GAME-BASED LEARNING USING WEB TECHNOLOGIES

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ABSTRACT

Game-based learning has been recognized as an important alternative or supplement to traditional in-class, face-to-face teaching. It can help both adults and children in learning new concepts, acquiring expertise and practicing knowledge. Although game-based learning has been applied mainly for teaching children, it can be quite helpful for adult vocational or university learning. In this paper, a web-based game is presented, which has been developed for enhancing the learning experience of university students. Its goal is to serve as a complement to classes, although it can be used independently. It provides the students with many ways of synchronous or asynchronous communication and knowledge acquisition. Through the game, students have to search for information, understand it and use it in discussions with the members of other teams. Many users are able to play the game simultaneously, while many teachers may run different game themes. Microsoft's ASP.NET scripting environment was used for creating the game's website and its rationale. The website utilizes also Macromedia's communication technology (Flash Communication Server MX) for enabling real-time communication by several means (voice, text, etc). Flash was used in the website for building the real-time communication modules as well as for creating a more elegant user interface.

INTRODUCTION

Game-based learning has been widely adopted for children's learning. Pedagogically highly valued products are on the market and have a proven success in the improvement of learning as well as in children's acceptance. Recently, game-based learning has also been proposed for adult education. Gaming is becoming a new form of interactive content, worthy of exploration for learning purposes. Universities are also looking for a new positioning in the changing setting of lifelong learning. Universities need to develop innovative forms of learning in order to provide concepts for lifelong learning to their prime customers, students. Modern technology requires its employees to be proficient in effective communication, teamwork, project management and other soft skills such as responsibility, creativity, micro-entrepreneurship, corporate culture, etc. Game-based learning is an approach to tackle the above issues.

Analysis of the current situation in the field of the game industry shows that at the same time, new multiplayer environments give opportunities for the interaction of thousands simultaneous players. The multi-user environments enable users to participate in real-time events, experiencing new

ways of communicating and interacting. In January 2003 a record number of 120,000 users simultaneously played EverQuest, an online role-playing game (Rowan 2003).

There are many examples of systems that adopt the game-based learning concept. In this paragraph the most important of these applications are presented. A more detailed description of the related work can be found in (Pivec et al. 2003). TopSim (TopSIM 2002) by TERTIA Edusoft provides different business games, which have been used in business education and advanced training. Another web-based game is Myzel (Myzel 2002), an on-line community game. The rules of this game are created by the players themselves, during its conduct. The Monkey Wrench Conspiracy (Monkey Wrench Conspiracy 1999) videogame tutorial puts players into the role of an intergalactic secret agent dispatched to deep space to rescue the Copernicus station from alien hijackers. It is a complete tutorial for a complex technical product, designed to teach industrial engineers how to use new 3-D design. The Environmental Detectives (MIT and Microsoft 2002) was developed by MIT (Massachusetts Institute of Technology) and Microsoft within the Games-to-Teach project, where conceptual prototypes for the next generation of interactive educational entertainment are developed.

Various examples on game-based learning, supported by the new digital technology are provided by Prensky (Prensky 2001). More detailed information on various games suitable for educational purposes can also be found in a Survey on online game-based learning (Dondi and Moretti 2003) that contributed to the UniGame project.

Based on the fact that games fascinate people and by applying elements of collaborative learning, researchers of the FH JOANNEUM Graz in the framework of the EU project UniGame created a new game concept. Searching for information, selecting the appropriate and necessary information, development of discussion strategies, "conflict" of the arguments, decision-making process and negotiation are the important central aspects of the game. But the target and the culmination of the game are reaching a consensus in a problem solution. Players learn to understand and to combine different points of view, such as: individual/corporate interests versus team/societies interests; their own standpoint versus understanding the standpoints and opinions of others; from single aspects versus integrating of multiple aspects, from confrontation to cooperation. By playing different roles students learn and obtain both basic knowledge and practical experience and soft skills that are needed for the organizations of the modern industrial manufactures. The developed game concept can be seen as a template where different instructors can introduce different knowledge and contexts to apply game-based learning for their particular topics and specific learning goals.

This paper continues with the description of the game in the second section. The game idea, the game scenario, the main interface areas of the game and some possible use cases are the issues highlighted there. In the next section, the architecture of the game platform is presented by describing the functionality of the different layers of the architectural structure. Then, the fourth section analyzes some implementation issues regarding the technological choices that were made for building the game platform and the selection of the most efficient methods in order to implement the desirable functionality. This functionality is divided in two main sections: the user's side and the teacher's one. The methodology used in order to provide the teachers with the powerful tools in order to create and distribute the content of the games is presented and the Unigame Theme Description Standard constructed by CTI, is analytically being described in this section. In the fifth section our future work plans are presented and finally the paper ends with the conclusions, which came up during the design process of the game concept and the development period.

UNIGAME: SOCIAL SKILLS AND KNOWLEDGE TRAINING

Game Idea

"UniGame: Social Skills and Knowledge Training" (UniGame 2003) is a framework that provides the possibility for every interested teacher to apply game-based learning to his/her classes. "UniGame: Social Skills and Knowledge Training" is a game where teachers are able to define various topics. By using this method, the game provides the teachers with the ability to modify most of the game's parameters in order to meet certain educational purposes.

It can be classified as a role-play game, that fosters participation in problem-solving, effective communication, teamwork, project management, as well as other soft skills such as responsibility, creativity, micro-entrepreneurship, corporate culture, etc. The game is based on constructivist learning approach and collaborative learning. Its fundamental aim is to be used additionally to regular face-to-face or online classes, while its separate use from any class source is feasible.

The game is web-based, thus it is accessible through a website, providing the users with the opportunity to join and participate in the game from different places. Also, it is a multi-user game; therefore many players are able to be involved in the game simultaneously. The players form four teams. Each team is comprised of six players maximum, depending on the game's topic. The game is moderated by the teacher (as it has been already mentioned, the game is designed to be used as supplement to normal in-class teaching, but it is not impossible to be used independently from a class course). Each game is described by a specific theme created by the teacher. The aim of the players is to comprehend their specific role inside their team and have an argumentation with the players of other teams over a specific subject, which is specified by the theme of the game. The players gain knowledge over this subject by searching for information and using it in the discussions that follow with other teams' members. The game's platform offers several means for communication to its users. Users are able to communicate with each other by using private or public forums, both text and voice chat modules and virtual meetings, which are enhanced by audio/video interaction, a shared whiteboard and a presentation table, where users are able to create an on-line presentation. All the above-mentioned functionality is provided to the users in the public forum or chat areas and in the teams or the common virtual conference area.

The game ends when all the specified sub-parts of the selected subjects have been discussed. In each discussion the goal of the players is to reach a consensus with the other teams. If they reach a consensus they gain some points (chips). The amount of points they can win from each discussion has been specified by them before the beginning of the discussions, when the 'chip allocation procedure' takes place. In 'chip allocation' each team allocates 100 points in total

to three of the six available sub-parts of the subject that will be discussed. The winner team is the one that has attained to gather the higher number of points when the game comes to its end.

