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Editorial: Special Issue on "Game-Based Learning"

Welcome to the January 2010 issue of Learning Technology.

Game-based learning attracts increasing interest worldwide, since it can bring significant benefits in various different learning settings. The issue introduces papers which describe new development frameworks and architectures, as well as specific case studies of games which are used in specific settings.

Emond et al. describe a project aiming to develop a virtual training environment using advanced user input technologies for military personnel; Padilla Zea et al. propose an architecture for designing educational video games with collaborative activities; Jurácz et al. describe a framework for developing flow-driven web-based educational games.

Chiong describes a game-based learning approach for learning introductory programming; Riemer describes a software product which was developed for facilitating the well-known beergame, a role-play game for simulating supply chain inefficiencies as depicted by the so-called bullwhip effect.

Caschera et al. propose an advanced multimodal platform for game-based learning (AMPLE), which enables the interaction in a gamed-based learning environment through a multimodal interface; Pincas describes a high-level pedagogic framework for designing educational games.

Baptista and de Carvalho describe a role-playing game (RPG) for learning, representing the setup of the city of Funchal, the capital of Madeira Island. Chu proposes a narrative approach based on informant design methods to build casual, educational games for children.

Casimir describes a management game that is used to allow students to integrate and practically apply their knowledge of all subjects taught in a specific course.

Marchiori et al. describe a visual, domain-specific language aiming to ease the creation of educational video games.

Arnab et al. discuss some design considerations for the development of game-based learning (GBL) for cross-cultural awareness, which are based on the experience of the eVita project; Boskic discusses how users perceive reality in computer games (and other artificial worlds), and how this can affect learning, as well the user's experience in general. Canbek and Kurubacak discuss self-representation of the real-self through humanoid identity immersive expressions of avatars in Second Life.

The issue also includes a section with regular submissions (i.e. not related to the special issue theme).

Ahmed et al. argue that existing learning technologies specifications and standards do not effectively support the need for dynamic adaptations in learning systems. In this context, the authors suggest the use of ontologies and related technologies.

Rosas-Colin et al. discuss work in progress aiming to investigate the epistemological bases of learning technologies.

Zouaq discusses how natural language processing and semantic web technologies and services can be used for improving learning systems.

Santanchè and da Silva describe a digital content repository (MediaBank) for storage, sharing and re-use of e-learning content.

Elwell proposes a progressive task-based virtual environment exercise (based on Second Life) which aims to improve students' competence, confidence, and independence in English.

Churchill discusses the conceptualization of learning objects, and the need for a broader definition that serves the perspective of diverse communities.

Finally, de Antonio et al. describe work in progress towards the implementation of a new student modeling approach, which is based on ontological engineering.

We sincerely hope that this special issue will help in keeping you abreast of the current research and developments in game-based learning.

We also would like to take the opportunity to invite you to contribute your own work in progress, project reports, case studies, and events announcements in this newsletter, if you are involved in research and/or implementation of any aspect of advanced learning technologies. For more details, please refer to the author guidelines at http://lttf.ieee.org/learn_tech/authors.html.

Editors

Sabine Graf
Athabasca University, Canada
sabineg@athabascau.ca

Charalampos Karagiannidis
University of Thessaly, Greece
karagian@uth.gr

A Virtual Game Environment for Learning Initiative-Based Tactics

Games and simulations play a growing role in interactive learning environments. Advances in computing power and graphical user interface are certainly important determinants of this phenomenon, but innovation in user input methods are also pushing the game and simulation platforms beyond traditional input devices and desktop computer applications.

This paper gives a brief overview of a project aimed at developing a virtual training environment using advanced user input technologies. The main intention is to allow trainees to acquire initiative-based tactics skills in an environment as similar as possible to the operational conditions. This virtual training environment, the Immersive Reflexive Engagement Trainer (IRET) is a collaborative research effort between the Canadian Department of National Defence (DND) and the National Research Council Canada, Institute for Information Technology (NRC-IIT). The purpose of the Immersive Reflexive Engagement Trainer is to blend a number of existing technologies to allow soldiers to train simultaneously within virtual and real environments.

