and open-ended), which as well can be mapped easily onto the three aspects, in the mentioned sequence. Given the example of the paper-and-pencil medium: It can be used for communication between humans, e.g. to make a drawing to explain and to instruct; it can be used to train drawing and handwriting; finally it can be used for communication of a human with herself—in the form of extended memory used for drafting and sketching hypotheses.

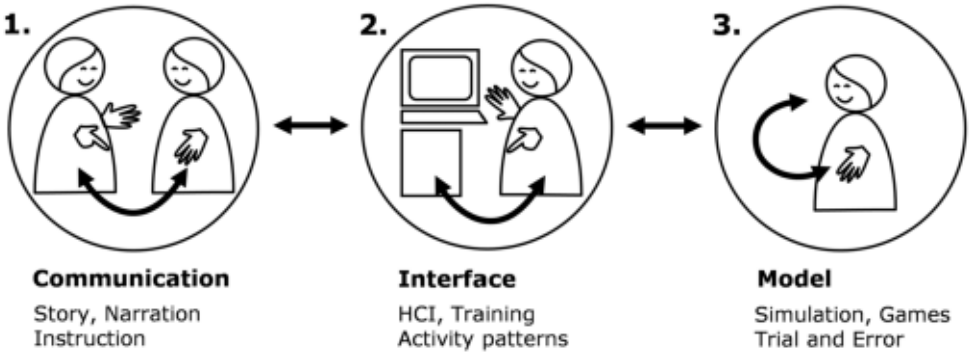

Figure 4: Three aspects of learning content: 1. Mediated communication of Human to Human, 2. Experienced actions between Human and Media, 3. Medium for thinking, and communication of Human with Self

Communication

At first, opportunities for learning with digital agents exist within the "storytelling" function: factual information can be conveyed through narration, using the agents as a medium, as puppets on a stage. Since they have been equipped through an author with the control about what they can tell, users are in the position of selecting what they want to hear next. It conforms to mediated communication (compare Figure 4, left) from a human author to a human user, essentially by more or less linear educational content. Even the initial concept of pedagogical agents emphasizes presenting animated instructions.

Interface

The second aspect regards the (physical and virtual) interface and its resulting activity patterns of cyclic repetitive actions, which have a training effect. For many of the examples, pointing and choosing is the predominant standard of interaction—be it through a mouse, or another spatial pointing device such as the physical prop in Figure 1. Pointing is the favoured action to be performed with a mouse—the most popular interaction device. Indeed, with many actions being reduced to pointing, one can "only" select from a limited choice. From the point of view of human-computer interaction, this constraint has resulted in better usability, since possible human errors can be reduced. Unfortunately, the point-and-click paradigm also dominates areas where actually free exploration, including the possibility to make mistakes to learn from, could contribute to learning. Instead, interaction with digital agents is rather often still reduced to operating a virtual video player, playing out stories and sequences.

While there is no doubt raised about the need for computer usability, the "selection" interaction style is an action that a learner is used to training over and over again. Skilled computer users accomplish a lot while "clicking around" without much reflection and thought. The need to phrase questions on one's own is less convenient if seen only as an action performed to use the computer. In the context of active learning, however, the requirement to formulate one's own utterances is desirable. Repeated hand-eye-coordination such as aiming and shooting gradually improves marksmanship, frequent talking improves pronunciation as well as verbal skills, as does typing, which also improves typing speed.

Model

The third aspect of learning media gives people a medium to think and to test hypotheses, and its structure is open-ended—in fact providing an abstract environment that provides a limited system of forces to explore. For example, proportional aspects of architectural design can be drafted on a sheet of paper, whereas the third dimension, the material properties, and gravity are ignored. While a sheet of paper provides little predefined structure, a toy construction kit can serve as a more realistic model of reality, and a today's flight simulator is an almost perfect mapping of reality to a computer model. A simulation model can consist of only a set of rules how to use a paper and a pencil, but can also be implemented in a computer that calculates states in a virtual world, based on the rules. Simulation models are tools, built to allow testing and especially failure, which in reality would lead to undesirable events. Digital agents are abstract simulation models of human matters, such as a visible body with locomotion and expressions, as well as a mind, containing world knowledge, personality traits, and emotions—including a rule set defining the behaviour towards user interactions. One of the opportunities for learning is to enable failure without severe consequences in interactions with the abstract simulated environment. Hence, a simulation model with digital agents would be meaningful in topics about so-called soft skills, embedded in social settings. Instead of working as a pedagogical agent, a digital agent rather occupies the role of a learning companion or a sparring partner.

The few examples of giving the user a more active role towards agents are actually either chatbots, or simulation games. In the current state of these applications, agents show verbal and/or animated behaviour, but it is still hard to converse with them. For example, "Virtual Leader" (Aldrich, 2003), doesn't yet make the underlying model really transparent during play. Agents are mainly used as actors to play out a script, which, in the most interactive case, is adapted dynamically, depending on user choi-

ces. Reasons for the current infrequency of simulation agents are the degree of difficulty with implementation, as well as accessibility and acceptance problems as mentioned in section 2.

Authoring aspects

Though authoring aspects shall not be in the focus of this article, it has to be mentioned that the majority of existing examples described in section 2 have been created mostly by computer scientists or at least by programmers. The current state of the art needs further development in suitable methods and tools for authors, who are teachers or experts in their field of study, independently making use of the agents. Then, considering the aforementioned three aspects, authoring aspects are also threefold—possibly with tasks distributed in a team.

Certain members of the author team can be considered to be mainly storytellers and to have a primary focus on shaping and scripting the dialogues and visual behaviour of the agents. The second possible focus of attention in authoring is the interface design. This comprises the conception of the actual interface that the learner directly holds and uses (typing, speaking, drawing, etc.), including visualized affordances, the design of the pacing, the turn taking, the timing (such as time pressure), the design of the immediate feedback, or possible constraints in the interface. Finally, the third aspect for authors is game design, starting with the creation of a simulation model. The model may contain actors, resources, and parameter-value pairs—states that can change through the user's interaction. Finally the rules used by the computational state machine have to be framed—according to experience not only once, since part of the game design is "tuning and testing", until the behaviour is properly balanced. This can only be done by people, who know the learning domain very well—being a programmer alone doesn't qualify for it.

Part of the reason why authoring of emergent media is still hard, is next to the lack of tools, the sluggish advancement of interdisciplinary development of concepts. Due to the nature of agents, there is a case of automation involved that leads to a "substitution myth", resulting in reluctance, for example of teachers, to engage with it. Christoffersen and Woods (2002) have formulated a concept to overcome the substitution myth by always including the human in the loop through the aspects of "observability" and "directability". Automated agents are seen as new team players, engaging in a joint system with human team members. For authors, it is necessary to see ("observe") what they are doing, what their plans are, and how to intervene ("direct").

3.2 Use of digital agents as educational engines

In "Engines for Education", Schank and Cleary (1995) have formulated the thesis that in American schools, the natural learning process is reversed, in the sense that answers are provided before a student has asked questions. They suggested several learning architectures, some of which are briefly discussed here to possibly benefit from digital agents. He called them (among others) "Learning by Doing", "Case-based Teaching", "Learning by Reflection" and "Learning by Exploring".

Learning by Doing

Roger Schank argues that the main obstacle to implementing "Learning by Doing" is economics, and that a computer simulation of an environment that allows users to perform tasks in a simulated system of modelled forces can be a solution. He points out that the simulation can never be as rich as the real world. However, in contrast to reality, simulations can offer a degree of abstraction that particularly emphasizes situations causing students to experience well-known traps and to work their way through them. It is important that the student is supported in the "mapping" process of the results of their simulation experience to reality. As shown with the example of "Virtual Leader" as well as the "Interparolo" project mentioned in the next section, digital agents can offer valuable functionality for the creation of abstract simulations.

Learning by Reflection

Another suggestion is the architecture of "Reflection", which consists mainly of a "sounding board" helping students to formalize their ideas, their thoughts as well as questions, and reflect them with the computer as a virtual partner. Schank argues that "what computers lack in empathy, they make up for patience", and suggests a system of questions to be asked in response to thoughts of the student. In its structure, these questions are not dependent from expert knowledge in the learning domain concerned, and therefore can be pre-phrased as generally useful questions uttered by an agent. A digital agent as a textual chatbot, containing a question base in a general chatbot-style, could possibly be useful without any claim to appear as a virtual consultant. The written conversation as such would be an exercise in reflection—in the sense of a diary communication.

Case-based Teaching

According to the argument, people learn from failure. According to Schank, experts could tell a lot of cases how failing can occur—so-called "war stories". Cases can be

constructed as stories together with tasks that the student has to work through, including possible failure. Interactive Digital Storytelling, introducing emotional agents acting as main characters with a problem to be solved by a student, offers possibilities here. However, there is a warning attached to Schank's vision, that case-based teaching only works well if there are a lot of cases, not just a few. There has to be a variety of possible ways to fail in the system, incorporating tailored advice, otherwise it wouldn't be case-based teaching. This warning is reminiscent of an inherent problem in interactive storytelling, namely to create the required complexity of variations in a story to be presented interactively.

Learning by Exploring

Another important idea, mentioning the idea of agents explicitly, is the Learning by Exploring architecture. Schank mentioned 1995 the necessity of search agents finding relevant information of many experts in story archives on the Internet, and making it accessible in classrooms. Meanwhile this has become a reality. Search engines, Wikis, Blogs and even recommendation systems based on demographics contribute to a great pool of expert knowledge on the net. Rather than modelling a virtual expert to ask as the one-stop agent, we are aware of a rather social and integrated conceptual model of knowledge systems.

The conclusion is there are many ways of using agents in a role which is not the expert, the educationalist or the pedagogue, making further developments worthwhile.

4. Project scenarios, chances, limitations and risks

The arguments for and against digital agents tackled before, point in a different direction from seeing the pedagogical agent guiding the user through factual knowledge as the only application possibility. In this section, two scenarios are sketched that assign roles to digital agents that are different from the "guide" metaphor. The first is being worked on in a current project at the FH Erfurt, University of Applied Sciences—the project "Interparolo". The second is a vision for future digital agents as personal learning companions. In both scenarios, the metaphor of a "dollhouse" is superior compared to a "Virtual Human". In the conclusion of this article, the "Virtual Human" metaphor is abandoned for the context of contemporary learning applications.

4.1 Interparolo: Conversations with digital characters

The project "Interparolo" is an interdisciplinary project concerned with the endeavour to build e-learning content that offers interactive text chat dialogues for learning. "Interparolo" is an Esperanto term for "conversation". Accordingly, conversations build the focus of exploration, not just the means of transferring the knowledge. The learning topic of "moderation and mediation" is a course at the FH Erfurt, University of Applied Sciences, within the faculty of transport and communications. Students learn how to moderate a discussion between several stakeholders in the context of urban planning. Naturally, these types of discussions bring together people of contrasting, even antagonized positions and with varying skills in expression and discussion. As a moderator of a meeting, one can run into situations that are difficult to master. These situations include deadlocked positions that make discussion impossible, dealing with difficult people, or with time pressure, just to name a few. The existing course material includes a collection of instructions and work sheets presenting factual background knowledge. However, the core skills that have to be achieved benefit at first from tacit knowledge, including the competence to identify situations and the ability to react accordingly. Hence, the traditional learning methods within the seminar concentrate a lot on learning by doing, for example by employing live role playing games, which allow simulations of cases and situations.

Within the project Interparolo, media content for this seminar topic is created and delivered via e-learning. First course material includes text, as well as videos which show live situations. Beyond these presentations, we explore the use of conversations with digital agents based on chatbot technology in two ways: first a virtual character was added to the digital learning environment platform "metacoon"[16] being used within the project. It works as a digital chat partner to answer glossary-like questions and to point to existing text material, following a guide agent metaphor. In a further development, several chatbots are implemented so that they can converse with each other and the user. We explore the adequacy of this technology for serving as conversational sparring partners in a digital role playing game.

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[16] http://www.metacoon.de

A digital role playing game simulates a live role playing game for learning up to a certain point, while showing several significant differences. These include disadvantages, since nothing is as suited to train for a real situation as the training with a live action role playing game. However, there are also advantages using simulated environments over real ones. Therefore, there is no intention to substitute existing methods by a virtual game, rather to enhance the learning material by additional possibilities.

Design considerations

Technically, the virtual game is designed by connecting several chatbots in a conversational loop of turn taking. As a prototype, the platform Scenejo (compare Figure 2) is used. The user is able to interrupt the conversation of the virtual characters, either by typing text or by using control elements of the graphical user interface.

Figure 5 shows an abstract sketch of the conceived visible technical elements, which allow the design of several sub-games. User utterances, which are input during runtime of the game by typing on a computer keyboard, are compared with a prepared database of pieces of dialogue covering possible verbal interactions. The matched patterns influence a set of parameters of each character by applying rules, which in turn are taken into account while the drama manager selects agent utterances from the scripted dialogue base.

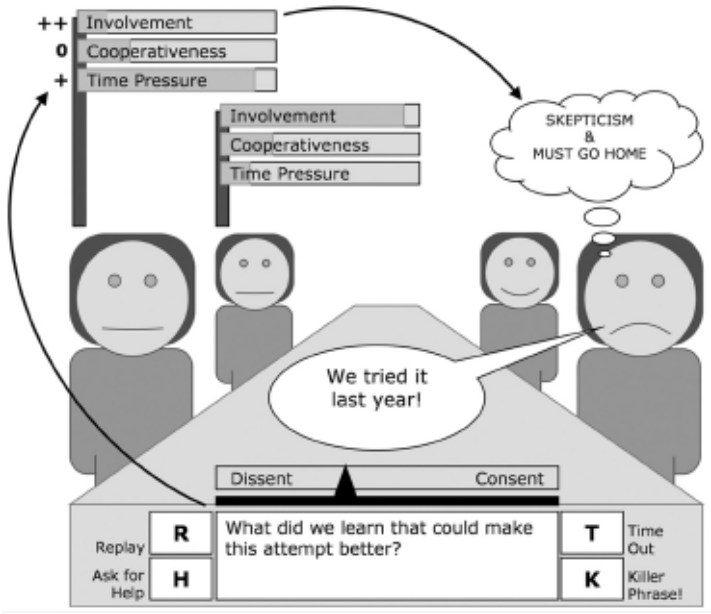

Figure 5: Design sketch of the partially visible elements of the "killer phrase" game, such as the parameter states of the virtual participants

The first learning game being built in the context of the course "moderation and mediation" tackles the topic of how to identify and react to so-called "killer-phrases" within a discussion. Killer phrases are "creativity killers", often used in a knee-jerk manner and destroying new ideas before they are discussed with solid arguments. The designed game assumes a scenario with two parties of planners and residents, arguing about novel plans for an airport expansion. The scripted conversation between the two parties, carried out across the table, contains killer phrases. The learner plays the role of the moderator and has to manage the meeting. There are several stages of complexity:

1. Modelling, without a game element: The agents model an ideal or a dysfunctional interaction of the moderator, providing context information, with no interaction.
2. Situation-Awareness: The player/learner has to simply identify occurring killer phrases, by hitting a "buzzer"-like button and reading more information about the situation, earning points on hits and failures.
3. Coaching: The player/learner plays moderator and has to interrupt and phrase verbal reactions to the virtual characters, in order to influence the meeting in a positive way. In a first "learning system"-version, several game features can help the learner, like wild cards. These are a time-out function to gain more time to phrase an utterance, as well as a Help-function, calling another agent working as a kind of coach or prompter. Game-like features include gathering points for managing a situation.
4. Simulation: The player/learner does the same, except that there is a simulation of a real meeting including the decision whether or not to interrupt, the time constraints for actions, and the experience of the outcome not measured by gained points, but by the reactions of the simulated meeting participants. Optionally, the influenced parameters are explicitly made visible, or hidden in order to let the player focus on the reactions only (such as in a real situation).
5. Reflection: Players/learners are able to replay their finished simulation, again with the option to either visualize internal parameter states or not. This can be embedded in a debriefing phase linked to the classroom course.

The aforementioned stages of possible virtual game designs with the created electronic chatbot material relate to an often-used instructional design approach of "Cognitive Apprenticeship" (CA). The step of the simulation, however, as a task of exploring the

territory, occurs at a rather early stage compared to CA methods[17]. It instead fosters the constructivist exploring of unknown territory with the opportunity to make mistakes in a risk-free environment. Stages 2 to 4 particularly benefit from digital material including agents, while the digital material is tolerant, uncomplaining, and repeated interaction with it is harmless. The digital material, however, cannot stand alone and has to be embedded in the course curriculum within a blended learning strategy.

Advantages and disadvantages of using the digital storytelling agents in this scenario
The project also investigates the suitability of using such a learning game for moderation and mediation in the University environment. Several strengths and opportunities, as well as weaknesses and risks, were identified in the early design phase of the game.

The advantages of the application of digital chatbot agents to the given topic are the following:

- Doll playing in general allows users to test boundaries more than in real live role play which occurs in a social setting. The "magic circle" with digital agents and thus the safe space of "just playing" is more clearly defined than with live participants in a role playing game.
- This reflects the attitude of people dealing with chatbot conversations: ignoring the usual rules of polite behaviour and trying to test the boundaries. In fact, this phenomenon is debated within the project. On the one hand, this can be a chance to experiment with situations like this, and experience the outcome directly. The counter-argument is the concern that students don't take it seriously and prefer to make fun of the annoying situations. Given the background that the games would be embedded in a classroom course, this objection is given minor importance during the design phase.
- The digital environment allows for adjustment of timing and pacing, for example to stop and to play single scenes for more emphasis, to increase the time pressure intentionally, or to replay achievements and played games for reflection and debriefing.

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[17] According to Collins, Brown and Holum (1991), the instructional design method of "Cognitive Apprenticeship" sequences the learning content by increasing complexity through the steps 1) Modeling, 2) Coaching, 3) Scaffolding/Fading, 4) Articulation, 5) Reflection, 6) Exploration.

- Through the text-only interface, phrasing can be judged explicitly, since parameters from the real world are missing that could have a disguising effect for recognition. Dealing with verbal language is the subject of interest being taught, so the choice of words plays an important role. The repetitive learning aspect addresses typing quickly and phrasing carefully. While the first one is only a side training effect and does clearly not support the real situation, the second one is focused upon.
- For a live action gaming simulation, a classroom setting with participants and a proper preparation is needed. Classroom realities dictate that this is not always convenient, especially when repetition is desired. Computer simulations can be beneficial as additional opportunities or for preparation of the live game in the preliminary stages. They are also useful for experiencing extreme situations which are hard to create in real life and repetition of a given situation is possible.

The identified disadvantages include:

- The argument against simulations in general also applies here: A simulation never represents the real situation properly with all its complexity. A mapping of the experiences in the simulated world to the real situation has to be achieved (Schank and Cleary, 1995). The computer simulation is even more abstract than the live role playing game, so it may also confuse the issue more than contributing to a successful transfer.
- Nonverbal cues such as body language are difficult to implement or non existent as in our first prototype. Verbal factors are presented in isolation, while life is more complex. Several emotional levels are left out, and the stress a learner experiences in the live situation is not part of the system. Voices of the characters are currently only represented electronically (by text-to-speech, which facilitates rapid prototyping during the design phase), or not at all (with text in speech bubbles).
- The work involved in the creation of the necessary dialogues for the chatbot knowledge base, before a game can successfully be played, is significant. The technology base used to run the chatbot dialogues still needs technical development.
- There is an underlying risk, that the typical flaws known from chatbot interactions also apply to the learning game, and that they may hamper the outcome of the game. The only way to work against it is an increased effort of scripting, in order to be prepared for many possible situations.

- Risks can also be identified in the lack of experience of teachers as simulation designers. The quality of the simulation model is crucial to the success of the learning experience. This model can only be built in a cooperative effort between experts of the domain and experts in gaming simulation. In this sense, the greatest risk is that the designed model can be plain wrong, which results in learning mistakes.

The goal of the project Interparolo, next to creating material for evaluation, is the building of examples of reference that can be used to expand the general idea to further content scenarios. During the design phase, one obvious learning effect has been the increased reflection on the dependencies within the system dynamics, particularly experienced by the game designers and creators of the modelled dialogues.

4.2 Looking to the future: Digital learning companions

Almost all conversations with digital characters looked at so far, follow a pattern that assumes no long-term relationship between the agents and the users. Moreover, the last conclusion that a significant learning effect has been experienced by the creators of the chatbot scenario and dialogues, leads to a radical constructivist thought: the people who make the digital agents smart, that is in our case the group of chatbot authors, go through a learning procedure, or at least have to apply knowledge in a creative and explicit way. The resulting chatbot reflects the applied "knowledge" directly, while reacting more or less appropriately to the questions asked or the utterances confronted with. These considerations result in a different concept for using digital conversational agents in learning environments: not as intelligent teachers or instructors, but as initially clueless companions with empty knowledge-containers, who need the learner to make them smart and to fill them with responses.

The learners' task, during an authoring mode, would be to create pieces of dialogue which gradually, during the learning process, fill the memory of the agent—teaching the companion, instead of being taught by it. In a playback mode, the agents' role would be to reflect what has been "taught". In a sense, one could build a digital "Alter Ego" that mirrors verbal knowledge that has been explicitly articulated by a learner, in a playful way. From an instructional design perspective, also in accordance with the Cognitive Apprenticeship method, a further level of complexity could be added:

the “articulation” stage. The resulting genre of a simulation game would be to put the learner into the position of a puppet master, being responsible for the puppet’s appearance during playback.

While only using chatbot-like pattern matching, the dimensions of applied knowledge are naturally as shallow as the pattern matching algorithm, focusing on explicit utterances. The full scenario, instead, requires a more sophisticated architecture. Depending on a context (situations, relationships, dialogue history, etc.), concrete language would have to be made adaptable to cases (compare illustration in Figure 6). This would also require the articulation of contextual rules, as a significant part of the knowledge that could be applied and tested during a playback mode.

The digital learning companion is a combined metaphor of a digital doll with an electronic diary function, a medium used by a single person for self-communication and reflection (compare section 3). Even more than the games within the “Interparolo” project, it fosters the active construction of knowledge in a creative way.