Scenario of the Game

In this section important parts of the "UniGame: Social Skills and Knowledge Training" scenario are briefly outlined. More detailed information about all the possible game's scenarios can be found in the UniGame website (Dziabenko et al. 2003).

The game initiates by the teacher, who has to define the 'Game Theme' that provides the students with the assignments and subjects to be discussed during the game. The students join in the game's website to participate in the game. During the navigation in the website, the students/users are capable of communicating or searching for information about the particular theme. The playtime of the game varies, fluctuating from several days to few weeks, depending on the difficulty of the theme and the basic skills of the students. The game flow and its various stages are presented in Figure 1.
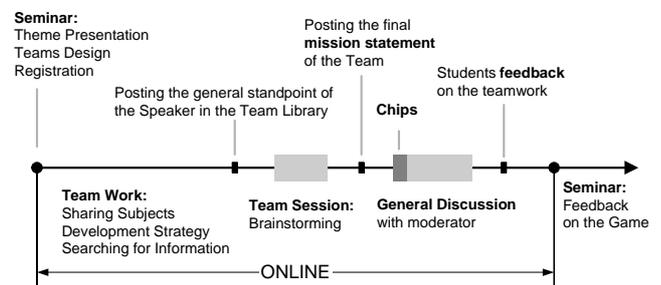

Figure 1: Time Plan of the Game

The basic stages of the game concept can be distinguished as they are presented in the next paragraphs.

Introductory Seminar
In this introductory seminar the teacher explains the theme to the students. The teacher provides information about the theme, the particular subjects (interest areas) of the subjects that are available for discussion, the teams that will be formed, and the roles within each team. The teacher discusses with the students about the theme and provides more information if requested. Finally, the teacher and the students reach an

agreement about how the teams will be formed and how the whole game process will be initiated and completed.

Team Work and Team Preparation

In order to play the game, the students form four teams. These teams are going to have totally different roles in the discussion that will follow. For example, in a theme about environment protection, the teams could be 'Government', 'Heavy Industries', 'Environmental Groups' and 'Labor Unions'. Each student has to select a particular role within his team. After that, the team members have to connect to the 'map of the Subjects', which are relevant for future discussions. In this screen each member of the team has to select a subject for which he/she will be responsible. Each team has to create a strategy for the general discussion that will take place with the members of the other teams as well as with the teacher (moderator) of the game. The preparation of the team for each subject has to be as perfect as possible in order to confront the other teams in the final general discussion.

During the teamwork, the players develop a game strategy, collect and select valuable information and prepare for the argumentation. Teams communicate and exchange information in the 'Team Space', which consists of several screens that allow synchronous or asynchronous communication of the members of a team (Forum, Virtual Conference, Library, Member List and MyInfo). Each team member uploads all relevant collected information about the subject he/she is responsible for, in the Library of the Team Space.

When search for information is finished, each team has to organize a 'Team Session'. This session enables students to discuss all the problems that came up concerning the subjects. Moreover, the members of the team have to categorize and rank all the gathered information that can be used during the argumentation process with the other teams, in order to use this information in the most efficient way to win the game.

At the end of the 'Team Session', the team preparation time has finished; consequently the teams have to present a final mission statement within the game platform. In this statement, the members of each team will outline their general standpoint.

Chip Allocation

Following the teamwork and preparation, the teams have to allocate chips (points) to the available subjects. Each team has to decide which subjects are more important for them. The team members can select up to three subjects for discussion. They have a maximum number of 100 chips that they must allocate to the three subjects they selected. The available time for the completion of this procedure is 30 minutes.

During the game the chips allocated to the subjects can be viewed by the members of the team in the screen. However, teams are not able to view the chip allocation of other teams.

General Discussion

The General Discussion is the process where all teams meet in the 'Virtual Conference' screen to discuss the subjects of the provided theme. In particular the representatives of each team participate in this conference. The discussions are moderated by the teacher. The aim of each discussion is to reach a consensus, while the specific role of the moderator is to formalize the reached consensus. If the moderator decides that the teams reached a consensus during the discussion about a subject, all the teams that had allocated chips in this subject win these points. These points are automatically added to their total score. The game winner is the team that gained the major number of points when all the subjects have been discussed. In this stage, the game ends but the educational process continues with the discussion of the game in a seminar.

Student Feedback and Discussion of the Game in a Seminar

This is the last stage of the learning procedure. The general discussion is followed by detailed feedback of all the players who participated in the game. This discussion contains a debriefing carried out in a seminar that highlights the most important aspects covered by the game.

Important Areas of the Game Website

In this section a brief description of the most important areas (screens or web pages) of the game's website are presented. Some of these web pages must not be accessible from all the visitors of the website. For this reason, the system specifies users' roles and rights, since there has to

be a distinction between visitors, players and teachers. These are the three different system users' categories and each one of them is able to access different web pages.

The description starts by describing the route of a simple user who registers and participates in specific game themes. In addition, some of the key functionality provided to the teacher in order to organise his game theme is mentioned. These pages are very important and are essential to the model of the presented web-based game.

The different sections of the game are designed in different colours in order to distinguish the different system roles. These sections are the following:

- Training (blue)
- Public (green)
- Players (yellow)
- Trainer (red)

The most important different areas provided by the system in the website are described in the following paragraphs.

Training and Help

These web pages are designed in order to provide the users with all the necessary guidelines on how to participate in the game. This section is composed of several screens which aim to help new users to join in a game, to get information about how to use it and finally to make a practice on how each player's game will be efficient. These pages are essential for the users' familiarity with the game's environment. One of these pages can be viewed in Figure 2.
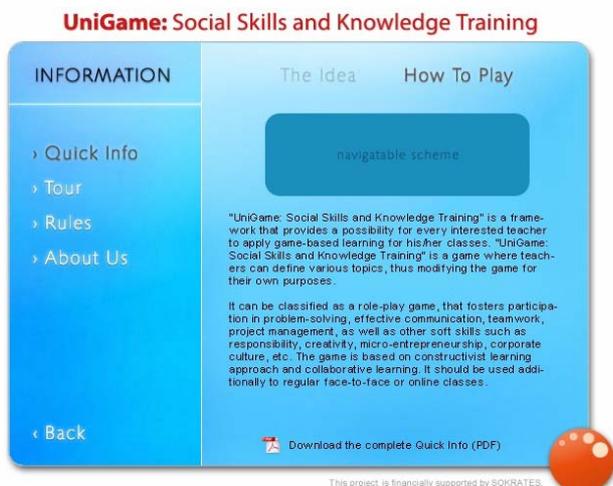