The primary use of the system is to train personnel in the rapid application of judgment to include the application of rules of engagement and the use of force. The system will provide interactive enemy forces that react to the soldiers' actions and movements, challenging the soldiers' skills and judgment. Instructors will be able to select and pace training challenges, assess performance during the simulation, and use "after action review" features to provide soldiers with essential feedback and remediation.

The initial seed for the collaborative project was a laser technology developed at NRC-IIT to interact with large displays (Lapointe & Godin, 2005), which is essential to allow trainees to interact in full body movement with wall-size displays. The Combat Training Centre (CTC)-CFB Gagetown (Canada) had already developed a prototype system for training soldiers in close quarters battle using off-the-shelf game engine technology. Subsequently other NRC-IIT technologies were incorporated with the DND game engine for speech processing, multimodal interaction, and cognitive modelling.

The training system development includes requirements specification and training objectives based on information collected and validated by course instructors and subject matter experts. A systematic requirements specification process will ensure that the training system is designed to meet the desired level of performance and readiness from soldiers. One of the objectives of the IRET project is to build high-fidelity elements such as immersive scene projection on walls, use of realistic laser based weapons (same feel and weight), simulated flash-bangs, feedback vests, and speech and gesture recognition for interactions with cognitively realistic simulated agents.

There is a growing interest in the Canadian Army for using off-the-shelf computer games in training because of the interactivity and engagement they create for the player (Roman & Brown, 2007). However, training simulations and games are designed with different objectives in mind; a game being focused on the entertainment value for the player, and a simulation being focused on the achievement of learning objectives. Roman and Brown present a comparison table of gamers and trainers' preferences (see Table 1), originally presented by Helsdingen (2006). The table shows important and possibly irreconcilable differences between the two points of view.

Gamer Preferences	Trainer Preferences
Entertainment	Learning Process
Emotion	Structure
Player Control	Learning Goals
Free Play	Instructor Control
Unpredictable Turn of Events	Standardization
Fantasy	Realistic Problems
No Boundaries	Effective and Efficient
Social Interaction	Transfer of Training
Surprise	Validity
Risk	Fidelity
Suspense	
Art and Beauty	

Table 1. Comparison of gamers' and trainers' preferences (Helsdingen, 2006; Roman & Brown, 2007).

Simulators provide many advantages for training, including high-fidelity to real-world operating environments. The main argument being that the closer the training environment is to the real world, the better will be the transfer of skills and knowledge acquired during training. However, it is now recognized that a simulator's fidelity must be measured not only by the physical appearance but also by its psychological and cognitive realisms from the trainee's perspective (Liu, Macchiarella, & Vincenzi, 2009). Simulators also offer instructors the capacity to select specific training conditions, as well as detailed recordings of a trainee's performance for the purpose of performance comparison, diagnostic, and evaluation (Moroney & Lilienthal, 2009), with the capability of repeating a simulation scenario several times without the cost associated to live simulations. The availability of simulators is crucial to maintain readiness and avoid performance degradation (Gorman, 1990; Proctor & Gubler, 1998).

The R&D project currently underway explores the impact of targeted simulation-based interventions in producing effective training outcomes while future papers will report in depth on the scientific theories and empirical results underlying the IRET system and training program.

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Bruno Emond
National Research Council Canada
Institute for Information Technology
Ottawa, ON. Canada
bruno.emond@nrc-cnrc.gc.ca

Hélène Fournier
National Research Council Canada
Institute for Information Technology
Moncton, NB. Canada
helene.fournier@nrc-cnrc.gc.ca

Jean-François Lapointe
National Research Council Canada
Institute for Information Technology
Ottawa, ON. Canada
jean-francois.lapointe@nrc-cnrc.gc.ca

Major Jeremy MacDonald
Department of National Defence Canada
Combat Training Centre CFB
Gagetown, NB. Canada
macdonald.jl@armyelearning.ca

An Architecture to Design Educational Video Games with Collaborative Activities

Abstract. PLAGER-VG (PLAtform for managinG Educational multiplayeR Video Games) is an architecture to design, implement and monitor learning processes supported by video games with collaborative activities, which we call VGSCL (Video Games-Supported Collaborative Learning). The architecture includes several subsystems, each one them with a specific and well-defined purpose. This separation of concerns allows dividing the main problem into several easier problems to face in phases, during development of the game and its execution.