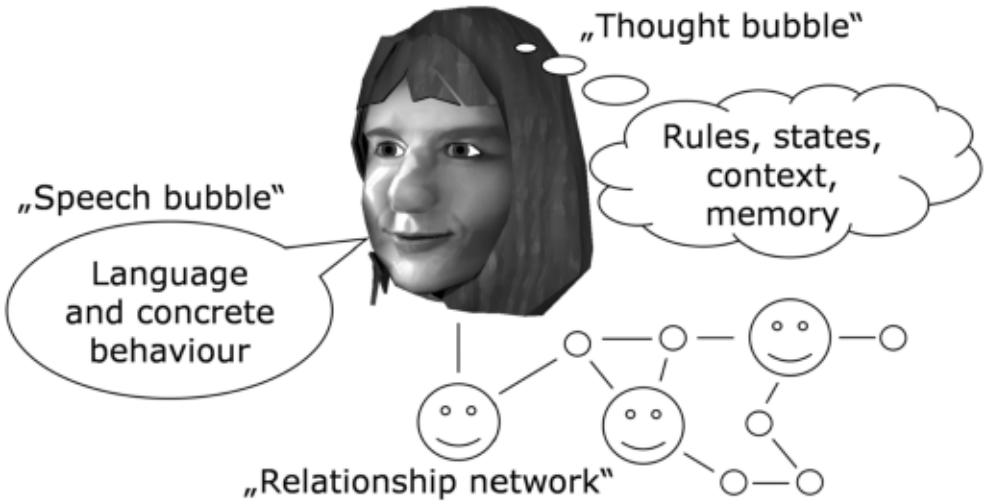

Figure 6: Scenario of a digital agent as an “Alter Ego” for construction and reflection of verbal knowledge

5. Conclusion

All discussions and examples presented here have focused on the conception of various forms of digital games, including storytelling and simulations, based on digital agent

technology. They have roughly illustrated the huge potential offered by these new technological endeavours. However, there are also limitations and risks involved that have led to initial acceptance problems.

The main argument made here is, that by only working on better technology, in the sense that digital agents get more sophisticated, intelligent and finally human-like, the acceptance problems will not completely be solved. The hypothesis is, that if a digital agents adopts a superior role to a human, there is always the probability that the basic trust that is needed to take advice will not be established towards a synthetic character, even if there is no doubt about the evidence of social relationships with technology. The thesis is supported by experiential phenomena from storytelling and robotics, such as the notion of the "uncanny valley".

On the other hand, when embedded in a game or abstract simulation taking place with clearly communicated limitations and goals, even doll-like visualizations, behavioural abstractions or repetitions don't produce a problem. Within the "magic circle" of a game, the rules are set by the game and not by expectations of reality. "Suspension of disbelief" will work for abstraction, and behaviour just has to be consistent with its own rules to be believable. Therefore, it is necessary that clear conceptual models forming realistic expectations are established by a suitable game design. Even the current state-of-the-art agent technology provides means to create simple games that can be applied to learning situations, as demonstrated by the "Interparolo" project.

The more technological "intelligence" is realized in applied agent architecture, the more challenging is the creation of suitable content. This is especially true when we assume that creators of the learning material don't have to have a diploma in Artificial Intelligence or even programming skills. Digital agents have the potential to be a welcome help for teachers, given that responsible authors will be able to define the agents' behaviour and tasks easily. Instead, doubts remain that the conceptual model of an intelligent pedagogical agent, represented on a screen by an almost realistic "Virtual Human", will be appreciated, when it looks like a substitution of a real teacher, or anything that delivers better results when done "in reality". Finally, the claimed key to success is that active construction by learners is involved as a goal to achieve by the game design, and that there are humans in the loop who take on responsibility and are enabled to do so since they are in the driving seat.

6. Author

Ulrike Spierling has been a professor of Media Design at the University of Applied Sciences (FH) in Erfurt, Germany, since 2002. Previously, she was the head of the Research Department of Digital Storytelling at the Computer Graphics Center (ZGDV e.V.) in Darmstadt, Germany, where she developed a research agenda for interdisciplinary approaches to the design of technology for interactive storytelling and conversational interfaces. Her current research includes the development of authoring concepts, models and tools for non-programmers, employing conversational agents for interactive digital storytelling and the design of knowledge media.

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Interactive Drama and Learning Experiences

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Keywords

Learning environments, emotional and social context of learning, virtual characters, narrative models, soft skills, story generators

1. Introduction

Even though computer-based training is becoming highly popular, e-learning applications are still dealing with high failure and dropout rates. This may be because e-learning applications are designed in a way that only address cognitive issues. For learning applications to be most effective, however, both cognition and emotion have to be addressed. The idea is to enable enhanced learning experiences that are more motivating and compelling through the integration of storytelling and game play. These learning environments will support both the acquisition of knowledge and the training of key qualifications and soft skills. In the following examples, narrative learning applications are introduced and the StoryGenerator which enables these enhanced learning applications is presented.

2. Point of Departure

Today's learners—especially the younger generation—are "digital natives" who are used to using digital applications for communicating, sharing experiences, creating personal artefacts, searching for information, exchanging opinions, and gaming—anytime, online and collaboratively. In contrast, most common learning resources disregard these factors which can make any application convincing and fascinating to a young audience. At the 2005 Learntec Conference, Marc Prensky gave an impression of the prerequisites of today's learners: They don't want to study Rome—they just

build it! (Prensky, 2005) His point was that engagement must come before content, and that detailed and boring learning applications are not sufficient.

Using narration can be an answer to this problem. Stories are the first and most important tools used to share not only knowledge, but also feelings, emotions, cultural and human context, and diversity. Children learn from the stories their parents tell. Beyond this, stories are the structures which underlie every learning process. While stories will address the emotional side of the learning process, game play can be used to ensure that the learning application is fun and easy to follow. As a future trend we can be sure that games will become part of our daily life. They will assume a place comparable to today's television, and will detach from the computer and its single monitor as their place of origin.

Each of these elements—learning, storytelling and game play, overlap in certain areas. Storytelling and gaming come together in 2D or 3D virtual environments—especially in adventure games but also in other game genres. Interestingly, the story part of these games is becoming increasingly important which is shown in the merging of films and computer games: On the one hand, films are based on computer games (Tomb Raider, Resident Evil, Final Fantasy etc.) and on the other, computer games are often released along with a corresponding film (Star Wars, Indiana Jones).

The combination of learning and storytelling can already be found in very different areas. Many books—such as "Sophie's World" by Jostein Gaarder or "The Name of the Rose" by Umberto Eco—combine learning material with a story. Museums and other cultural institutions often try to wrap their exhibits into stories to appeal to younger visitors—as do television shows like Sesame Street.
The question is how to combine these aspects of learning, storytelling and gaming?

Figure 1: Overlapping areas of Learning, Storytelling and Gaming

3. Digital Storytelling Projects

The challenge of combining learning, storytelling and gaming is approached by digital storytelling projects. The following gives an overview of learning related projects of the Digital Storytelling department at ZGDV in Darmstadt, Germany.

3.1 art-E-fact

art-E-fact[1] is an EU-funded project which aims at providing culturally enriching and entertaining experiences to museum visitors through interactive installations related to the artworks.

The art-E-fact installations are composed of stories that engage visitors in dialogues with virtual characters. The visitor interacts with the characters through keyboard input, by gesturing at the screen, or using dedicated interaction tools. Interactive devices, such as virtual and physical tools, allow the visitor to inspect the artwork more closely using unconventional means. By choosing a virtual x-ray-tool, for example, the visitor can scan the painting to discover hidden layers below the image surface. The visitor can also choose a torch or a magnifying glass. This way, visitors of art galleries acquire a better understanding of the artwork.

Figure 2: Pointing Gestures in art-E-fact: Magnifying Glass / Torch

1 IST-2001 37924, cf. www.art-E-fact.org

The knowledge of the multifaceted and deeply personal aspects of art is transferred to the visitor through conversations with well informed virtual characters. The discussions between these characters are embedded in a story which unfolds against the personal background of each character. This is a model for a new kind of interactive storytelling which emphasizes a narrative, interactive presentation of a theme through a discussion group (Iurgel, 2004). The gaming aspect lies in the playful interaction with the artwork. Further, at the end of the story the visitor must resolve a conflict where the fate of the hero lies in the visitor's hands. It is as much a question of winning or losing the game as it is a moral challenge.

3.2 Servingo

Servingo (2006) is funded by the Federal Ministry of Economics and Technology (BMWi) in Germany. The project will ensure an efficient and innovative flow of personal communication at the FIFA World Championships 2006. The main goal of the project is to establish an interactive platform as a logistic tool for all sorts of information about the championships.

One of the services provided by the platform is a personalized diary in which the user can store his impressions in the form of photos, videos, or audio files. An interface from this diary leads to the StoryGenerator, which combines the user's material with metadata like rankings, scorings, or categories to generate a short movie clip the user can send to his friends vie e-mail. In order to have his story generated, the user chooses a genre or story model which will then be used to structure his material. If, for example, the user wants to create a thriller with his material, he will choose the "thriller" genre. If, instead, he wants a show host and a guest to present his impressions, he can choose a "show" model. He can then decide which of the meta data should be used for the story. Once he has made these simple choices, the movie will be automatically generated, adding system content such as virtual characters and pre-implemented audio to the user's data.

It is expected that story generators equivalent to the StoryGenerator used in Servingo will become more and more popular, and perhaps evolve into a helpful tool for teachers to create stories with learning content for their students. Without the need to know anything about story structure or about how best to integrate knowledge into a story, the teacher can simply choose from a wide range of personalized data and then have a story generated automatically. Another possibility is to let students use the

StoryGenerator themselves, simply giving them a certain pool of information from which to choose. Not only will they create an enjoyable presentation of the content, they will also have worked with the information beforehand—having read each piece of information to be able to choose from the data etc.

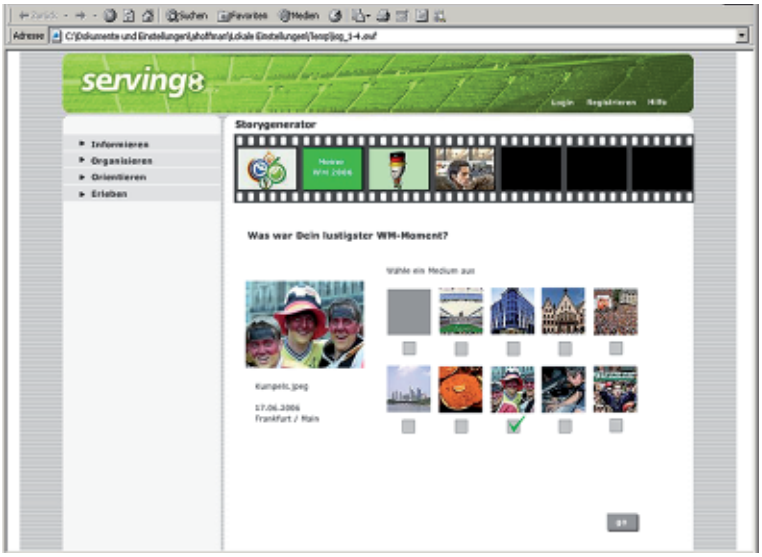

Figure 3: StoryGenerator on Servingo: Choosing personalized data from the diary

3.3 Virtual Human

The project Virtual Human is funded by the Ministry of Education and Science (BMBF) in Germany (Virtual Human 2006). Virtual humans are human-like interaction agents who are employed as personal dialogue partners in certain application contexts. A virtual human can engage in dialogues both with other virtual humans and with human users, showing credible emotional behaviour and employing non-verbal communication forms. A future research challenge of the project consists of the creation of convincing virtual actors. In one of the application scenarios of Virtual Human, the user becomes a football coach and can decide the success of the national football team. Improvisational abilities of virtual characters will enable them to tell jokes and to tease the participants, demonstrating the interaction of novelists and of an improved authoring process.

The learning aspects concern information about different teams, individual players, and which strategy will be the most efficient for winning the match. A so-called

"Trainer-Test" will show the effectiveness of the team line-up chosen by the user, including comments of two virtual experts on football.

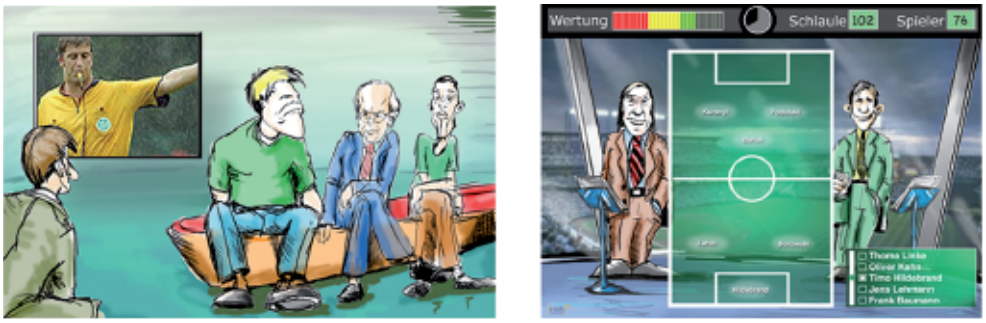

Figure 4: Virtual Human scenario: two virtual experts discussing the user's team line-up (Drawings by rmh new media gmbh, Cologne)

The scenario could be easily adapted to learning. First of all, the social abilities make the virtual characters more life-like and—even with their faults and moods, or maybe especially because of them—they become likeable. The user can actually bond with them and is emotionally satisfied. We expect applications to become more absorbing and rewarding this way, becoming more motivating and fun at the same time, all the while making learning easier. The content could of course be altered in any way. Instead of being football experts, the virtual characters could be high profile doctors or palaeontologists evaluating the choices the user is making. In a medical context, the user could be asked to write prescriptions to patients while listening to comments from the professional doctors. Similar to a "Trainer-Test", a "Treatment-Test" could show how the patient's illness will proceed in relation to the user's decisions.

3.4 Ask & Answer

Ask & Answer is an educational narrative game that demonstrates how virtual characters and narration can be employed to enhance efficiency, fun and motivation in learning (Iurgel/Ziegler 2005). It adopts the formats of familiar TV-shows for kids and families, where two teams compete, and scores are given for correct answers. In Ask & Answer two teams of 2-8 participants play over the network. A team scores when it knows the right answer to a question asked by the system. Each participant looks at his own screen and has its own speech enabled avatar. The demonstration's current domains of learning are history and geography.

The single autonomous virtual character has a decisive role in the game. It knows the right answer to every question of the game, and can give hints. But it will only help if the player assists it with its story related problems. The virtual character, called Fritz, can only be heard by the team it is near to. If the team does not succeed in endearing themselves, it might refrain from delivering the answer, or even worse, it might leave the neglecting team and move to the other team. But even if Fritz is satisfied with a group, it might first want to talk about some favourite topic (typically additional material related to the question), before giving away any solution. Thus, the players have to establish social bonds to Fritz, and have to dwell on further aspects of the theme that they are learning, in order get the hints and win the game.

Figure 5: Two teams confront each other, Fritz is in-between.

The answer is usually entered with the keyboard. Any participant may post an answer, but he risks negative scores for his team if the answer is wrong. Therefore, in order to coordinate the answers, the participants can communicate through their avatars. Avatars that are within a specific area, the territory of the group, can only be heard by members of the group that are located within this area. The players are allowed to use other material to find out the answers, e.g. textbooks.

Thus, this game involves social elements in a complex way:

- members of a team must cooperate to acquire knowledge and coordinate answers, in order to defeat the other team;
- a team must develop a common strategy to endear themselves to Fritz, for example by nominating a “Fritz-Friend” to exploit this source of knowledge, and
- the relationship to Fritz is a social relationship that pays.

Coping with the virtual character's peculiarities and establishing social bonds with it thus becomes part of the challenge of the game. Many edutainment and entertainment applications could be conceived from this starting point: The focus need not be in human-like behaviour of virtual characters; rather, the focus can be on the human-like situation where it is profitable to adapt to the social expectations and emotional peculiarities of the (virtual) other.

4. Future Prospects

What will the future bring us? We expect to see mixed groups of virtual and real humans interacting and learning together, in several directions, soon. Group formation of hybrid groups, in the sense of a feeling of belonging, is an important research issue. A hybrid group will go through exciting experiences, structured according to narrative models, and face challenges and learn together. The user will help virtual and real characters in need, compete, get assistance, create social bonds, and thus will have an emotional and social context for his learning experiences. These projects describe a step towards those novel learning experiences.

Due to the social embedding of learning, learning of soft skills, of social behaviour, emotional understanding, of empathy, and even self-growing and guided personal development are natural and important aspects of the research direction described above.

It is also expected that in the future stories will be automatically generated. As described in context with Servingo, story generators will give teachers, students, and users of any other field the chance to generate stories from their own personalized data or for that matter, any data at all.

Beyond story generators research and development focuses on authoring tools, which enable professionals as well as laymen to write interactive stories with self-made characters, individual interaction modalities, story-lines and content. By encouraging and assisting users to create content in the form of Interactive Storytelling, narrative learning applications will become more accessible and universalized.

5. Authors



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YoungNet—a Virtual Learning Community Platform for Youngsters

Fabian Kempf and Karin Hamann

Keywords

Edutainment, Avatars, 3D Multi-User Environment, Synchronous Communication, Voice over IP, Learning, Playing, School

Abstract

e-Learning has become a major buzz word said to make education and training more efficient in business. It is being introduced to universities on a larger scale. However, the situation at schools is a bit different: two key distinctive aspects are motivation and communication.

YoungNet is a two-year European funded project. It aims to help schools to introduce e-Learning during and in addition to their lessons by providing technology as well as content and guidelines. Game-based learning is a central element in the learning community.

e-Learning communities highlight the fact that learning may also be a joint activity. YoungNet offers an integrated virtual learning community which is accessible to various schools and individuals from different countries via the internet. They study, play, meet, exchange ideas about the nature, way of life, and culture in their respective countries. At a technical level, it offers both synchronous and asynchronous communication based on leading edge ICT like Virtual Reality, 3D representations, audio communications, shared applications and provides a fascinating and "edutaining" multi-user environment. The use of this platform is encouraged by intrinsic motivation and thereby overcoming the division between learning (school) and leisure.

1. Why YoungNet

Networked learning and virtual education has been already accepted not only as a new but also as a more efficient way of education and training in business especially at corporate universities. Academic universities have started to adopt e-Learning on a larger scale by centrally organizing the introduction of learning management systems. Pilot projects have readily been absorbed into mainstream use. At schools the situation still looks a little bit different. Money and resources are often restricted, therefore highly motivated teachers are a prerequisite.

However especially for young people such as pupils it is important to develop learning skills and cope with new learning environments and innovative learning materials as early as possible. Through them they can not only learn factual knowledge but also gain the ability to communicate, co-operate, learn from one another, play educational games together and acquire knowledge of foreign countries and cultures which is more important than ever in our globalized society. Furthermore positive experiences in youth will facilitate the development of a positive attitude towards internationalization and help students to deal with foreign cultures and to understand the need to be able to express themselves in a foreign language. In fact all these are key factors for future competitiveness.

These needs are addressed by the presented game-based virtual learning community for young people (8 – 14 years old) featuring a virtual meeting place where joint educational projects can be undertaken, educational games can be played, and informal information on day to day life can be exchanged across borders.

2. Objectives

In order to help achieve learning objectives, the YoungNet project is developing a virtual e-Learning community and playground for young people where they can meet and interact with other young people from different countries.

The major features of YoungNet are as follows:

Feature 1: A fascinating and edutaining multi-user learning environment with clearly defined learning objectives.

The multimedia game market is the driving force in the technological development. Good multimedia games—especially multi-user co-operative games—are very attractive to young people. The market potential undoubtedly is enormous. However, the objectives underlying these games are not always educationally sound (e.g. combat games). YoungNet combines this attractiveness with well-defined educational goals, e.g. the application of higher level cognitive goals, fostering problem-solving, creativity and specifically team work aspects.

Feature 2: Enable learners and teachers to communicate (including audio communication) and co-operate across national borders and cultures.

In an increasingly globalized world, the ability to communicate and co-operate with people from other countries is becoming a key skill for both individuals and societies as a whole. The traditional educational system can not sufficiently teach these communication skills. A stay in a foreign country is usually limited to a short period of time This ability can only be developed and strengthened by a continuous opportunity to communicate and co-operate with peers in other countries on a more regular basis than is possible in traditional classroom lessons.

Feature 3: Overcome the boundaries between school time and leisure time by intrinsic motivation created through attractive features of the YoungNet virtual meeting place

Most of the existing internet communities merely offer chat rooms and bulletin boards. A successful virtual community needs to take a comprehensive approach by incorporating the virtual environment, educational games (challenges), communication features and the navigational controls as integral components of the same system that depicts the real world in a virtual world (Soliman 2001).

Feature 4: Continuous evaluation by the schools involved

Teachers of 50 schools in various European countries were involved in different phases of the project. They are regarded as the core specialists for evaluating the YoungNet functionalities, tools, services and contents from the perspective of pedagogical specialists and experts in the conditions in their schools and their students.

The following sections describe the architecture of the YoungNet community which is composed of two major components the YoungNet system and the YoungNet contents and which fulfils the objectives mentioned above.

3. The YoungNet System

The YoungNet system is an integrated Internet/ Intranet solution for communication and administration tailored to the needs of teachers and their students, which combines the following technical components:

- An application of the Hyperwave eLearning Suite for communication and administration
- A 3D-Environment for synchronous communication and gaming.
- An audio component for authentic Internet communication

A Learning Management System (LMS) is the basis for the community platform. The LMS is constructed as a virtual training centre consisting of

- several rooms, for different purposes (such as a course room, a café, an administration centre, a private study room which works as a personalized learning portal etc.)
- tools of various types (asynchronous and synchronous communication and collaboration, information retrieval, authoring and structuring, administration and reporting tools) which complement the functionality of the rooms,
- different types and roles of users (such as students/trainees, authors, tutors and trainers, administrators) and
- strong knowledge and content management functionality (such as fine grained access control, automatic link management, distributed web based editing with version control and release management etc.).

The virtual 3D Environment of YoungNet is based on the successful results of the completed EU-project VIRLAN . IAT and IAO as the main technical project members developed a virtual community with the focus on collaborative language learning (Kempf, 1998). As in VIRLAN every user is represented as an avatar and the possibilities for interaction especially for youngsters are fascinating.