Figure 2: Training Area

Community Area

The Community Area consists of the game's web pages that can be accessed by all the website's visitors. It consists of two main spaces: the 'Community Chat' screen and the 'Community Forum' area. The Community Area can be used for communication among all the visitors of the game platform, even those who do not participate in a game. The communication can be synchronous (text chat) or asynchronous (forum). In Figures 3 and 4 the community (public) chat and the community (public) forum can be viewed respectively.
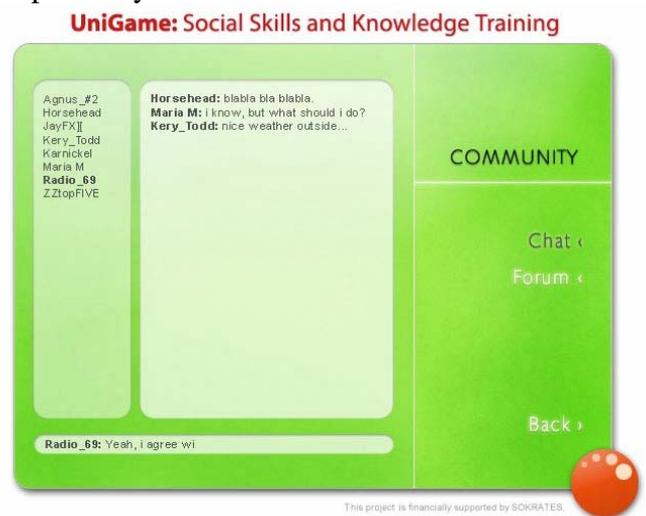

Figure 3: Public Chat

Figure 4: Public Forum

Registration Screen

The Registration Screen is a web page used for registration in the game platform. In this page, the user notifies its tension to participate in a game and provides the system with all the necessary information. This information includes user's personal data and options. Each user is able to choose which information is going to be visible by the other members of the game's platform.

Figure 5: Registration Form

Players' Personalised Home Area
A personalised home area is created for each user who is registered as a player. In this page each player can view all available game themes, join a selected theme, log-in the theme's game platform and view a record of the themes the player has already played (Figure 6).
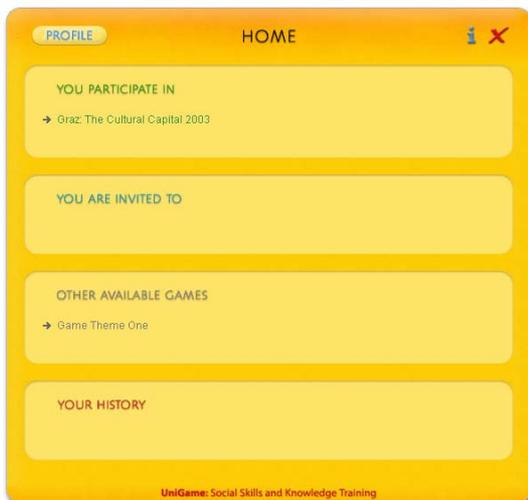

Figure 6: Players Personalised Home Area

Other Available Games
A Game Overview, called "Other Available Games", presents information for all the ongoing game themes and allows the user to ask permission for joining a new theme. The users who want to participate in a new theme must express their

interest through this page, and then wait for the teachers' invitation to join the game.

Seminar
Once the trainer has accepted a player's request for joining a theme the title of the theme appears on the personalized player home area under the title "You are invited to". There the player proceeds through the Seminar stage of the game, reads introductory information about the game's theme, is challenged to prove his/her knowledge by answering questions about the game's theme in the quiz area and is asked to select a team and a role.

Virtual Conference
The Virtual Conference is the area where a player communicates with the players of the own team (team/private areas) and with the players of all teams and the trainer (common/public areas). The following screenshot (Figure 7) shows a common General Discussion between players that represent their team in a Subject's discussion. Text chat, shared whiteboards, audio/video conference and presentation tables are the means of communication available to the players.
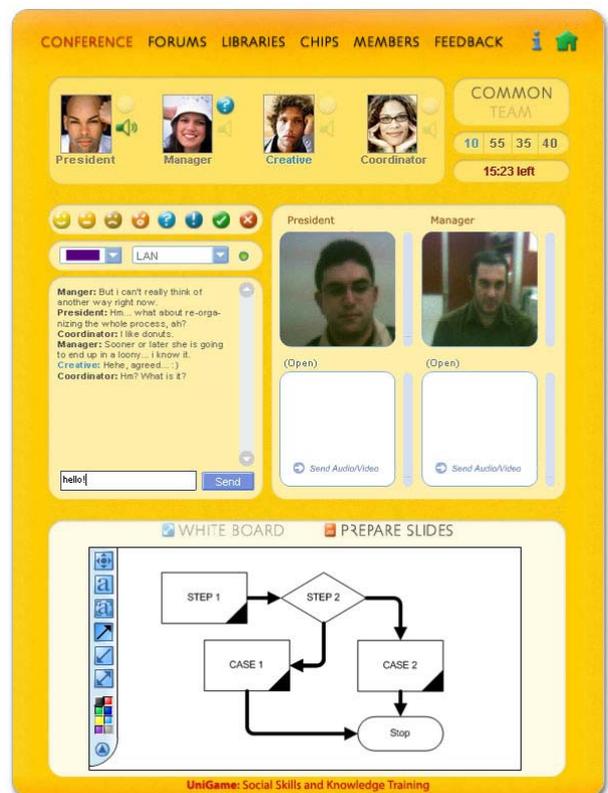

Figure 7: Virtual Conference

Team and Common Areas

These areas are composed of several screens, which are used by the players for communicating and exchanging information either in Team - private before and during the General Discussion, and in Common – public with the other teams and the trainer. These screens consist of the Forum Discussion, the Libraries, the Virtual Conference, and the Member List.

General Library

The General Library contains information about each game's theme. The trainer and the players have access to these pages in order to upload or download valuable information. This information helps the users to participate efficiently in the ongoing discussions. It has to be mentioned that both teachers and students are able to store information in the General Library.

Figure 8: General Library

Info-Bank

The Info-Bank is similar to the 'Library', that is an area where players are able to retrieve information. The main difference is not the type of information but the person that provides it. In this area only the trainer is able to upload the information that will be accessed by the players during the game.

Chip Allocation

This section of the platform contains the functions regarding the Chip Allocation. The members of each team have to decide which subjects are more important for them and in this screen they have to allocate chips (points) in three subjects for discussion.
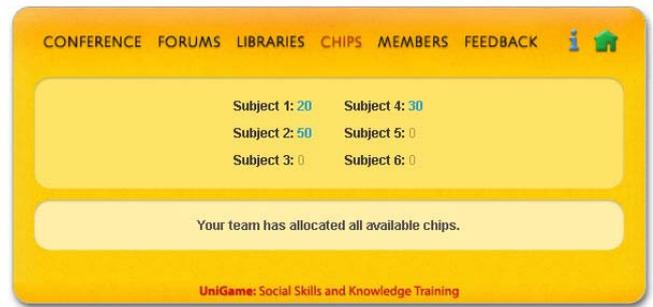

Figure 9: Chip Allocation area

Trainer's Home Area

Like the players, trainers are also provided with their personalised home area. This area, looking similar to the players' home area, provides a trainer with all functionalities necessary for creating, maintaining and moderating game themes. In the section Theme Creation/Editing a more detailed description of the functional and technical implementation of this area will be provided.