Introduction

Several studies claim for advantages of using video games as learning tools [1] and other studies prove that collaborative learning adds numerous benefits to the knowledge acquisition [2]. Therefore, in this paper we present an architecture to apply these two theories in an easy way.

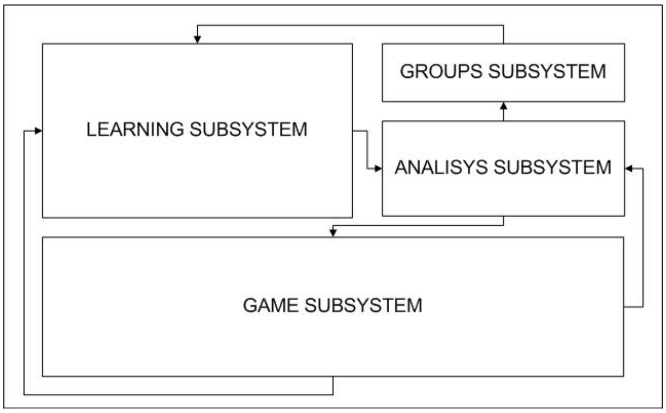

Figure 1: PLAGER-VG Architecture

Figure 1 shows the four interrelated and interconnected subsystems in PLAGER-VG:

- The *Learning Subsystem*, intended to store information about didactical objectives achieved by students, is composed by: 1) players and group models, with information about each of students as individual players or groups as a whole; 2) personalized didactical rules, to specify pedagogical restrictions according to students' needs; and 3) personalization processes, to specify which parameter the teacher wants to monitor.
- *Groups Subsystem*, which store the characteristics of different kinds of groups (size, structure or roles), defining General Group Models. These general models will be instantiated with specific students during the learning process
- By means of the A*nalysis Subsystem* we carry an analysis from three viewpoints, coinciding with the perspectives used to structure the player and group models: educational, recreational and interactive.
- The *Game Subsystem* contains the game itself, integrating design, execution and monitoring. The main element in this subsystem is the *General Tasks and Goals Model* [3], which is formed by two interrelated levels, one for educational contents and the other one for recreational contents.

Designing in PLAGER-VG

Due to the modular design of PLAGER-VG architecture, we can develop the video game by splitting the design and implementation process in several phases:

- Defining personalized User Model: In this phase, attributes used to describe the user must be specified. Since in our games we have both individual players and groups, it is necessary to define models for individual players and models for groups. This personalized design is based on a set of three ontologies (learner profile, player profile and collaborator profile), by means of which the teacher can select available attributes to be inspected. New attributes can be introduced in the corresponding ontology.
- Group Modelling: Since we have group activities, it can be necessary to define the characteristics of the group components and the number of students in each group. In other cases, groups can be formed in a free way, and a General Model for the group is not necessary.
- Defining educational Content: The teacher has to specify the educational objectives and tasks to define the General Tasks and Goals Model. Both goals and tasks can be shared between different games and PLAGER-VG manages its traceability. The educational objectives are selected from an ontology to name the objectives in a common way in order to: 1) relate recreational contents from different video games with the same educational content, and 2) introduce the desired attribute in the player and group models to have trace about the learning achievements.
- Defining recreational Content: In this phase the design of the activities of the game is made. We must not lose sight of educational contents to teach via the game, introducing goals and tasks which, although entertaining, introducing the intrinsic educational component to these games. In addition, in this phase the teacher defines the relationship between educational and recreational tasks in the General Tasks and Goals Models.
- Adaptation: In this phase, the teacher can establish personalized pedagogical strategies for a particular (or several) student or group. Then, the system will be able to adapt the game of each student, ensuring that the learning process is conducted appropriately. To do it, learning restrictions defined in the personalized pedagogical strategies are evaluated on the student's models, deciding which tasks can be undertaken.
- Re-design: PLAGER-VG analyzes the learning process by using the log file and user models, and produces an Improvements Report. In this report, the system offers a set of recommendations to the teacher, including changes in the difficulty level of tasks, different tasks to achieve a goal or changes in groups' composition, for example. All these recommendations help the teacher to re-design some parts of the educational game to improve the learning obtained by means of that video game.