The VIRLAN system (see Figure 1) has been successfully tested with a restricted number of users (Kempf, 1998; Kempf, Müller, 1999). The testing focused on functionality and technical issues, and the overall result has been very promising. YoungNet takes up parts of the technology of VIRLAN and shifts the focus away from mere technical development towards more concessive content and at the same widens the range of applications, develops new innovative functionality and offers a platform to the general young audience.

Figure 1: VIRLAN, avatars with speech bubbles

The design of the unified system will support a paradigm shift from pure instructivistic/ behaviouristic to constructivistic learning (Baumgartner, 2001) where teachers become a facilitator of learning rather than an instructor delivering factual knowledge. Communication and collaboration is offered on an individual level between teachers/ pupils by appropriate communication tools, meeting places (e.g. teachers' room) and games for leisure time activities. Teachers and students are free to use these features on a national or on an international level for establishing contacts.

However it is very important that the system is provided with guidelines, best practice examples and material for use during the lessons, otherwise it would not be very helpful. The chance to use it in the most efficient and planned way would be low. Therefore the project also includes the development of the YoungNet content. Some of the partners (especially the publisher Klett) have already gained a lot of experience in former EU-projects (Eurogame, Eurodelphes, see http://www.educational-concepts.de) which they have contributed to the content and usage guidelines.

4. The YoungNet Content

The YoungNet content is designed for use in school. It is a combination of materials optimized for multimedia-supported lessons, including:

- Multi-user educational content specific games which can be played alone or in teams
- Content specific teaching and methodological guidelines for teachers and students
- Multimedia materials (e.g. sounds, pictures, audio files, videos, etc.)

The content reflects subjects taught by multidisciplinary teachers involved, at moment Geography and English because they are the partners' specialism and both subjects are easily woven into a good overall story which is the background for the content.

Collaborative contents are exemplified by the "Travel Book" story board: here every school produces their own travel book in class concerning where they live: famous places, famous people, buildings, the landscape, mountains, seas, etc.

Documents are designed with a HTML-editor with the help of the teachers and templates, then uploaded to the YoungNet server, where other schools can look at the documents. In the next step they prepare questions for their travel book with several similar sounding answers, and these are also put in a special quiz engine on the server. All of the schools prepare for the national quiz contest which will be similar to "Who Wants To Be A Millionare". Afterwards the best schools participate in an international quiz game.

This is a good example of how the integration of the communication and collaboration between national and international classes into a scenario (story) works. The topics chosen have to motivate the classes involved and encourage collaboration with other classes. Generally speaking an integrated scenario has to be worked out, parts of this scenario are:

1. Work within the class (individually and in groups)
2. Asynchronous communication between different schools
3. Controlled synchronous events such as a competition

Experiences showed that synchronous events particularly must be well prepared to work properly because it is quite difficult to organize them between schools especially if they are in different countries.

Furthermore the YoungNet system enables the teachers to create their own projects in any subject they wish. They can upload their own instruction guidelines, create their own content by using the comprehensive administration and communication features.

5. Design Aspects

The actual work of implementing the YoungNet System was done after an intense phase of analysing the needs of the involved schools as well as the available technologies. Special consideration was given to:

- Graphical User Interface design
- Pedagogical guidelines

5.1 Graphical User Interface

When you go into YoungNet (see figure 2), you have the choice between the following areas: "All Classes" and "Edutainment Area"; teachers also have the "Topic Description" Area . Under these areas you will find the respective contents that you can click on to get to the corresponding areas. In "All Classes Area" you will find the public folders of all classes as well as that of your own class. Click on a document or open a folder to see individual documents. The class representative can include new documents. The "Topic Descriptions" are only visible to the teachers. Here they will find the relevant descriptions for each project topic. In the "Edutainment Area" all available games are listed.

Figure 2: Look and feel of the YoungNet

We took several considerations into account. The first precondition is the YoungNet Navigation develops according to the needs of the users. The YoungNet System includes all features needed for convenient communication between the users and administration of files and accounts. To facilitate easy navigation the number of features is minimized.

The look and feel of the system has to be attractive for youngsters. Therefore the LMS was adapted accordingly (see Figure 2: Look and Feel of the YoungNet System)

5.2 Pedagogical guidelines

YoungNet provides the involved schools with guidelines for project work with predefined content ideas. As the project includes international aspects intercultural communication will be needed and supported by the system. For language training especially synchronous audio communication is a very useful tool.

The games have a pedagogical background. By synchronous communication in virtual 3D multi-user environments the users are enabled to experience nearly authentic situations. The motivation for learning increases through the facility to design their own games according by simply uploading of individual multimedia files onto the YoungNet server.

6. Edutainment Area

In the Edutainment area students have the possibility to learn and deepen learning using games, some in 3D. The games can be played alone or with other YoungNet Users. At a technical level, it offers both synchronous and asynchronous communication based on leading edge ICT like Virtual Reality, 3D representations, audio communications, shared applications and provides a fascinating and "edutaining" multi-user environment. Users are self motivated to use the Edutainment Area thereby overcoming the borderline between learning (school) and leisure. And to keep in mind, the students have a strong incentive to practise a foreign language: they want to win the game!

6.1 Virtual Home—The Playing-table

In the Virtual Home there is a playing-table. The game leader sits on the purple chair. On one hand, the playing-table gives the possibility to opportunity and discuss project results as a presentation visible to all. On the other hand different games can be played together, where the participants are represented by avatars sitting around the virtual table. Here the students use Audio-Chat for communication.

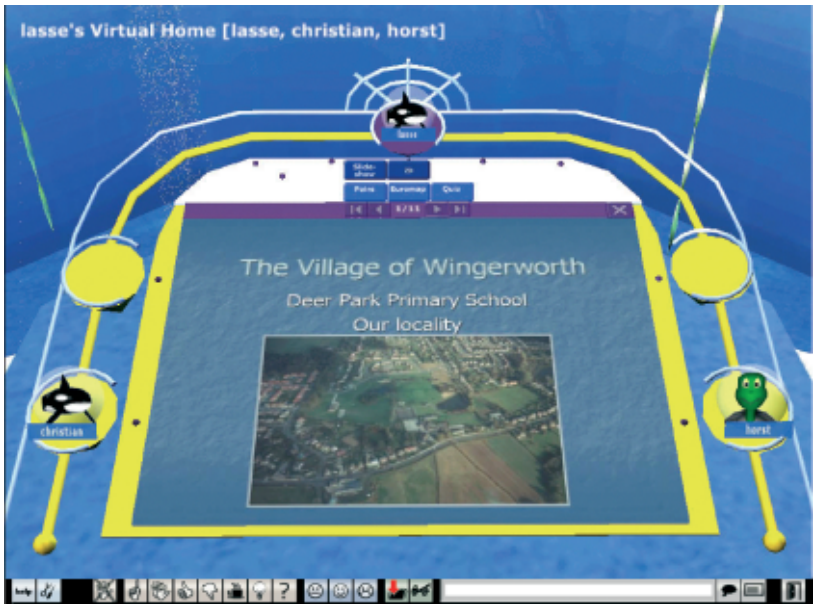

Figure 3: YoungNet Playing-Table

Figure 3 shows the following: The Virtual Home Screen is displayed in two sections. In the upper part (3D area) you can navigate within the house that you have selected. Beneath there are different buttons and an entry line for text-chat. Every Virtual Home includes a playing table, through which you can start the YoungNet games and a picture gallery, where you can show the pictures, which you have uploaded to the YoungNet System. Around the table there are 2-5 seats. The purple seat in the middle is for the game leader. Only the user, who sits on the game leader seat, can call up the different functions, e.g. start a game.

6.2 Pairs

One of the YoungNet games is Pairs (see figure 4). Here, it is possible to play games that have been designed by other schools or by the YoungNet system. Teachers have the facility to create their own game variations (Game-Editor). Pairs can be played using different difficulty levels and three different modes: picture-picture, word-word, pic-word. To practice, pairs can be played alone or with other students. To communicate with each other, the students use text or an audiochat (Voice Over IP).

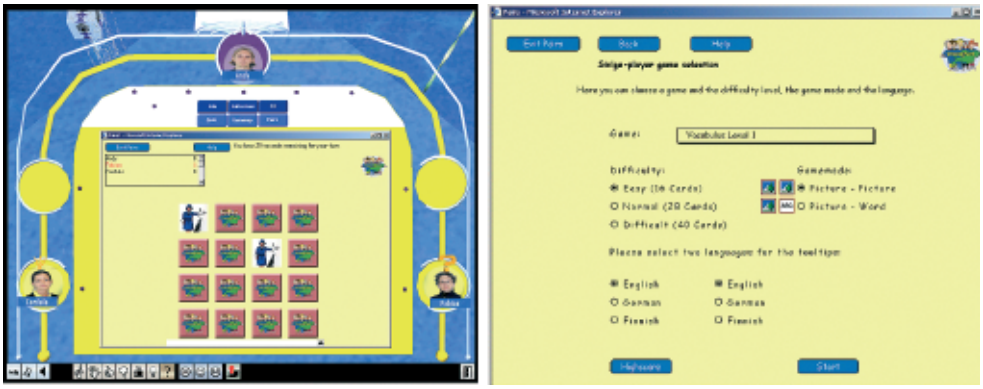

Figure 4: YoungNet Pairs

6.3 EuroMap

EuroMap is a virtual treasure trail for teams (see figure 5). At the start of the game there is a mission with three parts: Where was Beethoven born? In which city U2 was founded? The people in what country eats the most sweets in Europe? One of the players is the driver, who has to find the mission destinations on a three dimensional Europe map. The team-mates (navigators) will see the map from a bird's-eye view and will help the driver to find the necessary destinations. The players use the text chat to communicate with each other.

The game has two difficulty levels. At level one you just have to find the flag of the destination country. At level two, you have to put a ball into a hole at the flag using a virtual car (just like golf).

Figure 5: YoungNet EuroMap

6.4 Quiz

In the YoungNet project, every class has the chance to qualify for the YoungNet Champions League. This is a live quiz involving the best four classes from a year (see figure 6). The qualification takes place in the EuroCup, where each class has to perform in an online quiz during a period of one week. To practice the quiz module is available to every student in YoungNet. Teachers have the possibility to create their own quiz with the Game-Editor. The participants communicate via Audio-Chat.

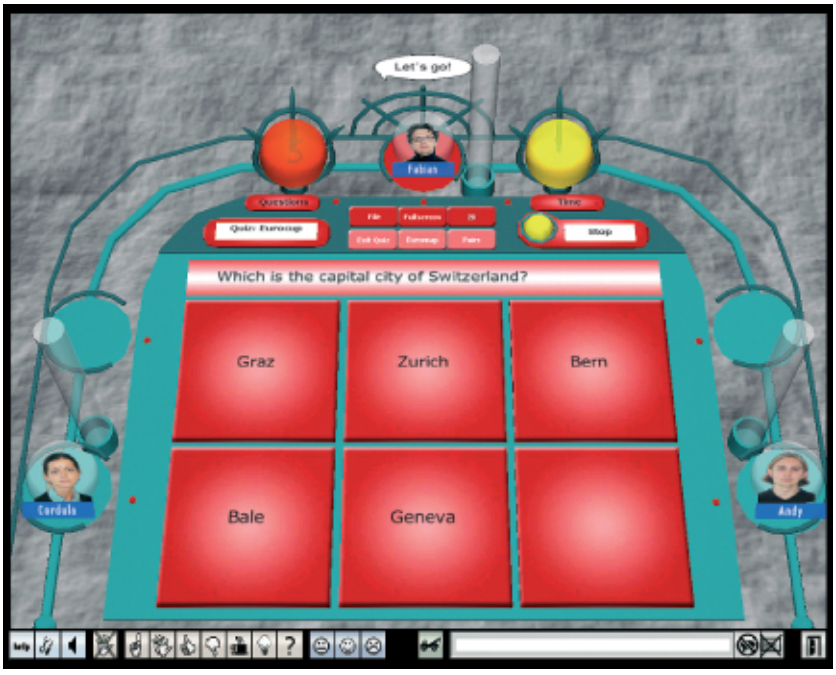

Figure 6: YoungNet Quiz

6.5 Virtual Home

The Virtual Home is the personal home in YoungNet (see figure 7), where 3D worlds underwater, in the air or underground are on offer. Friends from YoungNet can be invited to the Virtual Home to communicate and to play. In the Teachers' Virtual Home, planned events take place at defined times.

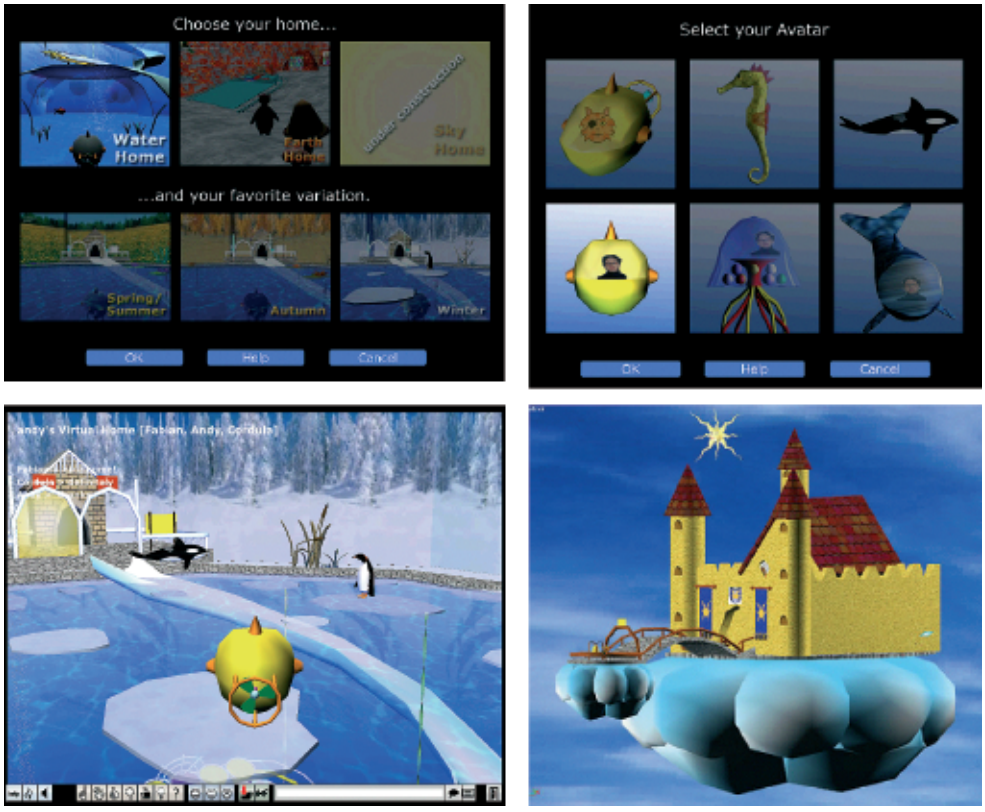

Figure 7: YoungNet Virtual Home

Figure 7 shows the following: Every YoungNet member has their own personal virtual house within the YoungNet System, called the Virtual Home. A maximum of five users can go into each Virtual Home. Each time you enter your Virtual Home you can choose between three different Virtual Home basic types (Water, Earth, Sky). Depending on the Virtual Home you have chosen different Avatars are available. An Avatar is the pawn in a game, which represents you in the Virtual Home. Once you have chosen a Virtual Home and an avatar, you can enter the Home. In your Virtual Home you can insert pictures in jpg- or gif-format, to show to your friends and

pupils from other classes. You can also play all of the YoungNet games in your Virtual Home. You also decide who gets permission to enter to your Virtual home and who does not.

6.6 Virtual Home—Avatars

The Avatar is the personal representative in the Virtual Home (see figure 8). In the underwater world for example you can move with a submarine. Three different expression (smiling, angry, normal) and five gestures support communication.

Figure 8: YoungNet Avatars

An Avatar is a kind of pawn in a game, which represents you in the Virtual Home (see figure 8). If you have uploaded a passport photo, individual Avatars, which include your photo are also available.

6.7 Game Editor

Using the game-editor teachers have the possibility to create new or to edit available learning games. They can choose from the games Pairs and Quiz. In addition the teacher can choose if he wants to publish the game for everybody or only for his class.

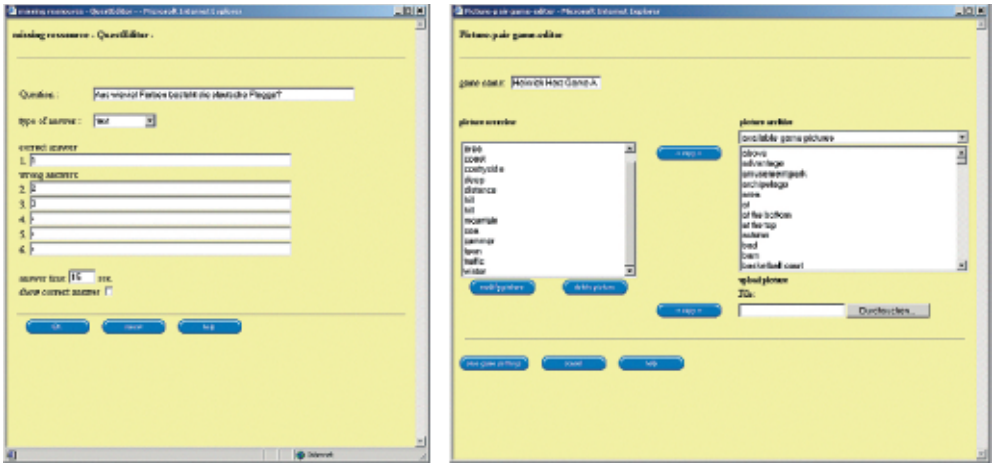

Figure 9: YoungNet Game Editor

With the "Quest-Editor" you can create or modify quiz games (see figure 9). You can edit or modify questions and the corresponding answers. For a live game at least 5 questions with at least two answers have to be defined. With the "Picture-pair-game-editor" you can create and/or modify picture-picture-pairs or picture-word-pairs. For a live game at least 20 picture-pairs with a vocabulary have to be created.

7. Summary

We have shown the outline of a concept to bring networked learning to schools and youngsters by offering an integrated real-time virtual education environment with both synchronous and asynchronous communication based on leading edge ICT technology. More specifically the objectives are to

- provide a community platform that enables young people up to 14 years of age to communicate and co-operate across national borders and cultures;
- offer a fascinating and edutaining multi-user environment with innovative services and learning materials with clearly defined, sensible content;
- provide a platform students are intrinsically motivated to use and thereby overcoming the division between learning (school) and leisure.

8. Outlook

The project promoted by the European Commission met with impressively positive response in the schools that were involved. Both teachers and pupils in the participating schools were enthusiastic about Youngnet and perceived a considerable added value in it as a worthwhile supplement to and even a worthwhile part of school teaching. Youngnet was an extremely successful project which was partly funded by the European Commission (European Commission Information Society Technologies Programme action line "Schools of Tomorrow"). Unfortunately, it was not possible to sustain the Youngnet System without follow-up financing—much to the regret of the schools (there were many schools which were registered on a Youngnet waiting list besides those that participated) and the Consortium. It is a little comfort that some suggestions from the Youngnet project were resumed in the product VITERO (a web conferencing and live e-learning software by the Fraunhofer spin-off VITERO GmbH). With financial support it might be possible to revive Youngnet.

9. Authors

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Games based learning or learning based games? A case study

Chris Brannigan and Angela Owen

Chris Brannigan

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Abstract

Educators have concerns over the learning value of educational computer games, this is a key barrier to the widespread adoption of such technologies within education. We describe our work at Caspian Learning in approaching this problem by embedding pedagogy, content mapping and assessment into learning based games. This article explores the reactions of educators and students to learning based games in a formal classroom situation. Tangible examples are provided within the article, demonstrating that the learning hurdle can be overcome. Learning based games can be powerful tools that clearly aid teachers and students, and are valued as such. When such conditions are met, educators are ready to embrace these technologies. The use of gaming technology in itself is not a barrier to achieving credibility and acceptance within education. There are a number of issues that are cited as barriers to the use of games for learning; "learning value" need not be one of them.

Games based learning or learning based games? A case study

For all of the excitement among educators around the potential for using computer games technologies for learning, there remain considerable hurdles to their widespread application in the classroom. These obstacles have been highlighted by many authors (Lunce 2004, Egenfeldt-Nielsen 2005) and include: very high cost; technical complexity; time to develop, the practicalities of classroom integration, teacher skills and the low specification technology in schools.

However, while technical and practical obstacles exist, the fundamental barrier to using games in the classroom concerns learning effectiveness. This is a frequent criticism levelled by educators, who are not convinced of the actual learning benefits that games based learning may offer (Kirriemuir and McFarlane 2004). For many, games based learning seems a bit 'frivolous'. Okan (2003) refers directly to this problem by questioning the value of 'edutainment' and the expectation that learning should always be "colourful and fun". Specifically, edutainment can be a diversion away from the "need to work, serious study and the development of cognitive structures".

In our experience, there are at least 3 major concerns for educators:

- Pedagogy. Where is the learning?
- Content. How to integrate learning content and map to a curriculum?
- Assessment. How can learning be measured?

In this article I will describe our work at Caspian Learning, and the work of other practitioners in approaching this problem. I aim to demonstrate, by means of tangible examples, that the 'learning hurdle' can be overcome. Furthermore, educators are more than ready to embrace games based learning methodologies, not for novelty value, but for their value as powerful learning aids in the classroom. It is possible to utilise games based learning methods to achieve learning goals that would be more difficult using other methods. Fun is only part of it!

Games Based Learning or Learning Based Games?

In the learning games community, we often talk about developing 'Serious Games'. There is no clear definition of what this means, but it generally indicates an experience where the student is clearly not just enjoying a game but is deriving obvious learning

benefits. In attempting to utilise or test serious games in the classroom many researchers start from the gaming perspective. They observe some popular commercial off the shelf game titles, and attempt to identify the factors that facilitate elements that are interesting from a learning perspective, such as, engagement, collaboration, competition, and the ever elusive 'systems thinking' output. The majority of writings in this field and classroom based case studies undertaken have taken this approach.

More recently, a number of researchers have begun to design and create games based learning applications from scratch. These researchers will often start from the learning perspective. That is, to consider what are known to be key factors underpinning successful learning, and then to utilise the tools and technologies from the paradigm of interactive 3D games, to enhance those factors.

Starting from the learning perspective

There already are some notable examples of this approach.