Figure 10: Trainer's Home Area

Create (New) Game

A trainer has two options for creating a game. First, by entering a new game title under the heading "Create New Game" a trainer starts the process of creating a new game theme from the scratch. A series of screens called the "Edit Game" area lead the trainer through the process by

providing guidance for all steps in the creation of a new game theme. The process starts with a screen for the definition of the games *title* and goes on to *difficulty*, then the *introduction* of the theme and the *quiz* questions, the *teams* that will be available for the players and the *roles* within each team. The trainer is also guided in the definition of the *subjects* to be discussed, selection of the *time* available for discussion and administering the *chips* allocation process. The trainer has the possibility to use multimedia presentations in the form of photographs, short films and sound files (for examples of the Edit Area see Figure 13 and below in the Theme Creation/Editing section). A trainer can also choose to make the game theme available for other trainers on line, or not. Here starts the second option for creating a game. If a trainer chooses to make the theme available for other trainers, then this theme's content can be stored/ saved in the Edit Area with a new name, and can be either adapted or used as it is. Games that are available for trainers can be viewed on the trainer's home area under the title Other Games.

Maintain Games

For maintaining and moderating the game the trainers are provided with specific functionalities in their virtual conference area. For example they can increase or decrease the time available for the discussions, they can decide whether the teams achieved a consensus or not, and they can announce the end of the game.

All screenshots from the Trainer's Area are provided by the Theme Creation/Editing section along with all the technical details of the specific implementation.

Possible Use Cases

To illustrate possible application of the proposed UniGame framework, we present two examples of the game usage. A teacher who wants his/her students to reflect actively upon interdisciplinary consequences and ethical behaviour of engineers defines a game-theme called Tunnel Building. The aim of the game is that 4 teams are competing to make the best offer and technical solution to build a tunnel on the defined location. The solution should consider different parameters like financial frame, time deadlines, technology applied, ecological acceptance, etc. During the game teams

can "buy" knowledge from other experts. Teams are also expected to be able to react on unexpected new conditions e.g. new emission law, or the law regarding an area near the tunnel location that was declared for natural park, etc. Teams use the preparation time of the game to elaborate their solution. During general discussion different important subjects should be discussed and a consensus on which solution is the most appropriate should be achieved.

To experience Multicultural Differences another game-theme could be defined. In this game students worldwide can form teams. There are various possibilities: multinational teams or each nationality builds own team. Teams should work on the same task e.g. to design a multicultural website. Within the team session teams should work on their proposition, research similar web pages in different cultural environments. Teams should publish their ideas and propositions about functionality and design of a page. Within the general discussion teams have to discuss the subjects and to reach a consensus (e.g. about features of a web page, which design would be the best, which parameters should be considered for cultural adaptation, etc.).

ARCHITECTURE

As mentioned above, the "UNIGAME: Social Skills and Knowledge Training" game is a web-based game. This means that the players and trainers do not need to install the game software in their personal computers in order to use the game. This brings the game closer to the habits of today's users who are accustomed to use Internet applications without having to install any piece of software locally. In addition, the fact that this is a web-based game makes its use easier, since the users are not 'bounded' to use it from a specific computer (every information that must be saved about a user is saved centrally and not in his/hers specific computer). The fact that the game must be downloaded every time a user wants to use it is not a problem since the game website is quite lightweight. Moreover, each game area is divided in different web pages; therefore participating in the game is similar to navigating a web site. A simple Internet connection is only needed (additional bandwidth is only prerequisite during the Virtual Conference for a high-quality audio and video interaction between the users).

The game is a web application. The game's website structure has a three-tier architecture (CTI 2003). This architectural structure is composed of the following three layers: the thin client (a web browser), the middleware (the servers that public through the Internet the game and enable the users to participate) and the storage layer (a database management system). The architecture is depicted in Figure 11 and it will be analytically described in this section.
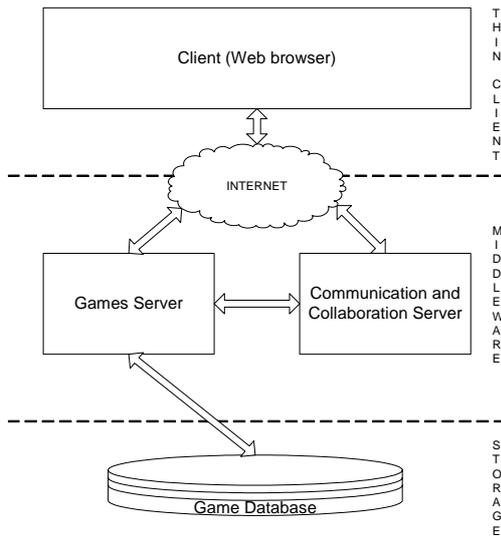

Figure 11: General End-To-End Architecture

Thin Client

The 'Thin Client' is the interface between the users and the game platform. It is a common web browser (like Microsoft Internet Explorer, Netscape, Mozilla etc.), which is used by the players in order to browse the pages of the game's website. Macromedia's Flash Player must also be installed in the browser as a plug-in, since some of the system pages include Flash objects. The Flash Player is available for most of the major web browsers. The thin client is the only piece of software running in the users' personal computers. It does not contain the logic of the game and does not use the local hard drive for storing information. All information is stored centrally. This enables the users to participate in the games through different personal computers (since no data is stored locally).

Middleware

The second layer in the system's architecture is the Middleware. The middleware is the server software that is responsible for the provided functionality. All the game's 'logic' is in the middleware. In addition, the middleware handles the communication between the different users of the game, presents the game to the users and connects (transparently) the client software with the storage system. The two main components that constitute the middleware are the 'Game Server' and the 'Communication and Collaboration Server'. The latter is responsible for the communication between the different users of the game, while the game server is responsible for all the other functionality. In this section these two components of the system are described.

Game Server
The Game Server is a web server. When a request comes for a web page by the user's browser, the web server creates dynamically the content of the web page and sends it to the user. The game server contains server-side scripts, written in a scripting language, that are responsible for the on-demand creation of web pages. These scripts include the 'logic' of the game. Wherever there is need for making decisions in the client-side, client-side JavaScript code is utilized. The Game Server, besides the scripts that dynamically create the web pages, contains all the other files that are needed for them, for instance image files or Flash files.
Almost all scripts that exist in the game server connect to the database management system ('Storage System') in order to obtain the needed information or to store information. When there is need for storing users' information (for instance storing a user's profile) the thin client sends this information to the web browser (included in an HTTP message), the Web server passes this information to the relevant script and this script stores the information in the storage system. If there is need for information to be returned, the opposite procedure is followed.

Communication and Collaboration Server
The Communication and Collaboration Server is the server software that provides the means for the real-time communication of the system's users. This is an important functionality of the game, since the whole game-play is based on the communication between the users. The pages that enable the users to communicate in real-time contain Flash objects, which provide this functionality. These objects connect to the Communication and Collaboration Server, which

handles their 'interconnection'. We will refer more analytically to the Communication and Collaboration Server and the different forms of communication it can offer in the Implementation section.

Storage Layer

The Storage Layer consists of a Relational Database Management System (RDBMS). It is used for the storage of the data that are required for the functionality of the game. These data are related to the users' profiles, to the themes of the game, to the games in progress or past games, to the presentation of the game site, etc. The thin client (web browser) does not have direct access to the storage system. The scripts of the game server are the only software modules that access the RDBMS.