Conclusions and Further Work

In this paper we have briefly described the PLAGER-VG architecture, for the design, development, and monitoring of educational video games with collaborative activities. The platform allows us to assess both learning achievements and learning processes carried out by students.

Nowadays, we are focused on the design of an educational video game for PLAGER-VG, which will be teaching human nutrition for students between 11 and 12 years, which corresponds to sixth primary in Spain.

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N. Padilla Zea
Video games and E-Learning Research Lab
GEDES Research Group, University of Granada
npadilla@ugr.es

F. L. Gutiérrez
Video games and E-Learning Research Lab
GEDES Research Group, University of Granada
fgutierr@ugr.es

N. Medina Medina
Video games and E-Learning Research Lab
GEDES Research Group, University of Granada
nmedina@ugr.es

HoloRena: a framework for developing flow-driven web-based educational games

The "flow" experience is a crucial factor both in digital game design and in the design of engaging educational resources [1]. Though good games should promote flow, it can be difficult to carry the desired flow concept through the complicated process of educational game development.

Going with the flow in the learning environment

In both Digital Game Based Learning (DGBL) and Scenario Based Learning (SBL) flow is typically experienced through a series of interactive scenes. The sequence of these learning activities is adaptive; it is governed by a set of composition rules that take into consideration the learner's performance thereby making the experience flow-like for the individual. Another goal of these rules is to take the learner on an optimal course towards the achievement of training objectives.

The concept of a series of scenes is sufficient to describe discrete aspects of the learning exercise, however in DGBL the flow is experienced through continuous user interaction with dynamic entities and objects, some of them spanning through multiple scenes.

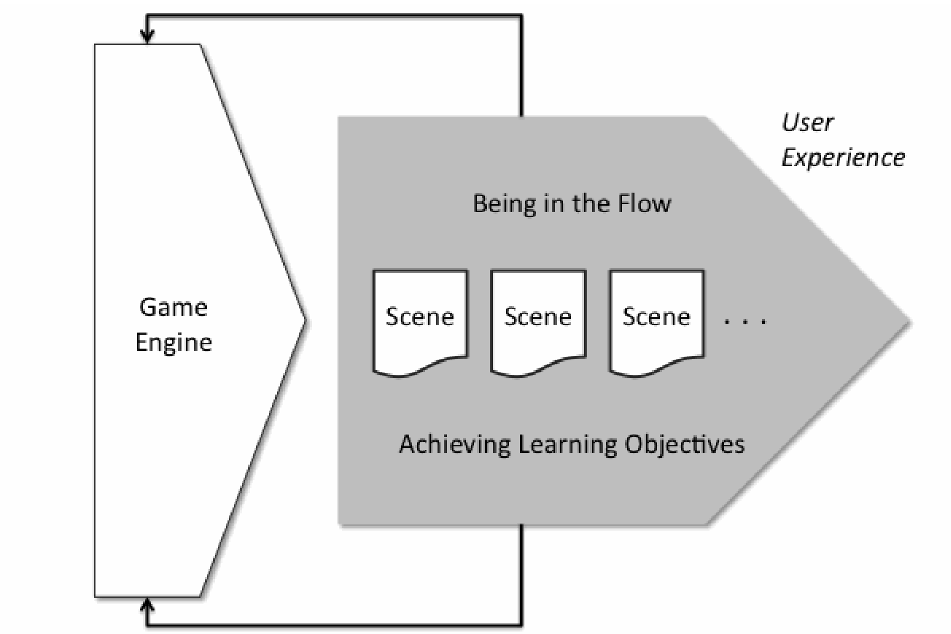

Figure 1: Adaptation in game engine

Considerations

Designing smooth and firm flows is primarily the responsibility of game designers, instructional designers and subject matter experts [3].