Immersive Education, a UK company formed out of research from Oxford University, target 'story telling' as a learning method. This method engages students in the construction of scenarios, and the retelling of events in their own words, or worlds in this case! Immersive's 'Kar2ouche™' technology, involves the student in an active process of story development, and scenario creation. To do this, the student must construct rich 3D scenes, and then, add in complex interactions. The student, or class can collaborate and share their content.

Immersive have published many titles using this approach covering all curriculum areas. This approach has been very successful, with deployments in over 5,000 schools in the UK, and is now also being used in the United States. **http://www.kar2ouche.co.uk/**

Team Play Learning Dynamics (TPLD), a company working with the University of Dundee in Scotland, have focused upon 'teamwork' dynamics and capabilities. Their approach is founded upon psychological research work into this area. TPLD have integrated this research as scenarios to be experienced within multi player 3D computer gaming environments. Their products are now being used in corporate training. **http://www.tpld.ltd.uk**

PIXELearning have applied computer game and simulation techniques to create business education applications. The learning application 'The Business Game' places the student in the position of running a business or business department. The game takes the learner through various stages from initial product selection and market research through to manufacturing and selling.

During the game the student will face many different scenarios and they must manage many different elements simultaneously if they are to fight off the market competition and make a healthy profit. Integrated performance information provides constant feedback to the student and educator during gameplay.

PIXELearning have also developed a platform called 'LearningBeans' that allows educators to create their own business running simulations using simple wizards. **http://www.pixelearning.com/**

Caspian Learning case study

At Caspian Learning our development work has focused upon thinking skills—an individuals ability to process information in different ways to achieve different learning outcomes. The objective was to engage students in the process of applying different thinking skills to manipulate subject content and to think about different thinking processes. For example, to be able to reflect upon the process involved within a structured enquiry and to understand how and when to apply that process. To achieve this goal we developed two complimentary technolgies for the classroom:

1. Subject specific learning applications based upon a technology named Qcognition®. This is a set of distinct thinking processes which can be embedded into a game as routines, options and actions.
2. Thinking Worlds™. A content authoring and classroom education tool. Using this tool, educators and students can use the Qcognition® thinking processes to edit, create, publish and share their own 3D learning games.

The technologies are complimentary. Educators can use the learning applications to engage students in different thinking processes around their subject content. Then educators and students can use the Thinking Worlds authoring tool to target meta level thinking as students can edit thinking tasks and content or create whole new thinking tasks within the subject. These technologies are described in more detail below.

1. Learning applications

At the outset, we wanted to leverage the real time interactivity of the games engine to create a range of different thinking processes that would support the learning processes of students. In relation to the research literature the thinking processes act as 'cognitive tools'. Van Joolingen (1999) describes a cognitive tool as an "instrument that is part of the learning environment that supports or performs an identifiable cognitive process".

The cognitive tools in our methodology are embedded as routines and options that a student must actively direct within a 3D environment, such as identifying information, sequencing information, evaluating an argument, or assembling a presentation. We describe these as 'cognitive tasks'. During a specific task, the student is set a learning objective determined by the embedded thinking process. For instance, a frog may ask the student to explain the food chain in the local habitat and the student (player) must then assemble a presentation to give to the frog.

Within a cognitive task, the student would have the opportunity to perform multiple behaviours all related to a specific cognitive processing operation. For example,

Figure 1: 'French Revolution' in game screenshot

In one low level cognitive task, namely a knowledge gathering task, the student would undertake simple knowledge gathering activities. They would interact with objects that would hold subject relevant information, such as meeting Louis XVI in a French Revolution scene, or a cell within the human respiratory system. The student has the option to receive different amounts of information and must collect multiple-choice questions, storing questions and answering them at any point. They can then search out objects that may hold information to help them.

In one higher order cognitive task, namely an information integration task, the student must integrate new information with old information in order to satisfy an outcome. For instance, the student would be given information about the normal conditions of a component within an electrical device and an outcome showing a printout of a fault. Students must then assemble the additional conditions that could give rise to the fault outcome. To do this, they may interact with different components, selecting different information elements to integrate with the starting information to satisfy the outcome.

Figure 2: 'Electronics' in game screenshot

The **Qcognition**® cognitive tasks can be aligned along Blooms taxonomy of cognitive skills (Bloom 1964) as shown in Figure 3.

For example, Blooms Knowledge category of cognitive skill relates the the recall and simple retention of information. This covers such activities as: recognising; gathering; recalling; identifying; selecting; and labelling. Qcognition® includes a number of cognitive tasks, such as Recognition, Elimination and Knowledge Gathering that embodie these types of activities and so can be positioned against the Knowledge category within the taxonomy.

Blooms Evaluation category of cognitive skill covers the ability to evaluate and make judgements about the value of information / materials for a given purpose. This covers such activities as: contrasting; criticising; arguing; appraising; evaluating; describing; and explaining. Qcognition® includes a number of cognitive tasks, such as Structured Investigation, Integrate New and Old and Assess Predictions that embodie these types of activities and so can be positioned against the Evaluation category within the taxonomy.

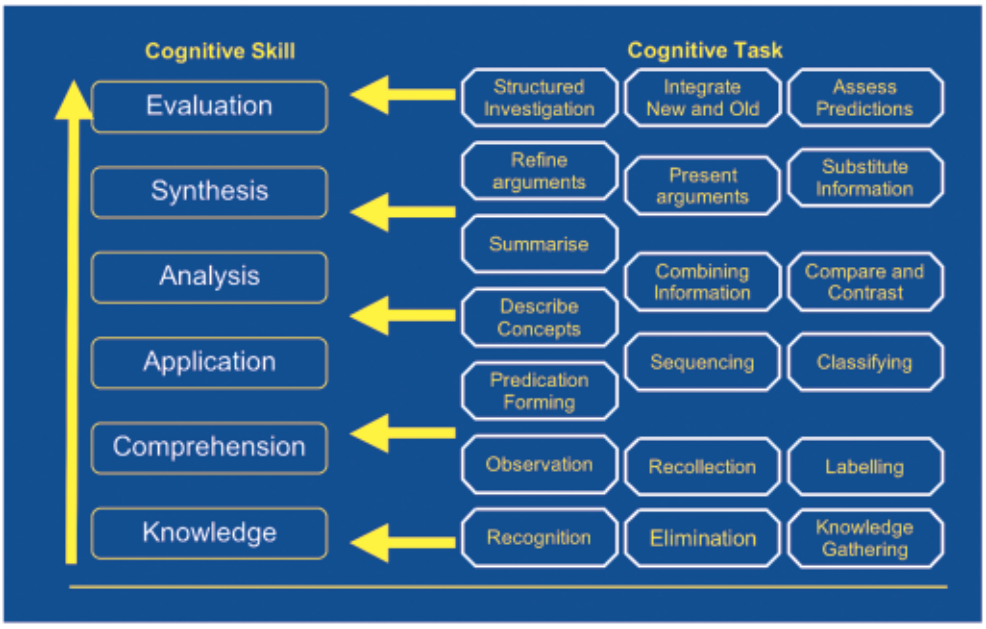

Figure 3: Qcognition® cognitive tasks mapped to categories of cognitive skill along Blooms (1964) taxonomy

Content and Curriculum Mapping

For games based learning methodologies to work effectively in the classroom, they must be actively embraced by teachers. Teachers in all education systems are under ever greater pressure to deliver results. These target 'results' are often set centrally. There will be specific learning objectives for the students to achieve. Curriculum guidelines will often also stipulate activities and methods that can be used to deliver these objectives. It is for these reasons that in many cases teachers are reluctant to work outside of the central curriculum. In this situation, to confidently utilise games based learning applications in the classroom, teachers need to be sure that the activities that they are undertaking are directly linked to their objectives.

Mapping to the Curriculum and Integrating Educational Content

The Caspian cognitive tasks can be directly mapped on to the cognitive learning objectives specified in a curriculum subject area. For example, in the English National Curriculum, for "World War 2—The Home Front", section 5 covers 'what did people eat during the war' and has the following required learning objectives:

- Infer causes of rationing

- Identify some similarities and differences between foods available during the war and today

We can map these objectives onto Blooms taxonomy of cognitive abilities and identify appropriate cognitive tasks to target these learning objectives. In this example the tasks are self evident as the learning processes are directly specified—'make inferences' and 'compare and contrast' processes.

The next step is to map the learning content by choosing the appropriate the 3D environment and subject specific content that will feature within the cognitive task.

Once tasks have been completed to cover a subject area, they are then formed into an overall games based learning application. Figure 4 shows the application menu for the WW2 application. To date this process has been employed to create applications for 21 different subject areas.

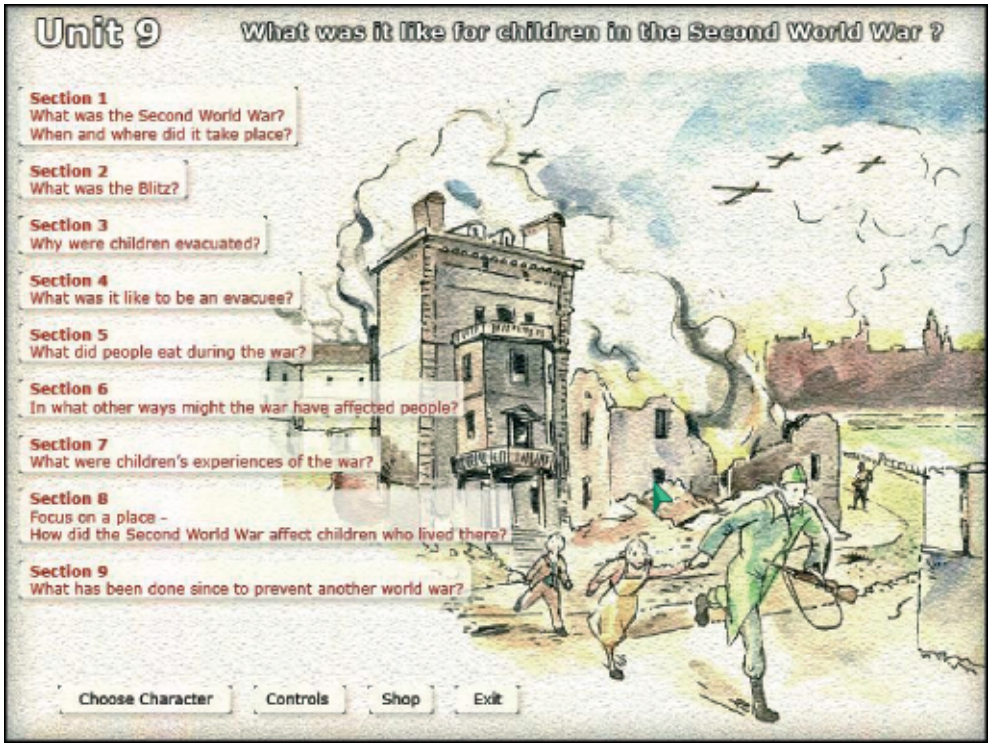

Figure 4: Front screen from WW2 application. The application is divided into sections based upon the English curriculum. Each section contains different cognitive tasks that target learning outcomes specified in the curriculum.

Assessment

The capturing of rich performance information for use in scaffolding processes and assessment is in our view one of the undiscovered oppotunities that games technologies offer educators. Games engines can measure any specified event within a volumetric space over time. The ability to be able to precisely observe students directing events and actions within a 3D world provides many opportunities for data capture. When this 3D world is contains embedded pedagogy where the user is undertaking targeted learning behaviours to achieve a learning outcome, then the opportunity is magnified. Within the Qcognition® architecture mechanisms are integrated within each cognitive task in order to record direct and indirect learning behaviours.

During the task we use this data to feed performance information back to the student, so as to indicate: correct behaviours; incorrect behaviours; information objects remaining; time taken.

This data is also analysed and fed into other mechanisms designed to provide cognitive scaffolding for the student. Such as:

- Rules which are built into each task to guide students learning process and performance
- A Revision System following completion of a task which comprises of three elements, namely:
  1. Quantitative Information Screen—factual performance information (see Figure 5).
  2. Verbal Feedback Screen—performance specific advice.
  3. Revision Materials Screen—Targeted content is fed back to the user based upon the errors that they have made during the task.

Figure 5: Screenshot from WW2 application showing the Revision Screen functionality. The page is open on the quantitative feedback. In this case the student has completed a Labelling task.

The information captured is also utilised to support the student and educator outside of the immediate lesson. When playing the applications the students cover alot of information and make many learning judgments. After each task, information on the task and the students performance is written into a personalised electronic workbook for the student.

Detailed information is captured within a performance database. This provides several standard reports and an exporting facility. The teacher is able to compare performance of individuals, classes and over time.

2. Thinking Worlds™ authoring tool

The development of the Thinking Worlds™ tool was motivated by the desire to target meta level thinking in students by actively involving them in the process of creating, editing and refining thinking tasks. In educational terms, students are asked to undertake the role of educators where they have to edit or create a learning application so that it can be used by other learners to achieve specific learning outcomes. Educators can use the tool to faciliate this learning experience. The second objective was to

provide educators with the tools with which to create their own learning games based upon Qcognition® that could then be used in lessons.

Teaching thinking skills and meta cognition has traditionally been very difficult in the classroom. By using games technologies we aimed to make this process highly engaging, very visual, collaborative and active. By embedding pedagogy in the authoring tool we were focused upon keeping the whole authoring experience focused upon the design and application of thinking processes. Authors can edit and customise a library of 3D assets, however to add interactivity and make a 'game' the author must create a thinking task.

Figure 6: Screenshot from Thinking Worlds™ editing screen.

Authors have access to a suite of interactive Thinking Behaviours that can be populated with subject content and then combined and arranged into Thinking Tasks.

The author can edit the rules, mechanics and measurement outcomes of thinking behaviours used in the overall task.

The author can customise all content including: 3D worlds, 2D, text, sound and movies.

Authors are free to use an ever increasing library of developed Thinking Worlds covering a multitude of subjects and scenarios.

Figure 7: Screenshot from Thinking Worlds™ menu screen.

Classroom Feedback

The technology was tested and refined by Caspian Learning during six months of piloting with students across Gateshead Local Education Authority in the UK[1]. Additional case studies have been undertaken by Oldham City Learning Center[2] and The Learning Lab under the guidance of Professor Steve Molyneux[3].

Across all studies students displayed enormous enthusiasm toward using the applications which extended beyond novelty engagement. Students exhibited great demand for the applications to be used as a self-directed learning tool in the home and at lunch time. However, the best results were seen when the technology was used as a classroom facilitation tool with the teacher using the cognitive tasks, learning content and recording methods to direct the learning of the students.

Figure 8: Screen shot from pilot classroom.

Engagement of students is the principal reason why practitioners contemplate using games based learning. Some studies using games in the classroom have noted student dissatisfaction either in not liking the game or in not seeing the relevance with their school work. In testing applications from a range of curriculum areas with students aged between 8 and 15 years old and across all ability levels, we saw consistently high observed and self reported levels of engagement:

- 98% students agreed that they would like to have the chance to use the software to learn in this way more often.
- 94% of students agreed that they preferred using the software to normal methods of learning in the subject area.
- 82% of students agreed that using the software made it easier to learn.

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1 The Gateshead pilot involved over 380 students ranging in age from 9 years to 16 years and over 2500 student hours of testing.

2 The City Learning Centre in Oldham has been using Caspian software since the start of the Summer Term 2005. In that time, eight different secondary schools and around three times as many primary schools tested the software have as have Oldham's Youth Service. http://www.caspianlearning.co.uk/Oldham%20Case%20Study.pdf

3 Learning Lab research undertaken on behalf of the North West Grid for Learning as part of the DiDA project. http://www.caspianlearning.co.uk/learninglab.pdf

During the pilot we monitored student opinions to maintain high engagement levels. As a consequence we layered additional engagement elements onto the technology:

- Greater task variety.
- Richer 3D environments.
- Greater choice of characters, and the use of vehicles.
- Elements of humour and surprise, for example, A.I. Chickens.

Each additional engagement element was monitored for adverse learning consequences to eliminate distractors.

Students perceptions of the 'game'

We were concerned that the level of thinking challenge and volume of subject specific content in the applications might disengage the students. Happily, we were wrong. In debriefs with individual students it became apparent that students clearly distinguished between the Caspian game based learning applications and games that they played while at home for entertainment purposes. Students in the main were comparing the learning applications to other methods of instruction typically used in the classroom, not to off the shelf commercial games.

Secondly, from the first engagement with the application the students were actively involved in the task mechanics and in discussing the learning content. Surprisingly, these elements were as important to the students as the graphics, fun elements and interactivity of the game. This was also borne out through live observation where the buzz of student conversation and interaction related to learning elements—answers and tips on performing tasks—rather than the thrill of the experience. Our preconceptions were coloured by a generalised view that modern students require entertainment and fun that maybe at the expense of hard work. The pilot testing quickly demonstrated to us that students were very interested in learning and being challenged. The key was to deliver the learning activities and challenge within an environment that stimulated them.

Hard work and challenge

A key criticism of games based learning has been the perception of this sort of activity as time wasting or frivolous. Games are seen as the 'easy option' where students can

pass idle time and avoid focused learning. We have used the term 'learning intensity' to describe the level of learning effort that a student may expend on a subject matter within a given time frame. Using the gaming environment and embedded pedagogy we were able to get some insight into levels of learning intensity by precisely monitoring the learning behaviours performed by the student during the taks and the difficulty of cognitive activity that the student was undertaking.

For example, these typical figures are taken from whole class averages within a classification type of task.

> In a 20 minute period, the average student: made 3 attempts, had observed 26 information elements about which they had to make a classification decision, made 17 classification decisions between categories 5 of which would have been incorrect, 10 decisions that information did not apply to any category of which 3 would have been incorrect. On 5 occasions they would have observed information and not made any decision about its properties.

This was typical of student effort levels and participation and was reinforced by observations from teachers. The students wasted very little time during the lessons. The learning games were the focus of intense learning activity. As we shall describe below, the integration of the learning applications into the lesson also provided a focus for enhanced participation in traditional lesson activities.

Competition and collaboration

Competition between students and groups of students was immediate. Prior to the pilot a few educators had identified competition as a potential concern that may negatively effect performance and student participation. The opposite was found to be true. The students inherently competed for higher scores, greater understanding of task mechanics and the acquisition of rewards, such as vehicles for their characters. This was a positive influence on student performance. It was made positive because of the high levels of collaboration that it also engendered. Competition and collaboration occurrred simultaneously. Whether working as individuals or in small groups, students would spontaneously compare their experiences, sharing answers, work arounds, methods and examples. Within a short period a whole class of students would be aware of 'best practices' within thinking tasks.

The collaboration and competition interactions were overwhelmingly focused upon learning outcomes. It was exciting for everyone to observe students that were usually extremely disinterested in the French Revolution to be actively discussing the differences between social groups within the Revolution, and directing their friends to approach characters from the Clergy or Aristocracy to learn more.

As the pilot progressed teachers running the lessons began make use of competition and collaboration more formally in their lesson plan, for example by dividing the class into groups to focus upon different elements of a thinking task before reporting back to the class.

Teacher Feedback

During the pre-pilot briefing, the elements of pedagogy and content mapping were identified as key benefits by teachers who understood that the students would be undertaking valuable learning activities with content and tasks precisely mapped to the curriculum objectives. This gave teachers the confidence to invest their time and resources into the project. This was reflected in the teacher comments during the sessions:

> *"I've never been a great fan of games-based learning, but this has captured our attention because it is based on research into learning, not simply on the motivational (gaming) aspects of using a 3D games environment. Listening to pupils talking to each other during Caspian sessions it is striking how much pupils talk about the subject, for example, the means of reducing the impact of earthquakes—not just about the motivational features like gold coins and skateboards". Dave Barter Oldham City Learning Center.*

Teachers as learning facilitators

The temptation with a learning game is to assume that it is founded upon a model of purely self directed learning at the expense of the expertise of the teacher. During the pilot work and in subsequent case studies the role of the teacher has been central to the success of the learning game in the classroom. We found that key elements of the learning game provided crucial support for teachers in adopting the role of facilitating learning among their students.

Firstly, the level of student engagement was an enormous benefit for teachers. The high student engagement levels freed the teachers to do what they wanted to do —teach.

During the pilot, teachers utilised the cognitive task structures as a foundation for 'learning conversations' with their students. For instance, using the cognitive tasks to undertake a structured enquiry, the teacher was able talk through the specific behaviours that the student would carry out in the 3D environment, observe and assist the students as they performed the behaviours, and post-task hold a class discussion on the different elements of the structured enquiry. This overcame real practical difficulties normally associated with teaching higher order thinking skills to a large group of students.

Teacher feedback also showed that assessment mechanisms and task structures enabled focused learning interventions during the lesson, aimed at either individuals or to the whole class.

Often a teacher would observe an interesting learning behaviour on a students computer. The teacher would then pause the class and convene a plenary session to discuss before returning to the task.

> *"I always have an insight into the students performance, how they are working through the task and how they have done. Knowing my students, I can give appropriate feedback to them there and then, based upon exactly how they are performing."—Tony Hannah, Primary School Teacher.*

These practices quickly became established as the norm during the sessions.

Refinements

Throughout the development testing we refined and added different elements to the software based upon teacher feedback.

The cognitive tasks were all timed to last 10 minutes or less. This enabled teachers to easily integrate the tasks into their overall lesson plans and to tailor their use to different ability level students.

The development of the electronic 'student workbook' (described above) that captured a detailed record of the students performance occurred early in the pilot. One of the reasons for this was simply to remove administrative burden from teachers. The main reason however was to support learning. Teachers would ask students to email their workbooks to review progress. The workbooks were sometimes used as foundations for homework assignments. Students also used the workbooks for revision purposes, that gave them an insight into their strengths and weaknesses within a subject matter.

The Performance Information system was used extensively post lessons to assess individual and class performance. However, it became evident that the breadth and detail of information captured within the applications was far more extensive than required. For example, within a compare and contrast task knowing the time taken to observe different information elements categorised by the action that the student should perform on them was too much information to be of practical use to the teachers. The reports were therfore refined to provide summary information for teachers.

Update

Since the pilot work, applications built using the software have been deployed in schools across the UK. The Thinking Worlds authoring tool has been piloted in Alpha version in January 2006 in Sunderland UK with groups of gifted and talented and also disengaged students. The Thinking Worlds tool will be deployed in a global beta trial in May 2006.