IMPLEMENTATION ISSUES

Technology and Implementation Tools

In this section we describe the technological selections made for the architecture described above and the way all the desirable functionality was implemented. Also, the interconnection of the various parts of the architecture is explained. These are shown in Figure 12.
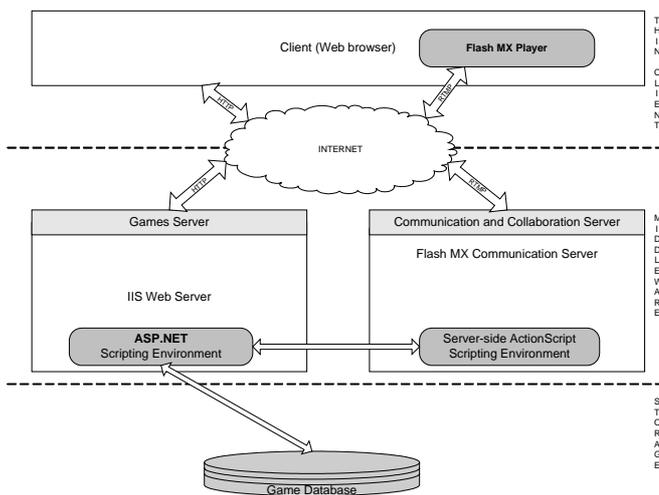

Figure 12: Analytical End-To-End Architecture

As mentioned before, the thin client is a web browser with Macromedia's Flash Player (Allaire 2002) installed. It presents the pages of the website to the users and gets their feedback. Through the web browser the users participate in the different game stages, search for the information stored in the game's libraries and communicate through forums.

The Flash Player is used because it has built-in functionality for the real-time communication of the users, besides being a powerful technology for building aesthetically elegant websites and animations. It is also quite widespread and is provided by Macromedia free-of-charge. It is used in the 'Virtual Conference', 'Team Virtual Conference' and 'Community Chat' pages of the system. These web pages can be accessed by many users simultaneously and constitute the multi-user environment of the system. Users interact through text chat, audio/video conference, shared whiteboards and presentation tables.

The middleware is the 'heart' of the game platform. It is managed and supported by the game administrator. It contains the application's logic, handles the real-time communication of the users, creates and serves the web pages of the system and holds the various files that are used in the web pages of the system. As mentioned in the Architecture section, the middleware is composed by a web server ('Game Server') and the real-time communication server ('Communication and Collaboration Server'). These two servers should be running in the same server machine or should be running in separate servers that are connected through a Local Area Network (LAN). This choice depends on the most important criteria (cost effectiveness or performance) during the system installation.

The Game Server is the web server of the game platform. Its role is to dynamically create and serve the web pages that compose each game to the browsers of the users. The web server selected to support the website is Microsoft's IIS (Microsoft 2003), extended with the '.NET framework 1.1' in order to support the ASP.NET scripting language (Homer et al. 2002), in which the functionality of the web site has been developed. In addition, XML – eXtensible Markup Language has been integrated with the ASP.NET scripting environment in order to provide the trainer with the ability to easily create and modify the Game Themes. The standard DTD containing the necessary elements, and all other technical details of this implementation is described in the next section.

The Game Server is the only part of the system that accesses the RDBMS (Storage System) through the use of the scripting environment

(ASP.NET). Users' browsers interact with the Game Server over the Internet using the HTTP protocol.

The Communication and Collaboration Server has been used for enabling the real-time communication among the users. The Flash objects that built this functionality connect to the Communication and Collaboration server and exchange data through it. The Communication and Collaboration server selected in order to support the above mentioned functionality is a product provided by Macromedia, the Flash Communication Server MX (Gay and Allen 2002). The types of real-time communication developed by the use of Flash Communication Server are text chat, voice chat, shared whiteboards, presentation tables and audio/video conference. All this functionality was developed by enhancing Flash Communication Server MX capabilities with the conjunction of the scripting language used for programming the server, ActionScript and the Flash Player as the client. The ActionScript is a scripting environment able to provide and support communication components through network connections, based on a client-server architecture.

The protocol used for the interconnection between the Flash objects that enable the real-time communication functionality and the Flash Communication Server MX is Macromedia's Real-Time Messaging Protocol (RTMP), utilized by the ActionScript scripting language.

An Internet connection is the only requisite for enabling the above-mentioned functionality. Users, who connect to the Internet through a high bandwidth connection, will experience the highest quality audio and video interaction. The user according his/her Internet connection is able to adjust the audio and video quality. By default this adjustment is taking place automatically when the user signs in the Virtual Conference.

The RDBMS selected for the storage layer of the game platform is Microsoft SQL Server 2000. This selection was made mainly because Microsoft's products IIS and .NET Framework are used in the middleware. Consequently, using SQL Server 2000 for the storage system of the game platform provides better integration between the system's components (Iseminger 2001) and the maximum performance.

As it has been explained so far, the software of the game is distributed between the users' personal computers (web browser and Flash player) and a central server (or more) of the game provider. The Game Server, the Communication and Collaboration Server and the SQL Server can be installed in the same machine in order to minimize the cost of the overall system, or they can be installed in more than one machines interconnected over a LAN, providing the best system performance, specially for the real-time communication functionalities.

A sample of the system's functionality, is provided in the figures that show the areas of the game, like the Virtual Conference screen. In the Virtual Conference the members of the teams are able to communicate with each other through various ways, such as text chat, shared whiteboards, presentation tables and audio/video conference. Each user is represented by an avatar (a photo chosen from a gallery) while some gestures are shown beside the avatar. The audio/video conference area and the shared whiteboard are also pictured in this figure.

Theme Creation/Editing Tool

Themes for games of the Unigame platform are represented by XML files. CTI has constructed a standard DTD, which defines the structure of a theme XML file. All the theme XML files must conform to this DTD. This standard is named "Unigame Theme Description Standard" (UTDS) and a description of it can be found in the following paragraphs. A theme XML file must always have the filename "theme.xml" and be stored in a folder (theme folder) with all the other complement content of the theme (i.e. image files, movie files and audio files). This theme folder must be placed inside a special folder of the Unigame website, called 'themes'. Storing a theme folder (with a valid 'theme.xml' file) inside the 'themes' folder is enough for constructing a new theme for the Unigame platform. Afterwards, new games can be defined based on this theme.

The themes of the games in the Unigame platform can be constructed by two possible ways: Either manually (by authoring an XML file), or by using the respective functionality of the administration area. The first approach is perhaps quicker for experienced trainers (since they can use only a text editor), but it is quite difficult for inexperienced trainers (since they have to learn and understand XML and the UTDS DTD and they have to build an XML file, which must be well formed and valid

to the UTDS DTD).