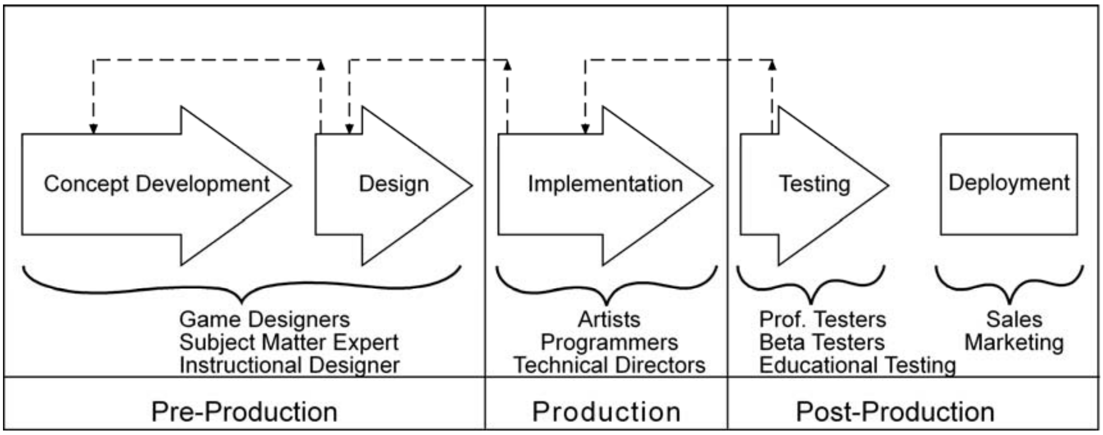

Figure 2: Game Development Process [3]

The necessary feedback loops in the development process assume some flexibility from the design itself and from the technology used in production phase. Conversely, as producing specialized interactive game elements and sophisticated artwork are extremely labor intensive and time consuming, re-working and re-implementing these assets becomes costly.

Excitement and curiosity is a crucial factor in keeping learner's motivation at the desired level [2]. Designers must consider carefully how to build remediation resources while still maintaining the motivation level of learners who are unsuccessful in their initial attempt at completing the training. Though the ideal solution of developing multiple custom assets for each training attempt may be out of reach, dynamically generating the content and maintaining it separately from its visual presentation offers a more feasible solution.

We propose a development framework that:

- supports isolation of the presentation interface from the content of the story,
- supports the concept of reusable, skinnable components,
- facilitates rapid modifications and creation of products.

Although numerous authoring tools fulfill some of these requirements, supporting the development of static, environment-based sequenced learning materials, they don't support:

- the concept of dynamic, cross-scene or global objects
- high-level implementation of flow experiences,
- various Learning Managements Systems.

Our goal is to provide a tool that meets all these requirements, facilitating the affordable authoring of flow-driven DGBL and SBL applications.

The HoloRena framework

Derived from the sequencing concept, the base of a game or learning resource can be implemented as a sequence of autonomous sub-applications. These sub-applications are implemented as configurable templates enacting a certain type of externally injected multimedia content. They can be used for multiple scenes, in different flows, displaying static or dynamic content. In our framework these sub-applications are called *presenters*. Presenters are pre-compiled and usually published to a remote location.

The game engine, or *player* is initialized with the content of the game flow. Flows can contain a sequence of scenes, actions, and other flows. A scene is an instance of a presenter configured with content for execution. Actions are segments of code written in a script language that act upon a globally visible data space and thus manipulate sequencing decisions. This configuration provides the freedom to maintain the content of the game and the player itself without modifying the presenters.