Conclusion

We have described applications founded upon research into cognitive processing methods that utilise interactive 3D games technologies to enhance these methods. These applications have successfully embedded pedagogy, content mapping and assessment elements into the design.

These "Leaning Based Games", have been shown to engender very high levels of student engagement and attention effort in the classroom. However, this effort is neither 'frivolous', nor just 'colourful and fun'. The applications map students efforts directly on to relevant learning content and activities.

Within each application, data captured about learning behaviours was analysed and fed back to support assessment, revision and other cognitive scaffolding mechanisms. Teachers made use of these mechanisms to make make real time learning interventions with students. The cognitive tasks structures were used to facilitate 'learning conversations' where teachers were able to direct students through higher order thinking tasks that would otherwise have been difficult within normal classroom conditions.

Learning Based Games can be powerful tools that clearly aid teachers and students, and are valued as such. When such conditions are met, then educators are more than ready to embrace these technologies. The use of games technologies in itself is not a barrier to credibility and acceptance within education. There are a number of issues that are cited as barriers to the use of games for learning; "learning value" need not be one of them.

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Field Report: Collaborative Blended Learning meets Game-based Learning or how Internet Platforms allow us to play 1000 "Low Tech Games"

Lotte Krisper-Ullyett, Johann Ortner, Barbara Buchegger

Preface

In mid-2004, I (Lotte Krisper-Ullyett) was invited to submit a paper on my practical experiences with game-based learning to an Austrian e-learning conference[1]. Since I had played such games with several groups of students during the previous academic semester I felt this was a good opportunity to reflect on what had happened, structure my thoughts and find out what others had to say on the topic. I must admit, I had expected to find like-minded tutors and lecturers using forums, platforms, chat rooms etc. to experiment and play games with their students or, to be more exact, to let their students play games with each other. I was very surprised to find that most of the other examples showed a world which was very alien to me: a world full of avatars, 3-D landscapes, beautifully designed games and simulations. All games which must have taken several man years to design and build. My first thought was one of minor panic. Was I the right person for this conference? After all, all I had to show was a forum thread and some simple children's games I had adapted for use on the Internet.

Nonetheless, I submitted my paper, gave my presentation and found that—despite my initial misgivings—I received a warm welcome in the game-based learning community. It seemed that although the origins of game-based learning lay in a different domain to my area of focus (collaborative blended learning), the community was just starting to embrace the idea of "low tech games", and the examples I provided happened to be "just the thing they wanted to hear".

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[1] 9th Business Meeting, TU Vienna, 2 and 3. December 2004, "Game-Based Learning und e-Assessment", organized by bm:bwk und fnm-austria, http://serverprojekt.fh-joanneum.at/sp/

About this paper

This paper begins with a discussion of why we might want to play such games in the first place. This is followed by a detailed description of two of the games we (Lotte Krisper-Ullyett and Johann Ortner) have played with our students. The paper concludes with a summary of our (the authors) findings and the proposal that some of these findings in the field of collaborative blended learning could well also be applicable to the world of game-based learning.

1. Why play online games?

The first issue we will look at is the question of why we might want to play online games with our students in the first place? What kind of problems do we seek to resolve using online games?

To answer this question, we would like to give the following two examples of situations in which we felt it appropriate to play a game with our students.

- In a course on "Personal Networking", it came to our attention that whereas students tended to judge other people's use of personal networks as "unfair", they saw their own use of their own personal networks as "quite acceptable" or "totally natural". In some cases, students simply did not even recognize the fact they were actually using personal networks. We realized we needed to find some way of helping them to get rid of these blind spots, i.e. to make them aware of the difference between their "theories in use" and "theories espoused" (as Chris Argyris[2] would describe this phenomenon).

- We also noticed that students identified with the use of "scientific terminology", even if they at times only had a very superficial level of understanding of what this terminology might mean. The German word Schaumschlägerei describes this phenomenon perfectly. Translated literally, Schaumschlägerei means to "whip up foam", but it also translates into English as "humbug", "bragging"[3], "hype" or even "blowing hot air". How could we make our students better aware of their use of language, encourage them to seek the original meaning of a term, phrase or statement (e.g. "win-win-situation", "intrinsic motivation", etc.) and even refer to the person who had coined the term in the first place?

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2 Argyris, C. (1996): Knowledge for Action. A Guide to Overcome Barriers to Organizational Change. San Francisco: Jossey-Bass

3 http://dict.leo.org, http://www.dict.cc

In both of the above cases, our solution was to let them play a game and draw their own conclusions for themselves! That way they would teach each other about the situation, and we as tutors would remain on the sidelines.

We felt that game-based learning was a suitable solution, since we were aware that there was little use in simply "telling" the students to change their attitudes or behaviour (an approach they would have found moralizing and boring). We could literally sense the resistance we would have faced if we had tried to lecture them on these issues. We also felt they would be more interested in what their peers had to say about these issues, especially since they concerned values, norms or attitudes. They would rather match themselves with their peers than with their teachers. Last not least, we also felt it would be fun to play a game and watch something "evolve" with the group as a whole in charge, not the teachers. The game would also provide us with plenty of pertinent, real-life examples for our next face-to-face session and give us the background material we needed to discuss how the picture might have changed (e.g. how 85% of the students had used their personal contacts to get their last summer job or how easy it is to fool people with buzzwords and statements which sound "mega-scientific" but are, in fact, nonsensical).

2. Description of two "low-tech online games"

In this section we will describe the way we designed the games/tasks to stimulate interaction between the students.

Case A: "Personal Networking"

To illustrate the use of personal networks, we asked the students to tell the story of how they had found their last summer job. In a first round, they were asked to analyse their stories in accordance with the following structure:

- the participants involved in the process
- their relationship to these participants
- the actions involved
- visualization of the process.

In the next step, the students were asked to generalise their stories using an abstract statement, a model or a theory. In the final round, students were asked to award a total of 10 points to those statements they felt were most relevant and based on actual

evidence. Not only did it become clear that (with a few outstanding exceptions) every student had used his/her own personal networks (family, schoolmates or friends) to find a job, the group also found the examples highly relevant when we later went on to discuss well known theories and concepts such as "the strength of weak ties", "structural holes", etc.

Even though the final task "visualization of the process" (intended to help the students identify the essential factors) was on voluntary basis, one third of students contributed visualizations of their stories: a knock-on effect that began when one student scribbled something down quickly on a piece of paper and posted a scanned copy in the system. As a result, others were inspired to visualize their stories (with increasing levels of complexity).

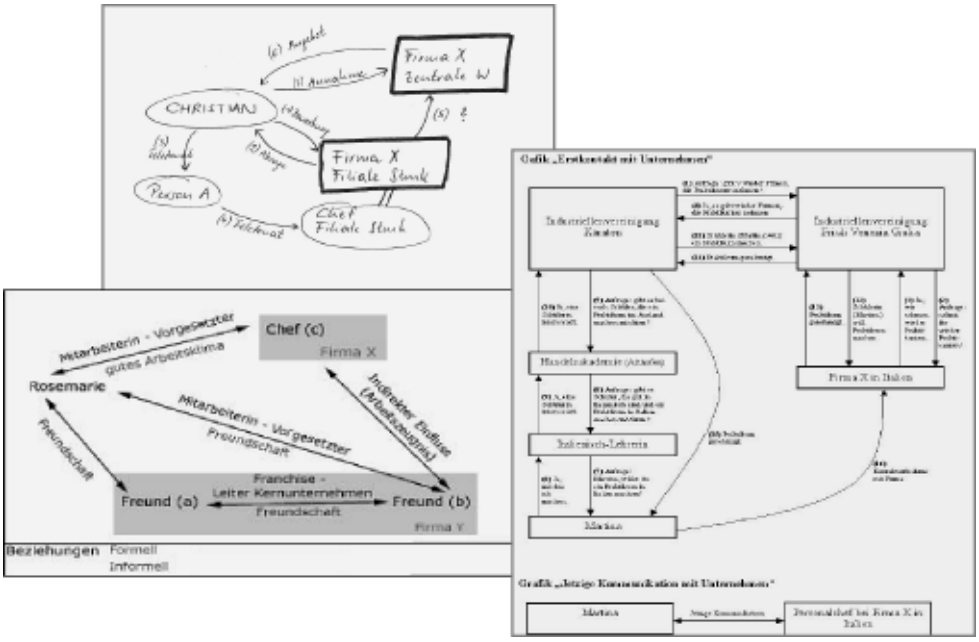

Figure 1: Student visualisations of their experiences with personal networking

This "level of sophistication" in turn inspired another student to post a comical visualization in which he pictured himself as the actor Brad Pitt, claiming it had been his good looks that had actually secured him his summer job:

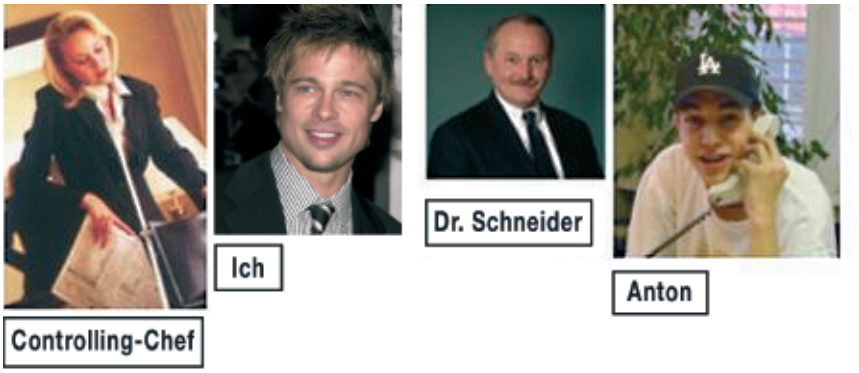

Figure 2: Student's ironic visualization of his personal networking activities.

Was this game-based learning? And if so, were we then "game designers"? At the time, we would probably have said no. All we had done was to formulate an e-mail that triggered a high level of forum activity over a certain period of time. All we had wanted to do was to find a way out of a situation we perceived as a barrier to a learning experience. However, with hindsight, we can now conclude that our didactic design did indeed have all the elements found in a game, namely:

- it involved a group of people
- these people had a set of tasks to perform or questions to answer
- a set of rules was in place
- the game took place on a "board", in the form of a clear forum thread
- the participants could win points
- a "referee" was in place to explain the rules, make sure the game was played fairly or help people get back on track if they got lost.

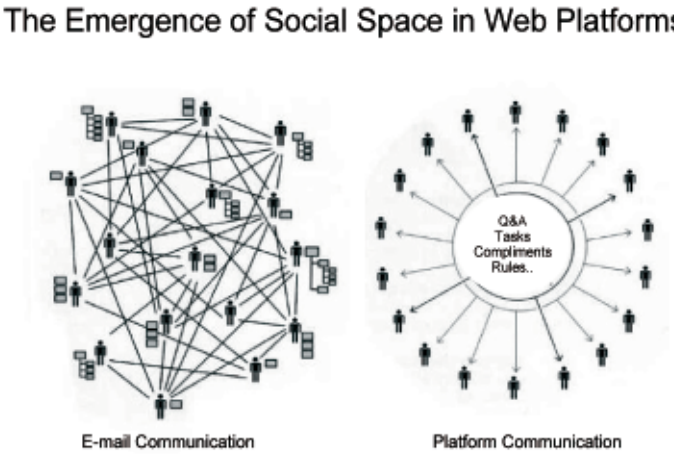

Figure 3: Online platforms generate space for social interaction—and games.

Today, we recognize the similarities in the concepts of "collaborative blended learning" and "game-based learning". Indeed, we even think of "collaborative blended learning" as a special form of "game-based learning". However, before we go on to discuss our experiences at a more general level, let us first look at another example of a simple "low tech" online game.

Case B: The "Bluffing Game" or "Encyclopaedia Game" (Lexikon Spiel)

This example describes the game we used to try to stimulate a learning process with regard to the use of "scientific terminology" (see above). "The Bluffing Game" is based on a "real" game we used to play as children on rainy summer days called the "Bluffing Game" or "Encyclopaedia Game". I remembered playing the game as a child while preparing the course material and thinking about playful ways of using language. The rules of the game(s) are as follows:

The original "Lexikon Spiel" (Encyclopaedia Game)

Target group: 12-99 year olds, with a keen interest in words and language. Recommended number of players: 5-10.

The game setting: Rainy day, with nothing else to do. The players sit around a table. Each player has paper and a pencil. One encyclopaedia is used by the whole group.

The rules: First, the players choose a word from the encyclopaedia (one none of them know the meaning of). Each player then writes down a (pseudo) definition in the form of an "encyclopaedia entry" on a piece of paper, folds the piece of paper in half so none of the others can read it and hands it to the moderator. The moderator copies the correct definition from the encyclopaedia on to a piece of paper and shuffles it with the definitions provided by the other players. Only the moderator knows the "right" definition from the "wrong" ones. He/she reads the definitions aloud, one after the other and each player writes down the one he/she believes to be correct.

How to win: Players are awarded one point for every other player who selects their definition as the right one. Extra points are awarded to players who pick out the correct definition from the other (pseudo) definitions. The player with the most points at the end of the game wins

Skills required: Good language skills. A good level of general knowledge and good judgement of plausible explanations are also beneficial.

The next step was to adapt the game for use in our workshop via the Internet. The results of this transformation are described below.

The "New" Bluffing Game

Target group: Thirty twenty-two year old third year students at the University of Applied Sciences in Burgenland, Austria. At the time, all the students were looking for companies to employ them for their compulsory 6 month work experience placement. Following that, they would return to university to write their final year dissertation.

The course setting: A soft skills workshop ("Personal Networks") for students who had chosen to specialize in "Knowledge Management". The aim of the course was to provide students with an understanding of personal networks and their relevance both for organizational knowledge management and for the students' own professional careers. The workshop was divided into three half-day-workshops interspaced with online phases—a typical setting for collaborative blended learning.

The targets of the use of is specific didactical design: To make the students think about their use of language, especially with respect to their final year dissertations. To encourage students to search for information. To relate the theoretical aspects of personal networks with the students' real-life situations, e.g. with the task of looking for a job.

Adaptations required to use the game on the Internet: The encyclopaedia was replaced with a bibliography of well-known authors and the students were provided with literature on the topic of social networks. Instead of pencils and paper and a table, students gave their answers via an Internet forum. Instead of playing for a couple of hours, the game was played over several weeks. The participants were not only permitted to but actively encouraged to research the term and refer back to the original author's statements and concepts.

The rules: In the first round, each student was asked to post three topic-related statements in his/her own words (i.e. not simply by copying & pasting any information they found) based on selected scientific literature. One of these statements

had to be fake, i.e. sound highly scientific, but in fact be nonsensical. In the second round, students were asked to classify the responses given by their peers as "correct" or "nonsensical". In the third and final round the cards (definitions) were put on the table and the fake definitions revealed.

How to win: There were two winners.

1. The student who was able to identify the greatest number of fake definitions.
2. The student who was able to fool the greatest number of other players.

The live game as played in the summer of 2004 can be accessed via the following link:
(permission for access has been given by the students, for scientific purpose only)

http://fhib5jg.factlink.net/147436.0
username: testlku, password: testen

The "game board"—a web-based discussion forum

The game took place in a discussion forum on the Internet. The game was launched on February 3rd, with Step 1 beginning on April 18th, Step 2 on April 20th and Step 3 on April 25th. Figure 4 shows the forum thread containing the students initial statements (Student 1, Student 2 ....). It also shows the reactions of other students, i.e. whether they thought a particular statement was "correct" or "fake" and whether it had any relevance for their own current situations.

Figure 4 contains a small extract of the forum thread (the names of the students have been blanked out) and shows three of the four statements made by one student in accordance with the e-mail instructions sent out for "Step 1". He selected Manuel Castells in 2001 on weak online connections (schwache on-line Verbindungen) for his first two statements and Robert Kaplan and David Norton on Balanced Scorecards in 1997 (customer relationships—Kundenbeziehungen) for his third statement. He posted all of his statements on March 20th (almost one month before the actual deadline —making him a so-called "early bird"—yet another typical phenomenon often found in online environments).

A month later, on April 20th, he received the first replies from his peers (in accordance with the instructions received for "Step 2"). They had been asked to assess the

Figure 4: Screen shot of forum activity in the "Bluffing Game"

statements provided by the other students as follows: "Is the statement relevant for my life?" and "Is the statement correct or fake (richtig/falsch)?" As Figure 4 shows, the students were of different opinions regarding these statements. Although they all considered the information relevant to their own lives, two of them thought the statement was fake, while one thought it was a correct rendition of what Kaplan & Norton had said in their book.

A week later, on April 27th, students were asked in "Step 3" to reveal their "bad eggs" and add up the number of points they had won. In this case, the student states in the posting headline that he had been able to find two fake statements ("2 Mal ertappt") and that he had been able to "fool" two of his colleagues with his own statement ("2 Mal getäuscht"). The text body of his posting is a good example of high quality work: the student corrects his statement ("...sind nicht auch rentable Kunden"), shows how easy it would have been to find the right answer using an Internet search engine such as Google and provides a link to the exact quote in the book itself.

Game Design

With games of this sort, the tutor assumes the role of "game designer" and is therefore not separated from the process of game design. In most cases the "game design" manifests itself in the e-mail or instructions sent to the participants in the game. In our "Bluffing Game" example, an e-mail of about 40 lines in length (see below) triggered and structured forum activity from 30 people for 6 weeks, with a total of over 300 forum postings. This included 90 initial statements, about 200 reactions and 30 disclosures/summaries.

Task Nr 2—Literature, recommended time: 4 H

Get inspired by the recommended readings (as handed out in the face-to-face meeting).

Step 1 Pick out relevant, interesting new insights
Choose one (or several) book(s) or author(s) from the above list that seem to handle a topic relevant to your current personal circumstances. If you come across a statement, an assumption, a concept or a recommendation for action, which you believe is particularly relevant for you and gives you new insight, share it with your colleagues. Try to reformulate this new insight in your own words (one sentence or paragraph is enough, copy&paste not allowed) and post it into this forum. All in all, choose four such statements regarding personal networks which are based on scientific work. Make sure your quotes are exact and correct, so that your colleagues are able to find this information (author, title, year, page, library.)

Attention: Challenge!
Now the challenge: one of the four statements should be fake and "smuggled" in. Ideally, your colleagues should be able to find out through simple research on the Internet that the statement can't be true and uncover your manipulations. In other words, please do not use any "false statements" that could never be uncovered or contain a negligible change such as a slightly wrong date, etc. Your manipulations should concern the very core/meaning of a statement. The most elegant manipulations which were able to fool many colleagues even though it would have been easy to discover will be awarded :-)

Form: One posting per statement (again: only a sentence or paragraph, own words, no copy&paste) Title: [Author—Year—Key word—why relevant]
Example: [Granovetter—1973—Weak Ties—Job Search]
Deadline: 18 April 24.00
Place of Delivery: here in this forum
Recommended amount of time: 2-3 hours research & formulation

Step 2: Rating of relevance / correctness
Choose 6 postings made by your colleagues. Do they seem relevant to you? Are these correct statements?
Form: [Last Name—relevant /not relevant—correct/faked]
Place: in the respective forum thread
Deadline: 25 April 24:00
Recommended amount of time: 1 hour including research

Step 3: Disclosure of fake statements
Now disclose your phoney statement. Set it right! Ideally show us the link to the website where we could have found it.
Format: Posting in relevant forum thread
Title e.g. [Fake—caught 3 times—fooled 0 times]
Deadline: Friday 30 April 24:00
Recommended amount of time: 1/2 hour

Once a process has started, it is very difficult to change instructions or rules. As a result, the text containing the instructions must leave no doubt about the task, time schedule, rules, prizes, etc.. It is a good idea to think it through step-by-step or ask colleagues to play it on a trial run basis. The instructional text needs to be particularly precise in cases where the tutor does not meet students face-to-face at regular intervals. There are a number of books available that offer advice on how to play such games with examples of possible designs, e.g. "101 e-Learning Seminarmethoden[4]" by Hartmut Häfele and Kornelia Maier-Häfele. However, our experience shows that games will always need to be adapted to the type/characteristics of the group and their "cognitive style".

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[4] Häfele, K. / Maier-Häfele, K. (2005):101 e-Learning Seminar Methoden. Manager Seminare Verlag

Critical review of the "Bluffing Game" example

What worked well in this case?

The students showed a strong interest in the game, always made their postings on time, spared no efforts in their attempts to fool their peers and provided some very elegant solutions when it came to the web-links leading to the correct answers. There was a high level of activity, and the quality of some of the examples was extremely high. The reactions and evaluations received from the students were all positive. Students took much more time than suggested in preparing their answers.

What did not work well or could have been improved?

Students complained that there were too many postings, and that they lost the overview. The students were given too many books to choose from. There were no synergies between the statements. Students don't go to libraries any more, they only use what they can find on the Internet. Intellectual activity remained more on a technical level; the game did not make use of the social potential in the group. Students complained about the amount of time they had spent on the task (an ironic complaint given the above).

Learning effects

Obviously, another important aspect is the learning effects produced by such a game. However, soft skills workshops of this kind often do not involve a written examination and, in this case, no research was carried out regarding its long time learning effects. Consequently, we unfortunately can provide little in terms of measurable outcome. However, what we do have is feedback, feedback that was even provided over a year after the event. Some of the feedback we received on the "Bluffing Game" was as follows:

> "That was the craziest lecture I ever attended!"
>
> "I can still remember the fake statement I posted and the fact that it was detected by XYZ."
>
> "I absolutely hated playing that game, but it made me realise how easy it is to manipulate text and therefore I think it was relevant for our lives."

Last not least, the assessments/ratings received from students (Did you learn some-

thing? Did you actively participate in the seminar?, etc.) have continuously improved since we began using collaborative blended learning methods. For us as practitioners, this is reason enough to continue with this method of "designing" learning processes.

3.Generalisation of observations

The above examples should provide a good insight into how we actually play games using little more than standard web-based forum technology. The following statements draw not only on these examples but also on our many years of experience in working in this field and reflecting this experience. They can be seen as "helpful hints and tips" or simply as input for lecture design:

(1)Game-based learning processes can be triggered without a need for special software. If a game can be played at a table using a pencil and paper, it can also be played online. There are literally thousands of games that could be played in this way.