The Unigame Theme Description Standard defines a simple structure, which must be followed by authors who manually construct themes for the Unigame platform. This structure is described by the following DTD.

```
<!ELEMENT theme
(intro,questions,teams,avatars,subjects,chips,news)
>

<!ELEMENT intro(text,media)>

<!ELEMENT text(#PCDATA)>
<!ELEMENT media EMPTY>

<!ELEMENT questions(question+)>
<!ELEMENT question(text,hint,media,answer+)>
<!ELEMENT hint(#PCDATA)>
<!ELEMENT answer(#PCDATA)>

<!ELEMENT teams(team+)>
<!ELEMENT team(title,description,roles)>
<!ELEMENT title(#PCDATA)>
<!ELEMENT description(#PCDATA)>
<!ELEMENT roles(role+)>
<!ELEMENT role(name,description)>
<!ELEMENT name(#PCDATA)>

<!ELEMENT avataras(avatar*)>
<!ELEMENT avatar EMPTY>

<!ELEMENT subjects(subject+)>
<!ELEMENT subject(#PCDATA)>

<!ELEMENT chips EMPTY>

<!ELEMENT news
(average1,average2,average3,expert1,expert2,expert3
)>
<!ELEMENT average1(#PCDATA)>
<!ELEMENT average2(#PCDATA)>
<!ELEMENT average3(#PCDATA)>
<!ELEMENT expert1(#PCDATA)>
<!ELEMENT expert2(#PCDATA)>
<!ELEMENT expert3(#PCDATA)>


<!ATTLIST theme name CDATA #REQUIRED>
<!ATTLIST theme locked (true,false) #REQUIRED>
<!ATTLIST theme published (true,false) #REQUIRED>
<!ATTLIST theme level (beginner,average,expert)
#REQUIRED>
<!ATTLIST theme appendix CDATA #REQUIRED>

<!ATTLIST media src CDATA #REQUIRED>
<!ATTLIST media type (image,video,audio) #REQUIRED>

<!ATTLIST answer eval CDATA #IMPLIED>

<!ATTLIST avatar src CDATA #REQUIRED>

<!ATTLIST subject num CDATA #REQUIRED>
<!ATTLIST subject amount  CDATA #REQUIRED>

<!ATTLIST chips ChipsPerTeam CDATA #REQUIRED>
<!ATTLIST chips SubjectsForChips CDATA #REQUIRED>
```

Unigame **T**heme **D**escription **S**tandard (UTDS)
Document Type Definition

It has to be noted that XML files must be constructed exactly as their DTDs instruct. Even a slight variation can cause an XML error (thrown by the XML parser) and the platform will not recognize the specific file as a valid theme description file. The following diagram graphically shows the structure that the content of a "theme.xml" file must have in order to describe a theme for the Unigame platform.
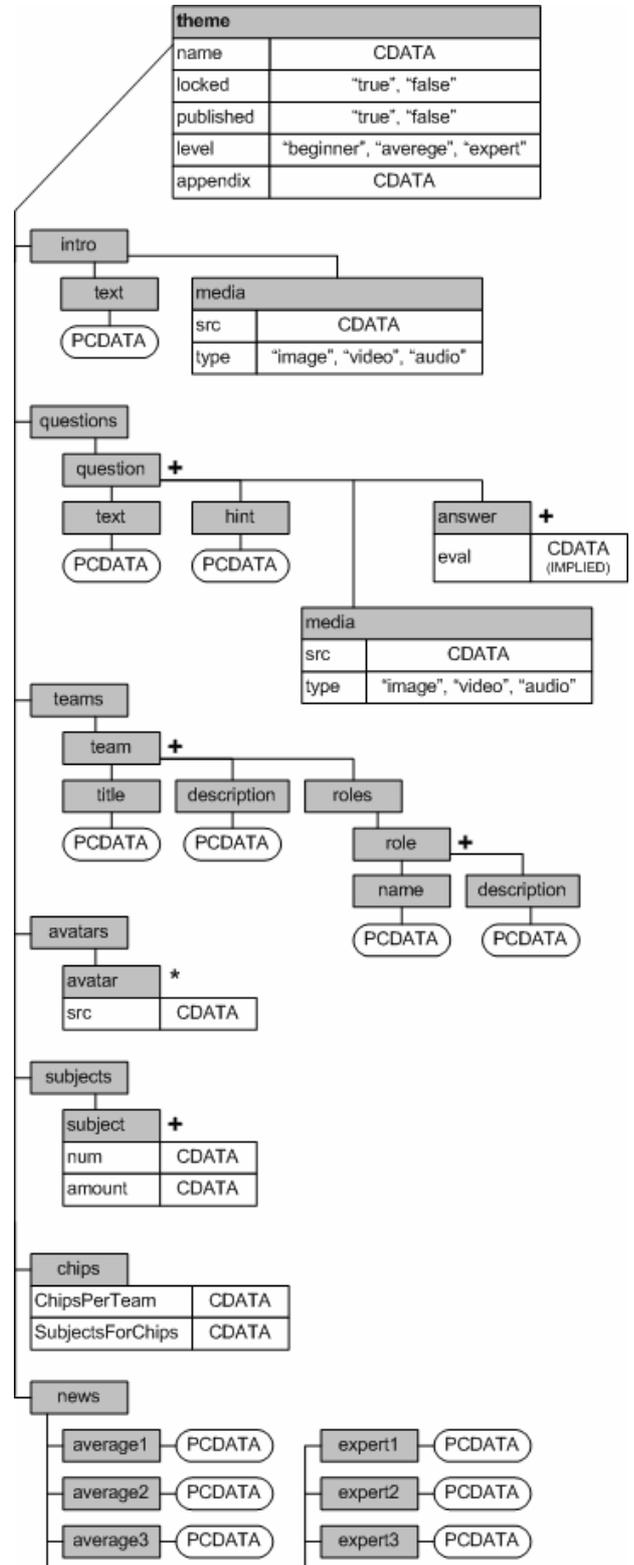
Diagram 1: UTDS Structure

This diagram presents all the XML tags that constitute a Unigame Theme and shows the type of data each one consists of. These different kinds of data are the two following:

- PCDATA (Parsed Character Data):
- CDATA (Character Data)

Think of the character data as the text found between the start tag and the end tag of an XML element. PCDATA is text that will be parsed by a parser. Tags inside the text will be treated as markup and entities will be expanded. CDATA is the text that will not be parsed by a parser. Tags inside this text will not be treated as markup and its entities will not be expanded.

The administration area of the Unigame website has a special section (sequence of screens) that is dedicated to creating and editing themes. If an author wishes to use this part of the administration area (instead of writing an XML file manually), he/she will be pleased to discover that the screens are quite intuitive and easy to use and no code has to be written at all! Indeed, the use of XML is completely transparent to the trainer, since the Unigame platform constructs the XML file as the trainer proceeds in the sequence of the "Theme Creation" screens. When the trainer reaches the final screen, he/she can press the "Publish" button and the theme will be published. Before this stage is reached, the theme is unusable.

The first screen (Figure 13) of the "Theme Creation" screens series, the tool that aims to facilitate trainer to design new game themes, provides the trainer with a checkbox for allowing other trainers to use this theme or not. The trainer, who is a constructor of a new theme, is able to decide whether to allow other trainers to access his/her work. If he does, other trainers have the privilege to copy the theme (using the graphical interface of the administration area) and edit all its parameters, right after the new theme has been published by the trainer who designed it.