The framework must also be designed to handle cross-scene objects and asynchronous events (like timers). In the HoloRena, cross-scene objects are referred to as *gadgets*. Gadgets are precompiled, dynamically loaded from the story flow, configurable sub-applications and are very similar to presenters though they do not necessarily have visual representation. In some cases gadgets can be considered as plug-ins.

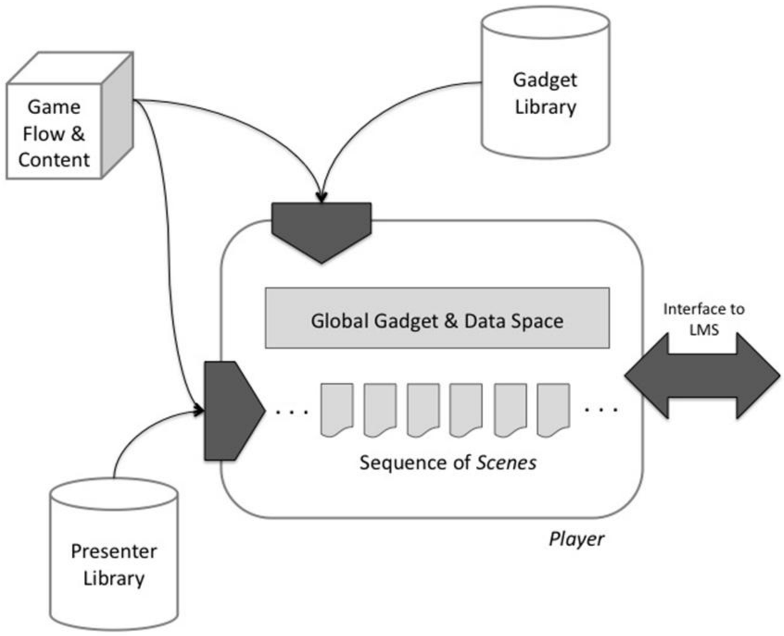

Figure 3: HoloRena architecture

Sequencing through the flow

When the content of the main flow is loaded, the player executes it. Execution of the upcoming flow element (scenes, actions, sub-flows) is based on certain conditions (expressed in the flow content), allowing implicit branching via skipping sub-flows, or flow elements. When the execution of the current flow element has completed, the player seeks the next executable flow element. This is the standard progression in the flow.

The player allows irregular (back, jump) navigation between flow elements as well, though it is a key point in the concept that the representation of the flow experiences (as flow definitions) should be kept easy-to-read, clear and simple.