(2)When formulating the task, the rules of the game, etc. consideration should be given both to the length of time players (students) will actually need for research, reflection, formulating their own thoughts and giving comments and to the time they will need for the more technical aspects, such as searches, finding their way around the game, etc. Precise, clear, simple and easy to understand tasks and set of rules will reduce the amount of time required for these technical aspects.

(3)The players' (students') focus should be directed more to the providing of relevant answers and content than to completing the task and playing the game correctly. The game itself is not the "content" of the exercise, it is simply the means to the end (at least as far as the tutor is concerned). The easier the game, the greater the role that will be played by "interesting" answers and content. Despite this, the game should not be stupid or childish; it should be intelligent and challenging.

(4)The players should be aware of the benefits of the game, i.e. their personal benefits or what they gain by playing. The fun of participating in the game, of competing against one's peers and of winning credits, etc. should not outweigh the learning aspects and their practical benefits (use of gaming pleasure for the purpose of promoting cooperative learning/working). In other words, "results" that can be expected from the game should be clear right from the outset: the thrill of the game; credits or

marks for completing the task; building block towards completing the course; social recognition in the group; self-presentation; community building; relevant, pertinent knowledge, skills, insight; useful experience for the future.

(5)It should be clear from the design of the game/task that the assessment and the awarding of marks by the tutor is not the ultimate purpose of the game. Instead, what is important is the use of peer-to-peer evaluation to assess knowledge generated in the group (Does it meet with consensus? Is it relevant? Is it of use to the individual members of the group?) Knowledge that has been developed jointly brings the members of the group together and they develop feelings of pride for their "baby".

(6)Since the same game can work well in one group yet not in others, game designers must strive to put themselves in the role/situation/conditions facing the prospective players. There are some relatively simple tried-and-tested games that generally work well in almost all groups (e.g. role playing games in almost all groups; or chain letter games for predominantly male groups) and others that have to be adapted to the needs of the respective group of students.

(7)It is advisable to offer an alternative way of contributing to the course (e.g. writing a term paper) rather than forcing people to play the game. In this way, you not only avoid the troublemakers, in some instances you might even encourage spoilsports to join in after all, if they feel they have been given the choice.

(8)Even though both genders like playing games, their tastes tend to be slightly different: men prefer straightforward, competitive games, while women prefer games involving social interaction and feedback loops.

(9)The greater the practical relevance of the game, the lesser the need for instructions. Players who share a similar professional background, generally don't need a lot of rules to encourage interaction. What they do need is a transparent social space in which they can share their experiences and position themselves through comments, questions, answers. Their game board—in a wider sense—is the Community or Practice (as proposed by Lave/Wenger 1991)[5] which provides ideal conditions for learning and knowledge sharing.

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5 Lave, J. / Wenger, E. (1991) Situated Learning Legitimate Peripheral Participation. Cambridge University Press.

4. Authors



Lotte Krisper-Ullyett
As founder and general manager of factline.com, a Vienna based company developing innovative software for knowledge communities, Lotte got interested in the concepts of collaborative blended learning and learning communities. Her additional occupation as lecturer at University and continuing education programmes give her the opportunity to experiment with innovative learning designs.

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Despite Barbara's academic training as an engineer at University of Natural Resources and Applied Life Sciences in Vienna, Barbara soon discovered her fascination with the possibilities of new internet technology and has been working in the area of virtual communities and e-learning since 1999. Barbara is implementing collaborative e-learning in different fields, such as education and vocational training, and has implemented and developed various methods for collaborative blended learning.

Johann Ortner
After many years of conducting research and teaching Literature, Philosophy and Social Siences at different universities in Austria, the USA and Japan, Johann worked as General Manager for Eastern Europe in the Neurodiagnostic Instruments sector. Johann has recently published several books and articles on knowledge management, knowledge networks, systemic consultancy, epistemology and the philosophy of language.

Dramaturgic E-Learning Strategy (D.E.S.) —evaluation of a story based approach

Michael Burmester, Daniela Gerhard and Frank Thissen

Keywords

Dramaturgic e-learning, story based learning, evaluation

Abstract

The Dramaturgic E-Learning Strategy (D.E.S.) has been developed at the Stuttgart Media University. Central assumptions of D.E.S. are that learning based on dramaturgic stories is more engaging; facilitates intrinsic motivation and results in positive emotions during learning. All these conditions are important to have a positive learning experience based on e-learning technology and finally lead to better learning results. An evaluation study was conducted with 135 students in order to find out, if the assumptions of D.E.S. are fulfilled and to find out how D.E.S. could be improved. No differences could be identified between D.E.S. and the traditional approach concerning learning success and intrinsic motivation. The general acceptance of a story-based e-learning approach was quite high. Several possibilities for improvement of D.E.S. are identified.

1. Introduction

When implementing and conducting e-learning courses at schools, universities and other organisations it is necessary that e-learning is accepted by all types of users, such as learners, tutors, teachers etc. Recently the development of e-learning technology has been the main subject of study. Increasingly the need for an effective and efficient multimedia didactic has become clear (Beck & Sommer, 2003).

After the euphoric start of computer based and internet based education in the early 1990s, more and more disillusionment can be detected. In many cases, the promise

of better learning and cost reduction in training did not come true. Developing, implementing and conducting high quality e-learning courses is often more expensive than traditional types of training or education. The reliability of technology has not met expectations and acceptance by learners is not very high. Reasons for the lack of acceptance could be that learners are not experienced in self-directed learning, in self motivation and solving technological problems on their own. Very often the learning experience is impaired by unusable and boring e-learning applications. In reality, very often e-learning is not a group experience; instead learners have to learn on their own.

The "Dramaturgic E-Learning Strategy" (D.E.S.) has been developed based on the assumption that learning is an information acquisition process with emotions and personal experiences. Emotions and immersive experiences seem to be important in order to learn and process new learning material in a better way. D.E.S. consists of emotional and dramaturgic elements in order to improve computer supported learning. D.E.S. is based on scientific results of brain and emotion research (Damasio 1995, Goleman 1995, Ciompi 1997, Spitzer 1996, Ledoux 1998, Markowitsch 2002), instructional design approaches like 'anchored instruction' (Bransford, Sherwood, Hasselbring, Kinzer & Williams, 1990: Cognition and Technology Group at Vanderbilt, 1991, 1992) or goal-'based scenarios' (Schank, Bergmann, Macpherson, 1999) as well as modern concepts of dramaturgy (e.g. Mikunda, 2002; Breitlauch, 2003).

2. Dramaturgic E-Learning Strategy (D.E.S.)

2.1 Assumptions

Taking into account all the problems listed above, D.E.S. tries to solve some of these problems. The starting points of D.E.S. are the following assumptions:

- Learning is an individual process of active knowledge construction. Knowledge has to be acquired by the learner in an active way (Gerstenmaier & Mandl 1994, Siebert, 2001).
- Multimedia does not necessarily add value. Even using multimedia all information presented must be actively processed, e.g. in problem-based environments (Issing & Klimsa 1995).

- Learning is a social process. The communication and interaction between learners and between learner and tutor or teacher is very important for the learning process.
- Learning is an emotional process. Emotion and cognition are closely linked together. Positive emotions have a positive effect on the learning process (e.g. Csikszentmihalyi 1999) and negative emotions can hinder the learning process.
- In order to integrate new information successfully and to create a positive emotional learning situation, stories are of central importance (digital story-telling).
- Computers are not neutral. The medial aspect of computers causes the fact that computers are seen as communication partner sending content-messages and relationship-messages influencing attitude and acceptance of users towards computers and applications (Weizenbaum 1978, Reeves & Nass 1996).

2.2 Elements of D.E.S.

2.2.1 Dramaturgic structure

The learners in a D.E.S. course can participate in stories via an e-learning platform. This facilitates emotional participation and immersion as well as situational and problem-based learning. The basic D.E.S. structure of drama has already been approved in theatre and film. By dramaturgic interaction the learner can influence the story (Breitlauch, 2003).

The development of the dramaturgical basic structure adheres to the classical Aristotelian philosophical configuration of a three acts scheme consisting of exposition, confrontation and solution (Aristotle, 1998). This structure is achieved through scenes and sequences (see Figure 1).

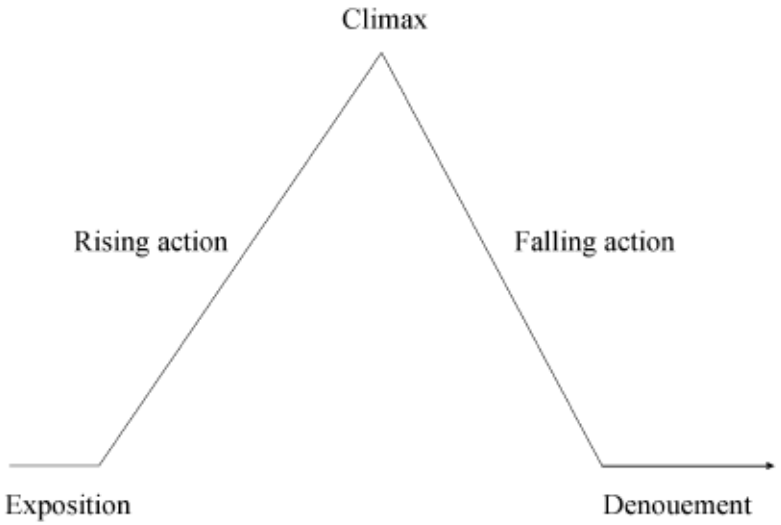

Figure 1: Classical dramaturgic structure by Gustav Freytag (2004)

When developing a dramaturgic strategy the following questions should be answered:

- What are the elements of content in order to achieve the dramaturgic goals? E.g. love, curiosity, hedonic goals, social status, success.
- Which characters implement the main dramaturgic concept? What are the challenges for these characters?
- Which character can be chosen for the antagonist, who will work against the dramaturgic goal of the story?
- How can the conflict of the character and the antagonist be solved?

2.2.2 Myths

For the development of dramaturgic structures not only authentic situations can be used, but myths, stories and narratives are of interest as well. Myths and fairy tales may have an additional advantage for remembering information: the dramaturgic structure is already established in the knowledge of the learner, because they have heard them several times during their life. The story to be developed can make use of this knowledge. An example of a well known dramaturgic structure is the myth of David and Goliath. The dramaturgic structure is conflict between small weak David against tall strong Goliath.

2.2.3 Cryptic Knowledge

The acquirement of knowledge is not solely based on collecting facts and information, but is integrated in an active process between the educator and the learner. The "cryptic knowledge method" structures the acquirement of knowledge in such a manner, that the learner must gain the knowledge through learning activities. Cryptic knowledge is an element of the dramaturgical basic structure and can for example contain new, current and exclusive information, which the learner receives through accomplishing a certain task. Cryptic knowledge also includes among other things rumours, incorrect information, symbols, etc. (Mikunda, 2002).

The "cryptic knowledge method" includes the realization, that during the conveyance of knowledge elements, so called conscious and unconscious functions such as brain scripts or cognitive maps are activated within the learner. Brain scripts are "screenplays in the head" of the learner, which are responsible for what the learner actually understands is really happening in a story. Cognitive maps are the "internal maps of consciousness" of humans and support orientation. Accordingly, they are developed within a dramaturgical basic structure, which motivate the learner to interactivity, through his/her own concern (Prensky, 2001).

2.2.4 Community

The integration of knowledge acquirement into a community conveys a contextually related, communicative social transfer of knowledge. The community contains different stages (levels) which the participant can reach through accquiring certain elements of knowledge. Within the initial stage, it is the participant as learner himself. Within a continuative course, the learner can become the tutor or coach who takes over the tutoring or coaching of others on account of his/her experience (Kim, 2001).

2.2.5 Multimedia information and communication system

In order to complete the learning environment of D.E.S. a knowledge pool is required. Here the learner gets background information, case studies, facts, news-ticker, discussion forums and other media. If the learner has to solve tasks embedded in the dramaturgic story she or he needs the knowledge pool. Figure 2 shows the integration of knowledge pool as hypermedia and the dramaturgic structure.

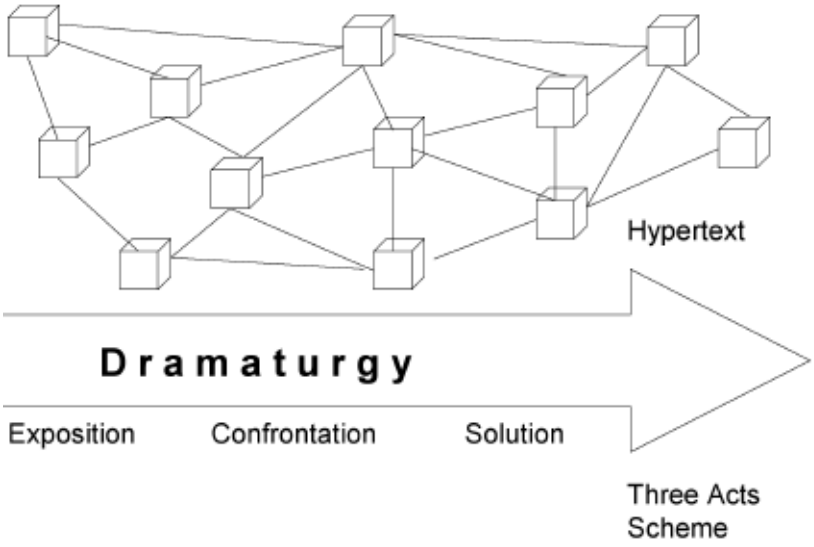

Figure 2: Integration of dramaturgic structure and hypermedia as knowledge pool

2.2.6 Five steps of D.E.S.

Electronic media such as film, audio, video, etc. can induce multifaceted emotional responses, but are in themselves emotionally neutral. The control of emotional responses therefore follows the special supportive structure of dramaturgy. The method uses a dramaturgical concept to create electronic learning modules. The development of a dramaturgical e-learning strategy according to the method is based on the following implementation steps:

- **Step 1**: Predefinition of the target group for learning (multiplicators, learners, etc.)
- **Step 2:** Ascertainment of the primary themes (basic knowledge in the form of hypertext modules)
- **Step 3:** Development of a dramaturgy (goal-solution-conflict, strategic elements such as exposition, confrontation, solution, plot-points, etc.)
- **Step 4:** Determination of exclusive cryptic knowledge (mythological knowledge, rituals, proverbs, etc.)
- **Step 5:** Community building (levels)

3. Study questions

The study was necessary due to several reasons. First of all, D.E.S. is a newly developed e-learning approach. Some pilot studies have been done, but without a systematic empirical evaluation. Therefore, one main objective was to evaluate the D.E.S. in a university course and to find out if D.E.S leads to the promised results and to improve the D.E.S. This was clearly a formative evaluation objective.

During the development and the scientific discussion concerning D.E.S. several questions came up, which should also be answered in the planned empirical study setting. The following questions were planed to be investigated:

1. Do learners experience more positive emotions when learning with D.E.S.?
2. Does D.E.S. facilitate intrinsic motivation?
3. Is there a general acceptance of story based e-learning seminars?
4. Is learning mor successful with D.E.S.?

4. Method

4.1 Study Design

At the Stuttgart Media University a screen design course was planed for 135 students in winter semester 2004/2005. The topic screen design comprises content concerning communication via internet sites, definition of target groups, layout, typography, use of colours and forms, accessibility, screen elements (orientation, navigation, motivation, content, interaction) as well as design of content such as text design, photographs, animations, and graphics. The students came from the information design and business information course. All students studied in their third semester.

The students were divided into two groups:

- **Classic Group**
  This group learned with a traditional e-learning seminar style. They got tasks in a weekly time schedule. They had to work on the tasks and to upload the results. They got support by tutors and a teacher via the open source course management system MOODLE (www.moodle.org, see Figure 3). 70 students participated in this group

- **D.E.S. Group**
  The students of the D.E.S. group learned in the framework of a (dramatic) story. The number of students in this group was 65.

There were several similarities between the groups. Both groups

- worked with the same hypermedia containing the screen design knowledge.
- worked with the same tasks contents. Only the presentation of the tasks was different, e.g. embedded in a story in case of group D and formulated as an ordinary task in the case of group C.
- had the option to ask questions and to contact a lecturer.
- were divided in working groups of two or three students.
- studied in the same semester starting at the beginning of October 2004 and finishing at the end of January 2005.

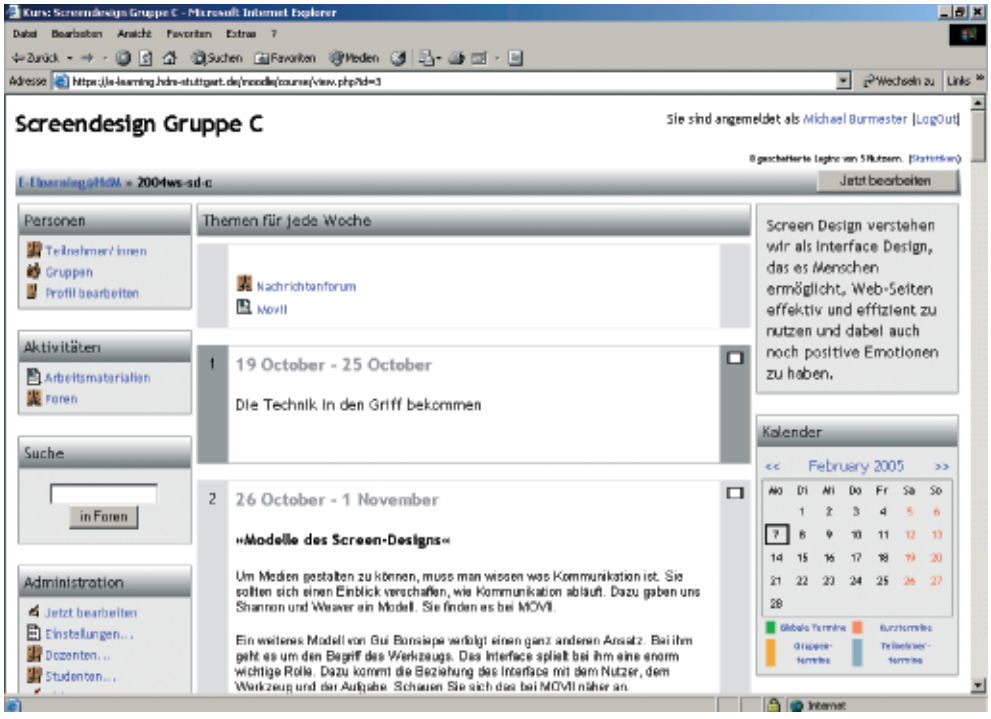

Figure 3: Screen shot of the group C course management system presenting the weekly tasks

4.2 The story of the D.E.S. group

4.2.1 Story development

According to the method elements and the five steps of D.E.S. development, a dramaturgic concept and a story was developed. A team of students together with a professor developed the complete concept.

4.2.2 The mythological basis

The myth that the story is based on is the Cinderella story: an old story that goes back to Egyptian times and has also some roots in 8th century China, the Romans and in North American Indian cultures. The idea is that a very badly treated heroin wins at the end and with the help of a good character (the fairy) the poor girl finds the handsome prince and becomes a princess. But it's a hard and long way.

4.2.3 The story

The story is the one of a small designer's agency run by three people working together. One of them—Thomas Jung—is an expert for print design and typography, his colleague Pierre is the web site expert and the secretary Lisa runs the office. They are not rich but they survive. Suddenly a big telecommunication company gives them a commission for a web-site development with a very large budget. In this situation Pierre as the screen design expert decides to work for the company on his own. So he leaves Thomas—our hero—and opens a new office with Lisa. Thomas tries to keep the business running—there are some customers with small commissions, but being on his own without Pierre's expertise and the secretary Lisa is a very hard job. And Thomas is crazy about Lisa, which now works closely with his new enemy Pierre. In this bad situation a mechanical engineering company asks Thomas to create a we site for them. He needs the money, but he has no idea how to design web-sites. He remembers a professor at Stuttgart Media University—Frank Thissen—who is an expert in screen design and sends him an e-mail asking for help. The professor sends the e-mail to his seminar students asking them to help Thomas Jung. The students become Thomas Jung´s consultants. For this task they can access information from a hypermedia system which presents the main information from the "Screen Design Manual" (Thissen, 2003).

Over the following weeks Thomas Jung gets various tasks from his customers as "Our web site has to be accessible for handicapped people. Please check it" (accessible web sites), or "Our home page seems not to attract our customers, what can we do?" (target groups and emotional aspects of web design), and others. With the help of the students who do some investigation and research Thomas Jung masters his new challenges and finally wins. Beside these struggles with his job he's fighting for Lisa, so a love story is running simultaneously.

The dramaturgic story was told by the following means:

- Thomas Jung´s e-mails to the students (and sometimes also e-mails from his rival Pierre). According to the events and plot-points tasks were embedded in the story and communicated by mail to the students.
- Company web sites produced by Thomas Jung that are changed during the seminar.
- The online diary: all personal information about Thomas Jung was told by using a public diary. Here, all his personal feelings are described (see Figure 4).
- Postcards that were sent from Thomas Jung to the students.

Several plot-points were integrated in the story, such as

- Thomas Jung's love for Lise who leaves him
- A big company offers a big job to Thomas Jung, but he is not able to do it on his own
- His most important customer is not satisfied by his work results.

The student participants were integrated in the story as supporting consultants. All teams were asked to act as a coach for screen design in order to help Thomas Jung to be more successful.

Figure 4: Online diary of Thomas Jung ('squares design' is the company of Thomas Jung)

4.2.4 Cryptic knowledge

The concept of cryptic knowledge was realized by rumours that ran among the students groups and gave the seminar a bit of mystery. Although we told the students at the beginning that it was a game and the people in it are unreal, the students started discussing the backgrounds of the story. Who wrote the online diary? Was it the professor? Or who else was it? And were Thomas Jung, Pierre and Lisa really fictional characters? Who sent the post cards? And weren't the web sites real?

The online diary was not publicized, but hinted about to some students, who told the rest of the class. (The interesting thing is that although the story in the online diary was fictional, people from outside the university who read the diary commented on it and gave Thomas Jung advice. So we ran into an ethical question whether it is acceptable to tell a fictional story in a public online diary).

4.3 Research instruments

4.3.1 Semi-structured interviews

Two types of methods were used in the study. In order to learn more about the acceptance of a story-based approach of learning and to find opportunities for improvement a qualitative semi structured interview format (e.g. Merton & Kendall, 1979) was chosen. A question guideline with open questions was developed. Questions were formulated in order to get information on the following themes.