Figure 13: Lock Theme Screen

All the screens of the "Theme Creation" area have similar layout as the one shown in Figure 15. In addition, some elements of this screen are common to all the next screens. The first button at the top-right of the screen opens a window with general information about the Unigame platform (where the trainer can find instructions about the process of creating a new theme or game) and the second one transfers the trainer to the home screen of the training area. The "Save" button at the bottom of the screen saves the work that has been done in the particular screen. If a trainer leaves a screen without previously pressing the "Save" button, all the work done in this screen will be lost. A navigation bar at the top of the screen allows the trainer to easily navigate in the "Theme Creation" screens (not necessarily sequentially). This navigation bar shows also the title of the theme.

The second screen (Figure 14) is as simple as the first one. The trainer defines here the name of the theme (and the name of the game that will be created based on this theme). This name can be changed later.

Figure 14: Title Screen

The "Description screen" (Figure 15), which is the third in the sequence of the "Theme Creation" screens, is used for constructing a description of the game, that will be shown to the students in the

"Introduction" to the game. In this screen the trainer can enter introductory text for the game and upload some kind of media file. This media file can be any an image file, a video file or an audio file. When the trainer presses the upload button, the media file is uploaded to the theme folder that was created in the start of this process by the Unigame platform, inside the 'themes' folder. If a file with the same name already exists, then the filename is slightly changed in order to avoid deleting a file that is used by another screen.

Figure 15: Description Screen

Figure 16: Introduction Preview Screen

The trainer can 'preview' the Introduction screen with the content that has been entered by pressing the "Preview" button. The screen that is presented in a new window (Figure 16) is the "Introduction" screen, as it will be shown to the students the first

time they enter the newly created game and follow the 'Introduction' process.

The forth screen in the sequence of the "Theme Creation" screens is the screen where the trainer has to create the questions that will be presented to the students in the "Introduction" quiz Figure (17). The trainer can create as many questions he/she wishes to be answered by the students (however, if more than 5 questions are entered, only the first five questions will be presented to the students). The trainer inserts the text of the question in the "Question" field and the possible answers (the questions are multiple choice) in the "Answers" field. The first answer is the correct one. As with the introduction screen, the trainer is allowed to upload media content (image, video or audio). The trainer can provide some hint by typing the text in the 'hint' field. Hints are provided to the students, if they press the 'hint' button in their quiz screen. The quiz screen also gives the opportunity to the trainer to preview the question and the hint as they will appear in the students' desktop.

Figure 17: Quiz (Questions) Screen

The next screen (Figure 18) is used for defining the teams that will participate in the game. This page has a similar functionality to the previous screen, but less content to be provided with. The trainer must enter the name of the team and a brief description for this team about the role that it will come about with and the goals it will target to achieve. He is able to create new teams by pressing the link "New Team" or delete the current team by pressing the link "Delete this Team". The trainer can also preview how the teams will appear in the students' introduction.

Following the team creation, the trainer has to create the roles of the students that will participate in the previously created teams. This is done in the sixth screen (Figure 19) of the "Theme Creation" screens. Using a similar interface as in the "Quiz" and "Teams" screens the trainer enters the name of each role and a description for this role. In addition, the trainer has to choose in which team this specific role belongs. This is done by choosing from the list of the teams in the drop down list beneath the name field. The trainer has to choose a team, because roles that do not belong in a team are automatically erased when the trainer presses the save button. Therefore, the trainer must have visited the "Teams" screen, before trying to create new roles.

Figure 18: Team Screen

Figure: 19 Role Screen

The following screen is the "Avatars" screen (Figure 20). Using this screen, the trainer has the possibility to upload some image files, from which the students will be able to choose the representing avatar for their role. The maximum number of avatars that can be uploaded is 8.
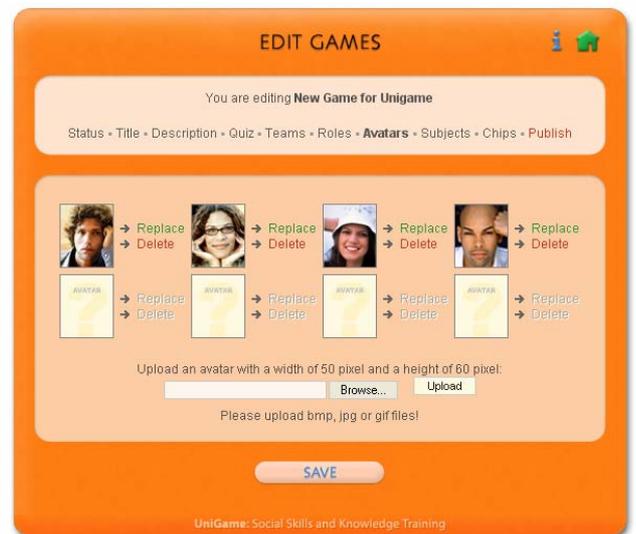

Figure 20: Avatars Screen

In the "Subjects" screen (Figure 21), the trainer enters the names of the subjects that will be discussed by the students. In addition, the trainer enters the time limit for the discussion of each subject. The maximum number of subjects is 11. The ninth screen in the sequence of the "Theme Creation" screens (Figure 21) is a simple screen with two fields dedicated to the Chips that can be allocates for the subjects' discussion. In the first field the trainer enters the total amount of Chips

that can be allocated in the discussions. In the second field the maximum number of subjects that can be allocated chips is entered (which can be less than the number of subjects).
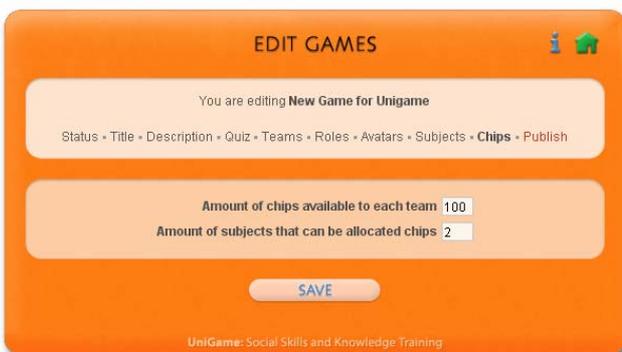

Figure 21: Subjects

Figure 22: Chips Screen

Finally, in the "Publish" screen (Figure 23), the trainer has to enter the random text messages that will appear in the students' desktops in random points of time during the discussions and the difficulty level of the game.