1. What can be remembered of the story?
2. Is the story believable?
3. What is the opinion on different elements of the story, e.g. type of story telling (e.mail, online diary etc.), the hero, the other characters, and dramaturgy?
4. Learning success
5. Emotional reactions
6. Hypermedia with screen design content
7. acceptance of story based e-learning seminar

For the first round of interviews six participants of the dramaturgic screen design seminar (group D) were randomly chosen. After all interviews were conducted they were analysed following a qualitative analysis according to grounded theory (Strauss & Corbin, 1996) and fast text analysis (Legewie, 1994).

After having the first round of interviews analysed a second round again with six participants was started. Based on the first interview results and reflections, the interview guidelines were adapted and new interview themes were added, e.g. more questions on the diary and the parallel running love story, new story telling elements such as a Christmas postcard to all students from Thomas Jung and further themes like the personal importance of screen design for the students and their course of studies and the role of the teacher as university professor and as part of the story. The second round of interviews were analysed the same way as the first round.

4.3.2 Questionnaire

From the interview results, theoretical assumptions as listed above, and theories of intrinsic motivation (Intrinsic Motivation Inventory, IMI, Deci & Ryan, 2000) statements were derived for the questionnaire. The participants were asked to rate the statements on the basis of a Likert scale. Figure 5 shows an example of a statement with a rating scale. The rating scale is translated from German. The German version is an approved scale (Rohrmann, 1978, cit. from Bortz & Döring, 2002).

The approach to present seminar content as a story is very good.					
○ absolutely true (5)	○ quite true (4)	○ fifty—fifty (3)	○ is less true (2)	○ absolutely not true (1)	○ no answer

Figure 5: Example of a question in the questionnaire (rating scale is translated from German).

The questionnaire consisted of two parts. The first part contained questions for both groups . The second part was just for the D.E.S.group .

The first part of the questionnaire for both groups contained 22 questions concerning the following themes:

1. Learning success
2. Positive emotions (e.g. fun) and negative emotions (e.g. frustration)
3. Interest towards screen design
4. Group work

The second part of the questionnaire for the D.E.S. group contained 28 questions for the following themes:

1. Questions concerning the story
2. Questions on the virtual seminar
3. Degree of participation and involvement
4. Acceptance of the seminar type

The main question type in both parts was statements with a rating scale. Only a few questions were open with the possibility of free textual answers.

In order to answer the study questions 1, 2 and 3 the results were statistically analysed by t-tests using the statistical software SPSS (2002).

4.3.3 Knowledge test

In order to get a rough assessment of the learning success a knowledge test was developed and presented to the participants at the end of the seminar. It was the same test for both groups.

The test consists of the two parts:

- **Factual knowledge**
  These are questions concerning theories (e.g. design theory of Gui Bonsiepe), methods (e.g. persona concept according to Alan Cooper), psychology (e.g. "what is the capacity of the short term memory?"), use of colours, text writing for internet pages, accessibility etc.
- **Learning transfer**
  Four web-pages were presented and the students asked to write down optimization possibilities from the perspective of screen design.

All tasks have a maximum number of points. The time to fill out the knowledge test was 80 minutes. For all students a professor assessed the results.

The students had to participate in the knowledge test, but the result was not relevant for their marks.

4.3.4 Complete study schedule

The study started at October, 15th 2004 with a preliminary investigation:

- Test of factual knowledge concerning screen design before the beginning of the virtual seminar to make sure, that the student didn't have already good knowledge in screen design before participating in the seminar.
- Questions towards the interest in screen design to make sure that—in case of good learning results—it wasn't the students' interest that lead to this success, because high interest correlates with better learning results.

The seminar started on October 15th 2004 and finished January 28th 2005. The qualitative interviews accompanied the seminar.

On January 28th 2005 the final investigation was conducted:

- knowledge test (knowledge of facts; learning transfer)
- questionnaires for formative and summative evaluation (questionnaire as described above)

Not all data can be presented in this paper.

5. Results

5.1 Qualitative Analysis of interviews

The interviews were analysed on the basis of a qualitative analysis. On the basis of the analysis, several themes and issues were identified. It is important to understand that these themes and issues are a variety of possible reactions and opinions towards the story-based e-learning seminar. Based on this analysis, questions for the quantitative questionnaire were derived.
The following themes and issues were identified:

5.1.1 Emotional reactions

Several emotional reactions were identified. It was fun to learn in the context of a story and an e-learning environment. Curiosity and interest were stimulated by the story and the content screen design as well. Frustration was closely related to deficits

in the organisation (group forming, technological problems, and instructions) of the seminar. Some plot-points were related with excitement.

5.1.2 Entertainment

For students who love soap operas and students without time pressure from other courses, the story could be rather entertaining "it was my daily soap". The seminar had a feeling of leisure time and relaxing from other lectures.

5.1.3 Time pressure

Some students were involved in other very time consuming seminars. Their interest in the story decreased and the e-mails generated in the framework of the story were just analysed in order to find the task related information. The main goal for these students was to finish the task efficiently. In this case the story was annoying.

5.1.4 Believability of the story

Students thought that it was not very believable that a web-designer running a small company was so helplessness,

a. that he contacted a university to get help from students,
b. that the web-designer tells his very personal love live and all his troubles with his business partner to a large group of people,
c. that his character was more like a student than a business man, and
d. that there was not enough explanation why he was so alone without any friends.

5.1.5 Reality and fiction

At the beginning of the seminar the students were informed that they would learn by a story and this story is just fiction. In order to make it a little bit more mysterious the story was told in a very realistic way by real media (e.g. e.mails, public diary, paper mail). Some students thought in the first third of the seminar that it might be real. After that they found out that it wasn't. This was a little bit disappointing. The

curiosity effect of the realistic story-telling elements was quite obvious. After this first phase the curiosity effect disappeared. Some students asked for a real project and they said that that would be highly motivating.

5.1.6 Consistency of the story

A break in the consistency of the story was a real "show stopper". Two reasons for that can be identified. First, an e-mail from the professor advising the students to work carefully and deliver the results on time was perceived as a break in the story. Second, as soon as it was clear that the students would get marks for their work, the story was not that interesting anymore. It was clear from that point on, that it was not fun, it was work. Furthermore, feedback for the delivered solutions is very important for students in order to assess their performance, but this feedback must then be part of the story.

5.1.7 Learning success

According to the subjective assessment of the interview subjects, they asserted that they learned interesting facts about screen design and that this type of seminar was more interesting than a classical lecture. Because the students had to work on problems integrated in the story, some students preferred the practical aspect of the seminar content. But some students said, that the overall standard of the seminar was not high enough. This must be interpreted in relation to the fact, that about one third of the students were information design students in the third semester. They already knew a lot about interface design and usability.

5.1.8 Elements of D.E.S.

The hypermedia system presenting the screen design content was well accepted and seen as an important part of the seminar. The only critique was that it should be better integrated in the story (see also "consistency of the story"). The e-mails were well accepted as means of the story-telling. The public diary, the company web-site and the postcards were accepted by the students who appreciated the story approach. Some suggestions like video clips and more interactive computer game like elements were made.

5.2 Quantitative Analysis of questionnaire

5.2.1 Positive Emotions

In order to answer the question whether learners experienced more positive emotions with the D.E.S. seminar (group D) compared to the traditional virtual seminar (group C), the participants were asked about fun. The question statement was "this seminar was more fun than a usual seminar". Figure 6 shows the results of the mean ratings. The story based virtual seminar is statistically significant higher (.05 level of significance, t-test statistic) rated than the traditional virtual seminar. The agreement level on the five point scale (see Figure 5) for 2 is "is less true" and for 3 "fifty—fifty".

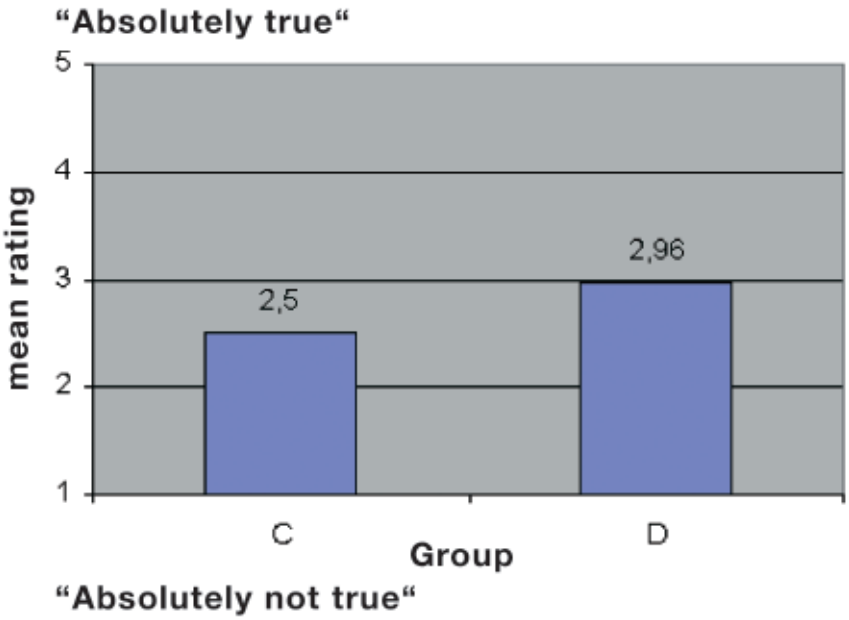

Figure 7: mean ratings of agreement with the statement " This seminar was more fun than an usual seminar" or group C and D

5.2.2 Motivation

One main purpose of D.E.S. is to facilitate intrinsic motivation in order to learn via e-learning seminars. The question is whether the intrinsic motivation is supported by story based virtual seminars compared to traditional virtual seminars.

Three questions were taken from the Intrinsic Motivation Inventory (Deci & Ryan, 2000) and adapted to this study. Table 1 shows these questions. There is no significant difference (.05 level of significance, t-test statistic) between the two groups for all three questions. The mean rating category of agreement for question statements 1 "the seminar motivated me more for independent working than an usual seminar" and 2 "This type of seminar encourages more intensive examination of the learning content than an usual seminar" in both groups is "fifty—fifty". Statement 3 "this type of seminar arouses interest in other material" was rated as "is less true" in both groups.

Nr.	Statements on learning motivation	C*	D*	Significance
1.	The seminar motivated me more for independent working than an usual seminar	3.07	2.98	Not significant
2.	This type of seminar encourages more intensive examination of the learning content than an usual seminar	2.97	2.61	Not significant
3.	This type of seminar arouses interest in other material	2.38	2.37	Not significant

* mean rating of the question statements

Table 1: Statements on learning motivation adapted from intrinsic motivation inventory (Deci & Ryan, 2000)

5.2.3 General Acceptance

Whether story-based e-learning seminars are accepted was another important question. Therefore, question statements were defined to assess the acceptance of the D.E.S. approach for virtual seminars.

Two question statements asked for a rating of general acceptance of story based virtual seminars.

The first statement was "I think it is a good idea to present the learning content of a seminar as a story". The result was, that 63% of the group D participants rated this as "absolutely true" and "quite true" (median is 4 "quite true"). Figure 7 shows the distribution of the rating result.

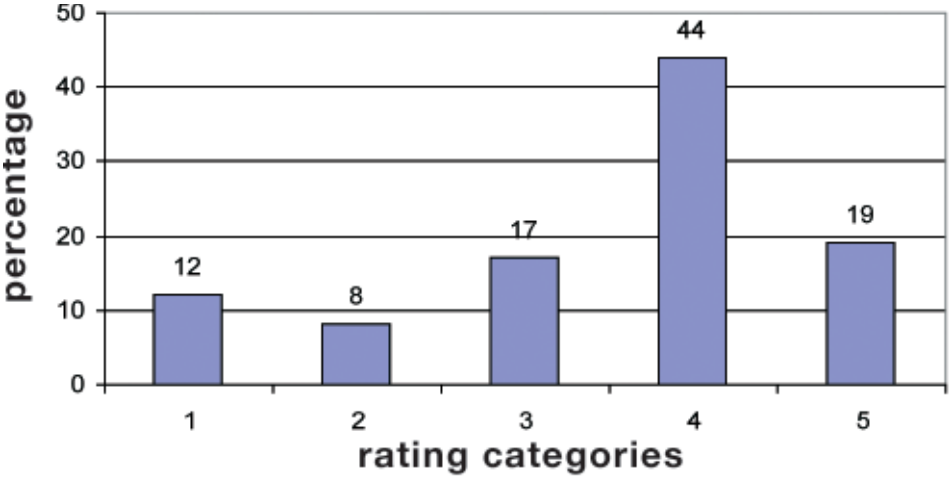

Figure 8: Percentage of the rating categories 1 to 5 (see Figure 5 as well) in group D for the statement "I think it is a good idea to present the learning content of a seminar as a story"

The second question statement on acceptance was "story and learning do not fit". This statement is a negative formulation concerning the fit of the use of a story for learning purposes. The result was that 66% rated this statement as "less true" and "absolutely not true" (median is 2 "less true"). Figure 8 shows the distribution of the ratings.

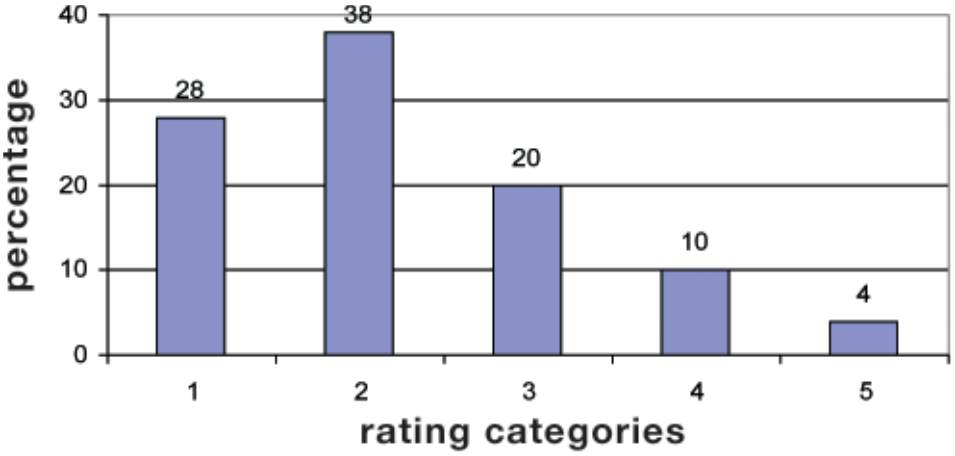

Figure 9: Percentage of the rating categories 1 to 5 (see Figure 5 as well) in group D for the statement "Story and learning do not fit"

5.2.4 Acceptance related to the implementation of the story based seminar

After having tested the general acceptance of story based seminars, it was important to check how the quality of implementation of the story-based e-learning seminar was rated.

The questionnaire contained three statements concerning the implementation of the story.

The first question statement was "if the story is well implemented I would enjoy a story-based seminar". Based on results of the qualitative interviews, we suspected that the implementation of the story was not very good. The purpose of this statement was to separate the actual implementation from the general acceptance. 70% of the participants rated this statement as "absolutely true" and "quite true" (median is 4 "quite true"). The percentages of the categories according to the statement are shown in figure 9.

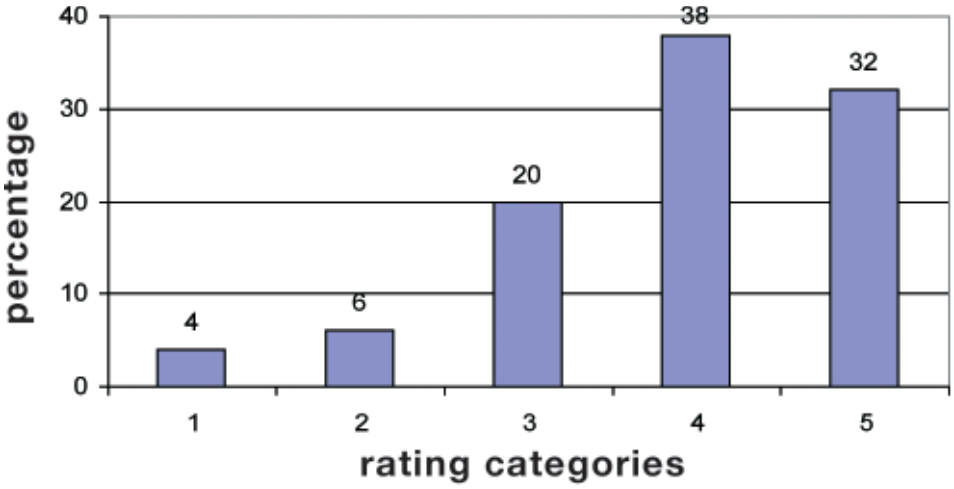

Figure 10: Percentage of the rating categories 1 to 5 (see Figure 5 as well) in group D for the statement "If the story is well implemented I would enjoy a story-based seminar"

The second statement focused on the excitement of the story. It was "the story was exciting". The result shows that 68% of the participants in group D rated this statement as "less true" and "absolutely not true" (median is 2 "less true").

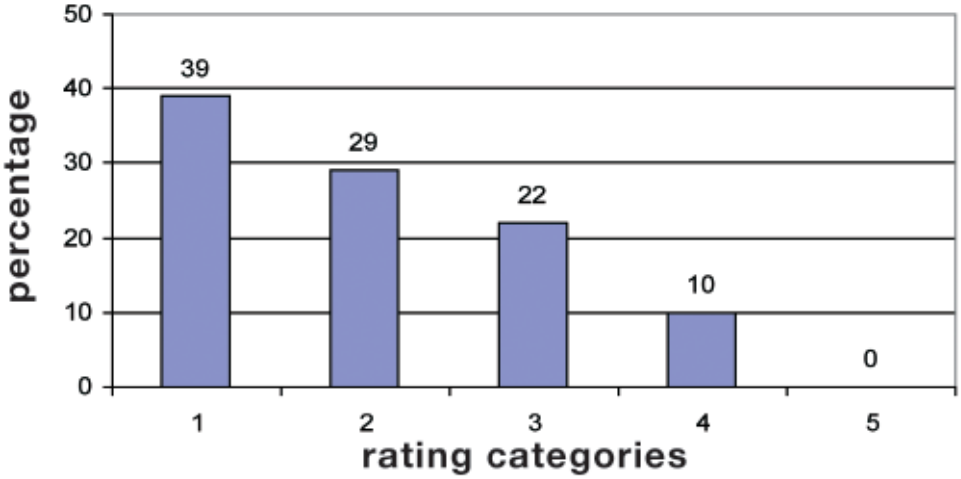

Figure 11: Percentage of the rating categories 1 to 5 (see Figure 5 as well) in group D for the statement "the story was exciting"

In order to bring some mystery to the story, the story was told in a very realistic way so that sometimes it was not clear what is real and what is fiction. At the beginning of the seminar all participants of group D were informed, that everything in the story was fiction. But after that, the participants of the seminar were integrated into the story as e.g. consultants of Thomas Jung etc. Therefore, it was an important question, whether the story is believable or not. The statement "the story was believable" was rated as "less true" and "absolutely not true" by 72% percent of the participants of group D (median is 2 "less true").

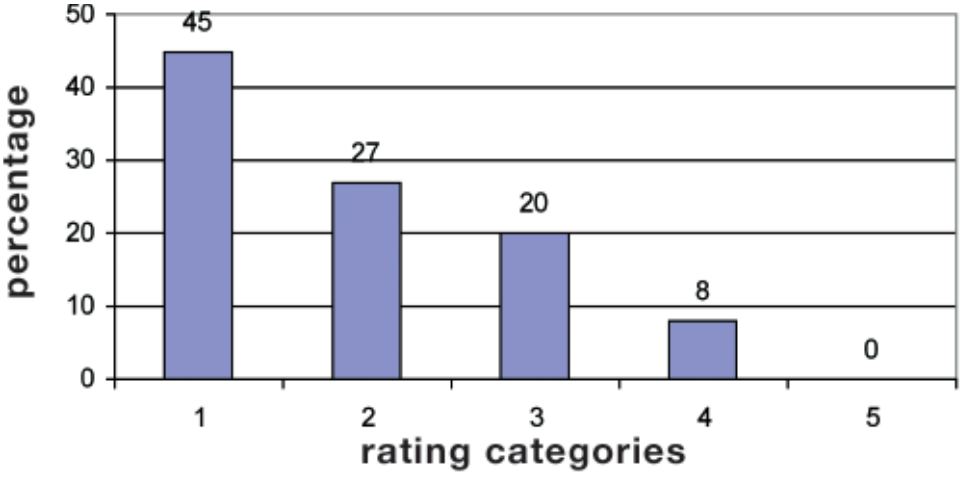

Figure 12: Percentage of the rating categories 1 to 5 (see Figure 5 as well) in group D for the statement "the story was believable"

5.2.5 Learning success

A first assessment of the learning success in both groups can be done on the basis of the knowledge test described above. 64 students of the Classic group and 50 students of the D.E.S. group participated in the knowledge test. The knowledge test scores were compared on the basis of an average comparison (t-test statistic). The result was that there was no significant difference between the mean knowledge test scores of both groups (.05 level of significance, t-test statistic). Figure 6 shows the mean scores

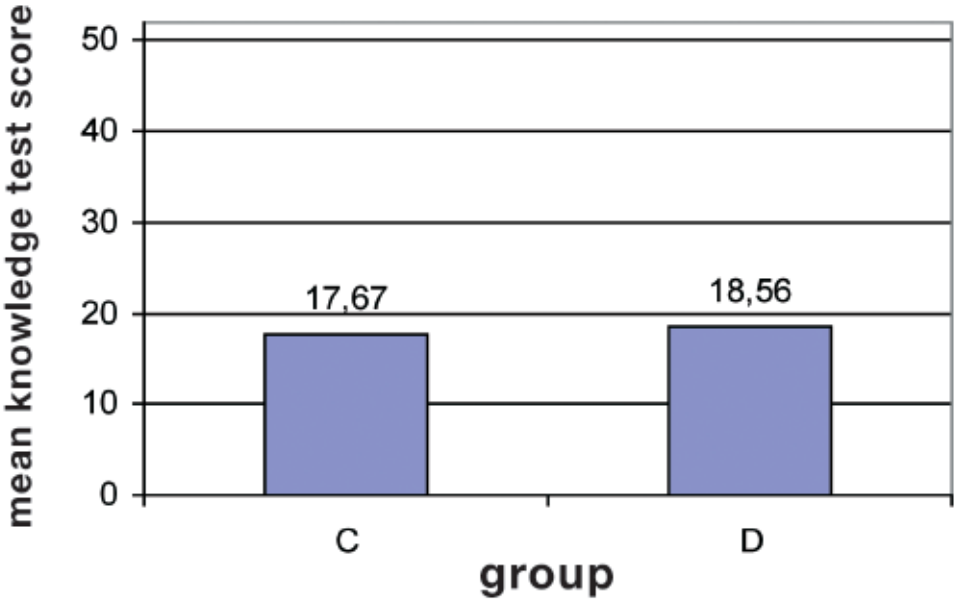

Figure 6: mean scores of the knowledge test for Classic (C) and D.E.S (D) groups

6.0 Discussion

6.1 Positive Emotions

There was a significant difference between the two seminar groups. The story-based seminars shows a higher score of fun than the traditional seminar. The overall value is not very high. The agreement of the participants to the fun statement (see Figure 6) is just "fifty—fifty". This is not very high. Here it becomes clear that several improvements of the D.E.S. method and its implementation in seminars are necessary.

6.2 Motivation and acceptance

On the one hand we saw that there was no significant difference between the groups concerning the motivation statements. The conclusion is, that there is not motivational advantage of the story-based approach compared with the traditional approach. In both groups the level of motivation is just medium, which is not convincing as well. On the other hand we find a clear acceptance of the story based approach (see Figure 7 and Figure 8). One reason of the small value of motivation might be that the story was not implemented very well. This can be seen by the agreement to the statements "if the story is well implemented I would enjoy a story-based seminar" (Figure 9) and the disagreement with the statements "the story was exciting" (Figure 10) and "the story was believable" (Figure 11). This is supported by the qualitative results as well, since the curiosity died when the fictional character became obvious. Furthermore, the story and its main character was not seen as believable. The inconstancies between a playful story-based approach and performance rating by marks hinder intrinsic motivation.

Also from a theoretical standpoint some explanations concerning the low intrinsic motivation level can be found. According to the self-determination theory of Deci & Ryan (2000) three requirements for intrinsic motivation are important:

1. Learners need to have the opportunity to perceive themselves as competent and to feel self-efficient.
2. Learners must have the opportunity to determine their learning by themselves.
3. Learners must learn together with others (social involvement)

Social involvement was part of our setting, but regarding the two other points we can say, that there were deficits in the story-based seminar. The deficits for requirement one were, that there was a lack of feedback from the lecturer and there was no possibility to influence the story. The students just could give advice as consultants, but not affect on the story line. Furthermore, for requirement two of the following deficits could be identified. First of all, the story and the tasks for students followed a weekly time pattern. Therefore, there was not enough freedom in organizing the work. Second, the learning goals and the content to be learned were predefined by the tasks and the story. Students had little opportunity to follow their own interests. Third, they worked in predefined working groups, so they could not choose their learning partners.

6.3 Knowledge test

The result of the knowledge test is not very encouraging. First of all, there is no significant difference between the mean knowledge test scores of group C and group D. Second, the overall level of the test score is not very good. The maximum score was 52 points and both groups reached around 18 points. A reason for the overall level is that the knowledge test was not relevant for the student's marks. Therefore, the motivation to learn for the test or to work hard on the test might be quite low.

Obviously, concerning the learning success the story-based approach has no advantage over the traditional approach. Possible explanations will be discussed in the context of motivation and acceptance.

6.4 Conclusions

From the results the following conclusions can be drawn:

- Story-based virtual seminars are accepted on a university level.
- The story-based e-learning seminars should give the students more freedom in organising their learning and following their own interests.
- The whole dramaturgic seminar must present all elements in a consistent way. This means that there must be no breaks between story, content (e.g. hypermedia system), seminar interaction (co-operation of students as well as co-operation between students and story characters) and communication (e.g. feedback from the teachers or tutors). Everything must be integrated in a dramaturgic structure of a convincing story.
- The dramaturgic seminar must fit in the organizational and administrative structure of a university, e.g. performance assessment is not really compatible with a playful approach towards story-based learning.
- The story must be appropriate for the target group and must have a professional dramaturgic structure.

Future studies must show, that by better implementation of the story-based e-learning approach, the learning success is better than for other e-learning seminars.

7. Acknowledgement

A special thank you to all students who were involved in that study as participants of the seminar groups C and D as well as story writers and interviewers. Thank you very much for all the engagement and a lot of work done.

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Quality in eLearning and quality of learning games

Claudio Dondi and Michela Moretti

Keywords

Quality, eLearning, learning games, quality stamp, criteria

Abstract

This paper is focused on the quality of learning and teaching processes by new technology and methods such as eLearning and game-based learning. It is structured in four main parts:
The first one is aimed at briefly presenting the results of the ongoing debate on the quality of eLearning at European level. The second is focused on showing how the game-based learning can answer the needs of the Knowledge Society; the third illustrates a framework for assessing the quality of digital learning games developed within a European funded project. The last part concludes the contribution by presenting some relationships amongst eLearning and learning game sectors and some final remarks.

1. Quality in eLearning in the European scenarios

Information and communication technology (ICT) offers many advantages to the educational sector not least by providing an endless range of formats and mediums for communication and creation/exchange of large amounts of information and knowledge. However, despite enormous potential there is an ever present need for quality and reliability in teaching and learning services provided by eLearning experiences. This need relates to both the users' requirements and also to ensure its acceptance among the educational and training communities as a whole.

It must be remembered that distance learning (the predecessor of eLearning) was originally conceived as a "second chance" approach to education that resulted, almost inevitably, that it would also considered a "second choice" solution in the eyes of most learners and teachers. The evolution of technology together with increased demand and supply has made it abundantly clear, to even the most orthodox academics, that eLearning is not necessarily associated with "poor" quality. There is plentiful evidence that through individualization, internationalization, flexibility to address the needs of users, and the ability to provide professional community building, eLearning can produce better quality results (at least as perceived by users) than conventional teaching, in which these characteristics are not usually found. Nevertheless quality in eLearning is not always assured and agreed. eLearning product/service providers find themselves in a competitive and constantly changing commercial environment where the final judgement of the suitability, meaningfulness, relevance and quality of the services provided is usually determined by the end user. For those involved with eLearning in the educational/training sector, this setting differs greatly from that of traditional education where the learners are provided with a learning experience on which they are unable to exert any great degree of control (Scienter, 1998).

ELearning educators have now to be concerned with the learners' specific needs and requirements and the quality of the service provided, which ultimately determines the success, uptake, and development of any particular programme or course. ELearners will not choose or continue to use a specific course or programme if it fails to meet their needs. The learners are unlikely to choose to be involved in a eLearning experience again if their first exposure has been negative. This happened in many cases and contributed to the slow eLearning market growth and related expectation of investors. So quality, (or better the perceived lack of quality) has been one very strong inhibiting factor for eLearning adoption.

The increased specialization and technological complexity of today's world presents many challenges. In general people have the opportunity to be more informed and to that end learners are generally more aware of the specific requirements they need. Learners take up courses with specific objectives in mind, e.g. licensing examinations, specific job functions, new company skills/ requirements etc. Distance educators must attract and engage with the end user; otherwise they will fail to survive in this commercially competitive and learner-driven environment.

With the emergence of new forms of learning in the so-called Knowledge Society and the pervasive character of ICT in most of the education and training systems, quality, in its broad understanding, is becoming the catalyst for excellence, openness, and increased opportunities for learning in our societies. In this context, quality in eLearning is going to be a long-standing aim for the social stakeholders and especially education and training institutions, in their quest to sustain learning opportunities for real added value for European citizens (Boonem & Petegem, 2005).

As it has emerged from the analysis of the European scenarios; different initiatives, institutions, and groups in education and training environments have designed and delivered tools, to assure or to promote a culture of the quality in eLearning (Dondi & Moretti, 2005).

Some key elements of difference can be underlined:

Quality is a concern for all the stakeholders.

Without quality, learners may not achieve specified objectives, fail licensing examinations, perform poorly on critical job functions, leave dissatisfied with their experiences and tell others to avoid specific courses or programs. Without quality, educators may find it difficult to attract and retain learners, experience difficulties facilitating and managing the e-learning process, receive poor student evaluations and fail to demonstrate an adequate return on investment. High quality programs are also necessary to demonstrate that e-learning is a legitimate form of training and education.

The concept of quality is a complex concept.

The concept of quality applied to eLearning is a complex one and must always take into account plural perspectives: there cannot exist a unique vision (one size fits all) of quality that can be considered the best one. This implies that quality has a "subjective", "contextual" and "objective" component. The latter involves defining a set of common criteria by which the quality of e-learning can be assessed, but it is certain that the weight or significance that different stakeholders attribute to the quality criteria will differ greatly. Therefore quality can be only derived from a process of negotiation, mediation and agreement among the different stakeholders.

The way that stakeholders approach and see quality in eLearning is different.

The difference emerges not only between education and industry sectors, but among the stakeholders belonging to the same sector. In particular, if we look at the industry and educational approaches we can note that: increasing quality from an industry perspective means reducing variance around set standards. Industry standards are defined primarily to assure the technical quality, reusability and interoperability (or sharing) of much smaller units of instruction called learning objects, rather than courses and degree programs. The primary difference is that education guidelines focus on the quality of e-learning courses and programs, whereas industry standards concentrate on the technical quality, reusability and interoperability of learning objects. Nevertheless, if you look at the experiences carried out with the education sector, it can be noted that the emphasis given to the different eLearning elements is not homogeneous. Quality seems to be in the eye of the beholder.

Quality varies tremendously within the eLearning courses and training programs.

Despite efforts and existing quality tools and approaches the delivered and perceived quality of the initiatives (course, materials/resources) is very different. There is a lack of understanding of what exactly is meant by the "quality of learning" (let alone in relation to eLearning). In this respect not all Learners have reached a stage where they are capable of defining concisely their quality needs or requirements or providing an explicit statement regarding learning quality. In order to be able to ask for a quality eLearning experience, users must be in the position to recognise what constitutes quality (or indeed the lack thereof). In other terms they need to have "quality literacy". Recognizing quality involves a raised awareness of what learning implies and also an increased familiarity and knowledge of what an eLearning course should provide and what learners should ask for SEEQUEL (2005).

The focus of these quality initiatives/approaches/framework diverge

It ranges from eLearning materials to services, from the user perspective to the institutional perspective with some specific actions to the regional and societal perspective.

2. Game based learning and the Knowledge Society

The Lisbon European Council (March 2000) set the European Union the strategic goal of becoming the most competitive and dynamic knowledge-based society in the world (European Parliament, 2000). This goal was further reaffirmed at the Barcelona European Council in (March 2002) which provided a mandate to make European education and training a world-wide reference by 2010 (Barcelona European Council, 2002). Teachers and educators in general are facing greater changes in their job/profession due to the increase complexity and demands from the society and as well as the changing needs of students' and their different attitudes toward learning and knowledge acquisition as a whole. Taking into consideration these demands, teachers are required to promote five main pillars of education:

1) **learning to know** (it is intended that students discover and master knowledge-seeking skills that will serve them for the rest of their lives),
2) **learning to do** (the challenge facing education today is to find methods that will succeed in transforming school knowledge into practical competence),
3) **learning to live together** (it is a means of facing the challenges presented by social, economic and political globalization of the world and requires that citizens have the capacity to understand that their actions will have far-reaching effects on those around them. It also means being able to under stand that differences in culture exist and are legitimate and can represent a source of enrichment)
4) **learning to be** (provide opportunities in which students can express themselves and both their beliefs and view points),
5) **learning to learn** (students self discovery of the best way of learning and joy of learning as a process from which can derived pleasure, satisfaction, motivation and empowerment at an individual/personal level).

In addition, if we look from a different perspective such as: training for adults and lifelong learning, the policy guidelines, principles, concerns and priority recommendations presented, as example, in the Report "e-Inclusion in the framework of eEurope: new Perspectives, New European Policy Agenda (eEuropa Advisory Group, 2005) underline that the one of the main factors of the Digital Divide is related to "Disabilities and Education and Skills" (level of education, ICT literacy, competence and learning abilities, use of ICT in specific professions)".

These policy priorities clearly highlight that there a quite large group of workers, the majority of whom have little education qualification, IT competence, and rarely take part in life-long learning path are at the greater risk of being marginalized from both labour market and society at large.

The game industry is one of the fastest growing, which has lately drawn the attention of policy makers in the EU. Especially under the Danish presidency it has been a hot topic, and the Danish media have produced several items on the potential of computer games. The latest development is that the EU Commission has now passed a resolution with the intention of securing the communication of European cultural values through interactive media, especially computer games (Egenfeldt-Nielsen, 2003).

It must be underlined that research findings have illustrated that the attributes of **computer/online and video games** are coherent with the way people learn and they can act to create effective active learning environments. In this respect **game-based learning can accommodate different learning styles**: games provide players with a continuous variety of emotional conditions or psychological stimuli. Players can learn through performance or learning by doing, active learning, or experiential learning. Such learning methods overcome many of the limitations associated with learning by static learning situations, in which the knowledge gained is not often directly transferable or applicable to the real world or to unfamiliar scenarios. The learning experience being active, naturally promotes active discovery, feedback and stimulation.

In addition the use of games can support the process of learning without remaining dependant methods that have not been perceived as effective and positive in meeting learners' aims. Game environments can offer a non-linear, immersive environment, active performance-based setting into which there is the potential to incorporate varying levels of complexity as well as to support the development of Strategic Thinking, the use of Logic, Memory, Problem Solving and Critical Thinking Skills. These conditions might include satisfaction, desire, anger, absorption, interest, excitement, enjoyment, pride in achievement, and peer recognition to name but a few of the complex mix of psychological conditions that influence motivation.

Games, in particular team-orientated games and those incorporating multiplayer systems, are social environments, sometimes involving a distributed community. Multiplayer systems and games requiring external information-inputs necessitate collaboration, communication and the concomitant development of social skills

and teamwork amongst the players. Learning becomes a social and participatory process with the potential to be carried out on a vast scale, and with high feedback levels. Through the provision of various feedback mechanisms, games provide the player with the opportunity of self-evaluation and assessment. Regular use of these functions helps to develop their self-analytical skills. These skills help them to identify their strengths and weaknesses and adopt an independent, self-directed approach to their own personal learning and improvement (Pivec, Koubek & Dondi, 2004).

Despite the results from extensive research on the usage of game-based learning, the educational/vocational training and lifelong learning practitioners have very different attitude towards therefore to game-based learning. If we use for example their attitude toward ICT, we can say that, there was and still is substantial resistance to adopting and using ICT by the majority.

Teachers reacted to and are still reacting to the introduction and usage of game-based learning in different ways, for example:

- The ones, who are using game-based learning as an integrative methods for their traditional teaching. They have understood the potential of the methods and the higher value in supporting motivation and in developing skills.
- The ones, who are using only a specific type of games (many of them do not consider a game) like simulations (for specific subject-matter) but they are reluctant to try other typologies.
- The ones, have never used game-based learning in their teaching and they are reluctant to use these products since they haven't seen any "good quality" ones, they do not consider "game-base learning" a "serious approach" or "they are not fully aware of the potentiality of this approach and they a reluctant to change".

As in the eLearning sector, **the issues on "quality" of learning games** came up during the last years. The broader adoption and usage of games in the formal, non formal and informal sectors also depends on the **assurance on the quality of learning games as well as the availability of good practices and experiences of the usage of games in teaching and learning processes.**

3. SIG-GLUE quality stamp: an initiative to support the evaluation and the certification of the quality of learning games

Within the SIG-GLUE project (Special Interest Group for Game-based Learning in University and life long Learning), supported within the eLearning Initiative of the European Commission, a framework for assessing and certifying the quality of digital learning games has been designed and tested, and from May 2006 becomes an available service for those who want to have the quality of their games certified. (http://www.sig-glue.net).

Having established from the beginning that the quality of a learning experience does not depend exclusively from the quality of teaching or learning resources but depends also on the processes involved and on the context in which the experience occurs, the SIG-GLUE partnership considered it important to make an effort to develop an evaluation quality framework (criteria, evaluation tools and processes) for digital learning games.

For learning games it means games which have an explicit "learning" purpose and can be used, adapted and adopted for supporting, improving and fostering processes within formal, non formal and informal learning scenarios. The quality stamp focuses on: fully developed games already used or to be used in learning and teaching processes. These games are eligible for obtaining the "SIG-GLUE quality stamp". The list of criteria presented below (Table: "Quality criteria for learning games"), which represents the SIG_GLUE quality criteria for Learning games, has benefited from the experiences acquired from two previous outstanding initiatives : Cerfad Initiatives (1995-2004) and SEEQUEL Project (SEEQUEL 2004, standing for Sustainable Environment for the Evaluation of Quality in E-Learning supported by the European Commission—DG Education and Culture—2003-2005).

The SIG-GLUE Partnership has decided to identify different criteria in three different area: methodological and context , content and technological. This choice does not mean that the SIG-GLUE Partnership is not aware of the links between the different areas, but rather that there is a need, in the present situation, to have adequate and qualified "points of view". The analysis and evaluation grid which is derived by the criteria has been tested within the SIG-GLUE project life-cycle and it is now used by the SIG-GLUE Quality Commission for assessing and certifying the quality of educational games.

As mentioned before the quality the criteria have been divided into three different areas: methodological and context, content and technical. The criteria have been articulated in different sub-criteria. The full description of the criteria and the sub-criteria is presented in the "Guide to Quality criteria of Learning games" which will be available on the SIG-Glue project website from May 2006 (SIG-GLUE, 2006).

CRITERIA
Pedagogical and context criteria
Target groups and prerequisites
Identification of target groups
Identification of prerequisites
Learning objectives
Clear definition of objectives
Correspondence between established objectives and the objectives that can actually be reached by using the learning game
Context of usage
Clarity of practical instructions for the use of the learning game
Indications/suggestions on the context in which the learning game can be used
Coherence of the game with the targeted context
Coherence between the learning game structure and the planned training and learning context
Link between the learning game activities and the professional/working context
Didactic strategy
Indication of the average play time
Incentives and support to motivation
Support for engagement and fun
Coherence between the game strategy and learning objectives
Quality of the game strategy with the individual player characteristics
Clarity of the game environment/ setting

Organization and structure of the learning game
Clarity of the rules to be followed and decision making process
Coherence between rules and consequences
Constant focus on the player experience
Clear definition of roles (e.g. players, instructors, animators, etc.)
Coherence of the social and collaborative activity with the objectives
Communication and media
Clear and user-friendly tone and language
Quality of the interaction between the learning game and the user/player
Quality of the interaction amongst users/players/etc.
Coherence between the media used in the learning game and the contents, the established objectives and the target group
Evaluation
Clear identification of evaluation criteria and procedures
Adequate number and distribution of evaluation activity, during the game and at the end
Type of evaluation activity proposed
Quality of the feedback to the evaluation activity
Relevance of evaluation activity and consistency with the objectives and/or the contents
Support to the reflexive process (e.g. players can review and rethink their performance)
CRITERIA
Content criteria
Correct technical/scientific language and contents
Updating or obsolescence of contents
Correct and logical organisation of contents
Link between the contents and the subject area/knowledge domain/curriculum

Practical contextualization of the content
Correct balance of the context in relation to the target group
Coherence of contents with the established objectives and the target group
CRITERIA
Technical criteria
Credits
Information on the producers, authors, etc.
Portability and conformance to standards
Robustness of the game
Conformance to standard
Structure and organization
Ease of installation (for offline digital games)
Modularity of the design
Modularity in use
Aesthetics and usage of the media
Quality of user/game interface
Possibility of intervention on the use of materials (stop, rewind)
Positioning of the different elements on the screen
Technical quality
Quality of image definition
Quality of image composition
Rhythm of images
Quality and definition of audio
Integration between audio and image elements
Synchronization between audio and image elements
Quality of typographic characteristics and clarity of texts
Quality of typographic characteristics and clarity of texts

Technical quality of drawings
Technical quality of pictures
Technical quality of graphic animations
Information produced
Privacy and security of personal data
Storage of the game play
Storage of evaluation and activities results (e.g. save progress)
Print of the information

Table 1: Quality criteria for learning games

Quality in eLearning and quality of learning games: final remarks

If ones analyses the criteria identified above and the issues presented in the whole contribution, some general remarks can be derived:

1) Any digital resources which are employed in learning and teaching processes should meet quality criteria related to methodological/context, content and technical areas. The importance of each area depends on the overall design of the learning experience and the role attributed to the resources themselves.
2) It goes without saying that, as mentioned before, the learning resources are only one component of the experience: the processes involved and the context in which the learning is taking placed, play a fundamental role in the success of the learning.
3) The comparison between the criteria used to assess the quality of eLearning resources and the ones specifically targeted to evaluate learning games shows that there are some specific criteria which are strictly linked to the nature of the game-based learning, just to mention a few: support for engagement and fun, clarity of the rules to be followed, clarity of the game environment/ settings, etc.. These criteria are very relevant when assessing learning games because they refer to features which are deeply embedded in the game design and they are specific to this typology of product. Nevertheless, since we are referring to learning resources and not simply entertainment products, the quality of some aspects (e.g. definition of the objectives, coherence between the game strategy and learning objectives, etc.) which are relevant to any didactical and methodological resources should be met. In other words: a

learning game should be a "good game" thorough which the player will achieve the stated learning objectives.

4) The need for assuring quality in eLearning as well as in Game-based learning is very high. It is probably higher in game-based learning where cultural, psychological and social resistance can be overcame only by showing that the games are "serious", "reliable" and "effective" in supporting the learning and teaching process.

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Digital games are a significant element in the digital media and information society. They influence the development of media technologies as well as interface design, online social interaction and new evaluation approaches. The game industry develops not only products for leisure, but also for work and learning, with many dimensions in the area of social life, knowledge acquisition and application, gaining of soft skills and of other experiences. Digital games attract researchers from different science fields e.g. sociology, cultural studies, educational theory, psychology, computer science, etc.
The Fourth Symposium for Information Design focused on the question of how game based learning environments can motivate and stimulate learners in different situations, and improve learning. It presented didactical and pedagogical issues, as well as actual examples and concrete applications.

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