The "Publish" screen is the final screen of the "Theme Creation" sequence of screens. Upon pressing the "Publish" button, a new game is created that is based on the newly created theme and is made available to the students.
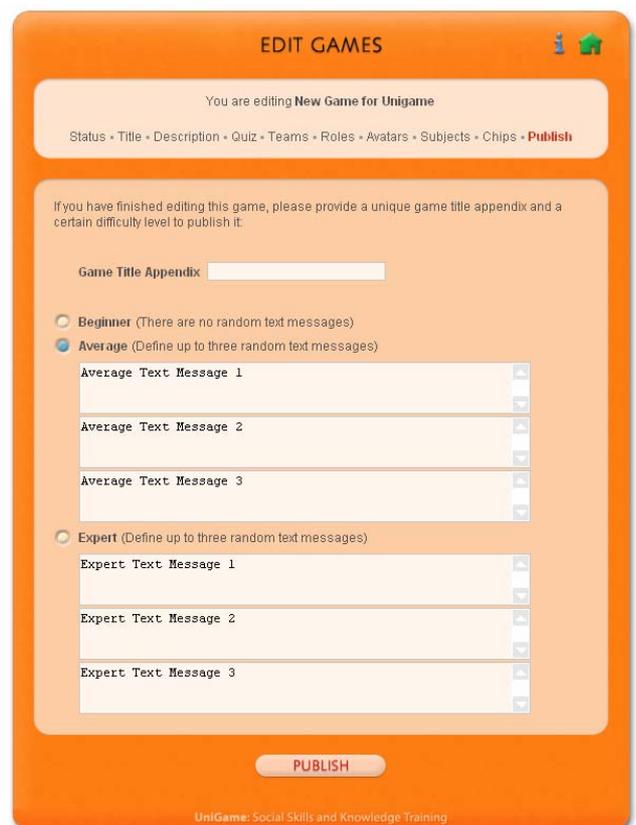

Figure 23: Publish Screen

The "Theme Creation" screens offer an alternative way for authoring new themes. They are intuitive and easier than authoring an XML file manually. In addition, the process of authoring XML is completely transparent, since it is done by the Unigame platform. However, themes that have been constructed by the "Theme Creation" screens, do not differ from the rest. There is a "theme folder" (inside the "themes" folder of the Unigame website) with a "theme.xml" file dedicated to each game that has been constructed by the Unigame platform instead of the trainer. Inside the theme folder, all the files that constitute each theme are located. Except from the XML file can also be stored images to be used during the game, and in the future other multimedia rich content.

An example of a "theme.xml" file, which conforms to the UTDS DTD is shown below. This XML file describes a game that is compatible to the Unigame platform and can be used directly in it.

```
<?xml version="1.0" encoding="utf-8"?>
<!--new theme created 18/2/2004 12:49:35 μμ-->
<theme name="New Game for Unigame" locked="true"
published="true" level="average" appendix="">
  <intro>
    <text>Description for Introduction</text>
    <media src="kunsthaus.jpg" type="image" />
  </intro>
  <questions>
    <question>
      <text>Question 1</text>
      <hint> hint text</hint>
      <media src="kunsthaus02.jpg" type="image" />
      <answer eval="correct">Correct
Answer</answer>
      <answer>Wrong Answer 1</answer>
      <answer>Wrong Answer 2</answer>
    </question>
    <question>
      <text>Question 2</text>
      <hint>hint</hint>
      <image src="kunsthaus03.gif" type="image" />
      <answer eval="correct">Correct
Answer</answer>
      <answer>Wrong Answer 1</answer>
      <answer>Wrong Answer 2</answer>
      <answer>Wrong Answer 3</answer>
    </question>
  </questions>
  <teams count="2">
    <team>
      <title>Team 1</title>
      <description>Description for team
1</description>
      <roles>
        <role>
          <name>Role No. 1</name>
          <description>Description</description>
        </role>
      </roles>
    </team>
    <team>
      <title>Team 2</title>
      <description>Description for team
2</description>
      <roles>
        <role>
          <name>Role No. 2</name>
          <description>Description</description>
        </role>
      </roles>
    </team>
  </teams>
  <avatars>
    <avatar src="gooffy.jpg" />
    <avatar src="mickey.jpg" />
    <avatar src="superman.gif" />
  </avatars>
  <subjects>
    <subject num="1" amount="20">Subject
1</subject>
    <subject num="2" amount="15">Subject
2</subject>
  </subjects>
  <chips ChipsPerTeam="100" SubjectsForChips="2" />
  <news>
    <average1>Average Text Message 1</average1>
    <average2>Average Text Message 2</average2>
    <average3>Average Text Message 3</average3>
    <expert1>Expert Text Message 1</expert1>
    <expert2>Expert Text Message 2</expert2>
    <expert3>Expert Text Message 3</expert3>
  </news>
</theme>
```

Example of an XML theme

EVALUATION

In order to clarify the usefulness of the system an evaluation process took place. A test of the platform was done, by four different participants, both usability experts and educators. The participants had a list with tasks that they had to carry out, while the usability evaluation method used was the Think Aloud User Testing.

This is a form of user testing, where user's interaction is recorded and then analyzed to improve the product. This method was chosen because it provides the developers with a very close approximation to actual individual usage and also uses fewer users. By the end of the process the testers also completed questionnaires that will be further analyzed.

The overall evaluation remarks were very useful in order to reform certain parts of the system. These remarks were categorized, ranked and prioritized according to how often they were expressed. Most of them were related to the graphical user interface. The help options should be present during all the phases of each game, in order to assist inexperienced users to clarify notions of the game such as the chip allocation process.

FUTURE WORK

The "UNIGAME: Social Skills and Knowledge Training" game has been designed with the goal to enhance the communication skills of its users and to make learning easier by using the theory of the lectures in practice. In order to achieve an efficient and powerful platform the important phase of the game evaluation has to be completed. The game will be used in classes with themes that will be developed for these specific classes and the trainers will try to understand whether the game effectively enhances the teaching experience. This evaluation will be used for improving the game concept and achieving better acceptance and playability. In addition, feedback from the users will help in identifying which points of the game could be enhanced. Perhaps some enhancements would be to make the game more media-rich (for example, using streaming video in the introduction) or even enrich the games' functionality by providing the users with a 3-D multi-user environment, which will enable the students to practice what they have learned during

the educational process, or by providing the ability to include external simulation programs.

CONCLUSIONS

The "UNIGAME: Social Skills and Knowledge Training" is a game aimed at enhancing the traditional learning process, emphasizing e-teamwork and soft skills training. By using the game as a complement to lectures or even as a standalone learning process, it is believed that it will enable the students to understand better the theory, as they apply it in practice. Moreover, the students acquire knowledge in other fields too, such as communication and team management, while they also increase other soft skills such as responsibility and creativity.

Towards this direction, a game environment was created that emphasizes on the communication and collaboration of the users. By joining a team in the "UNIGAME: Social Skills and Knowledge Training" game and participating in the game procedure, the user acquires experience of working as a member of a team, communicating effectively, working as a team leader and using in the discussions knowledge acquired in the lectures or in the game. The game is a web-based and multi-user (multi-player). It offers its users many different communication and collaboration means, such as a text chat module, a forum (public or private) and several areas where they can upload or download information. Moreover, the Virtual Conference area provides the users with the ability to communicate and collaborate through audio/video interaction plus shared whiteboards and presentation tables. Having completed the implementation phase, the game must now be tested in real classes by students and evaluated by the users. The received feedback from the students will help the development process, in order to apply usability and playability improvements to the game, according to the suggestions.

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