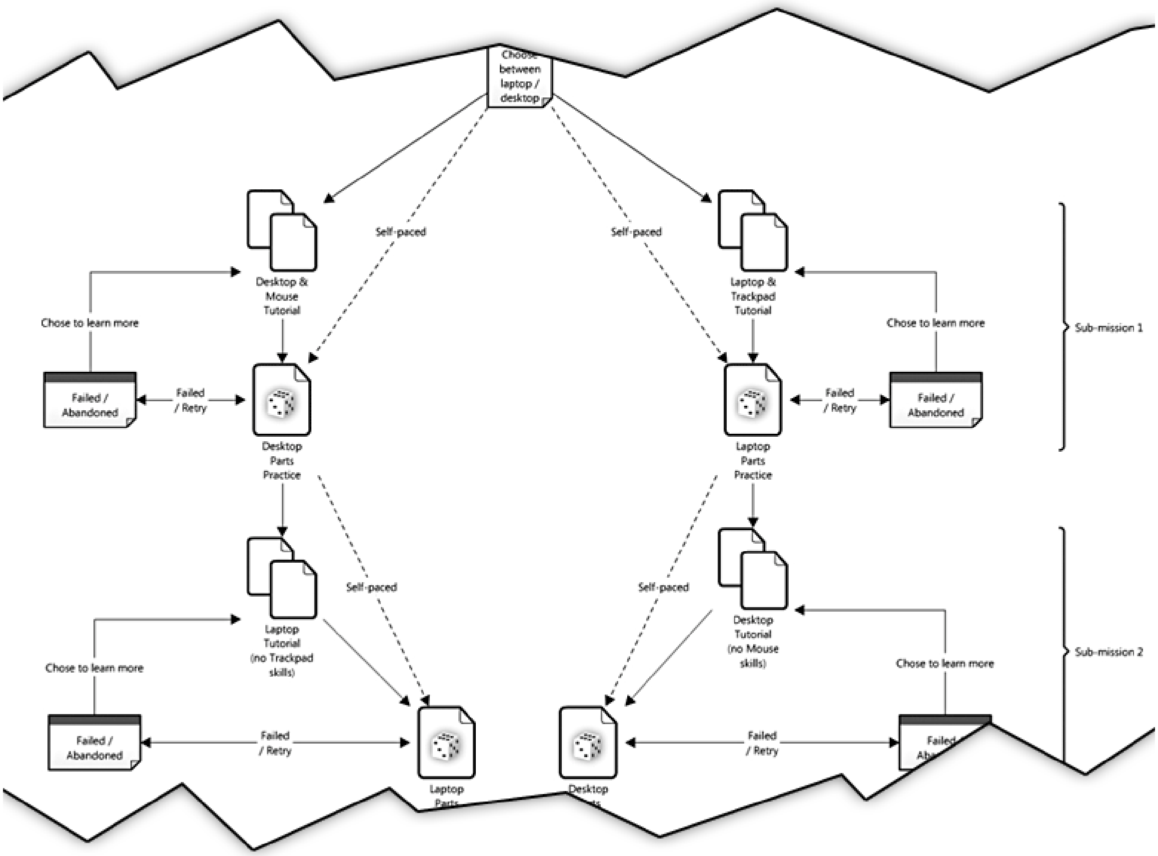

Figure 4: Sample flow content for a game mission

Integration with the LMS

Presenters and gadgets can be preloaded asynchronously, synchronously or on demand. Designers can easily implement preloading actions before intense, fast flow sections (for example before starting a mission) so as to avoid interruption in the flow experience. The player facilitates holding the learner's attention while the execution of a flow is blocked by a loading event.

The HoloRena framework's persistence relies on communication with either a SCORM or eLMS [4] server.

Implementation and status

Our research team is currently developing the proposed framework in support of online learning resources to be used in professional cyberforensics training. Taking currently available web technologies into consideration we chose Adobe Flash/Flex as the platform for the framework. We intend to deploy the first courses based on HoloRena in the summer of 2010. For more info visit: http://www.prototus.org/

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László Jurácz
Vanderbilt University
Nashville, U.S.A.
laszlo.juracz@vanderbilt.edu

Gábor Pap
Vanderbilt University
Nashville, U.S.A.

Larry Howard
Vanderbilt University
Nashville, U.S.A.

Julie L. Johnson
Vanderbilt University
Nashville, U.S.A.

Programming with Games

Introduction

Programming is known to be a difficult subject for many students. Being a fundamental part of the computer science curriculum, the high dropout and failure rates in introductory programming units pose to be a problem that requires urgent attention in our department. As a measure to counteract this situation, the teaching committee responsible for programming units at introductory levels conducted a curriculum review over these units in early 2007. Over the course of this review, three main obstacles have been identified as to why students were not doing well in these units: (1) *problem-solving ability*; (2) *logic thinking and innovation*; and (3) *motivation and persistency*.

Game-based Learning

Inspired by the fact that most of the young people like computer games, we have resorted to game-based learning as a remedial solution to the obstacles identified. Computer games have been known to offer several benefits in the educational context, e.g. engage learners in learning environments [1-3], increase motivation [4-6], intensify retention of information [7-8], and improve problem-solving skills [9-11]. In addition, computer games also allow groups of learners to share knowledge, skills, resources, and cooperate for solving problems [2, 11].

Eck [12] pointed out three approaches for integrating games into the learning process: (1) learners create their own games from scratch; (2) instructors design games to integrate learning and game play; and (3) use existing games in the classroom. After some careful considerations, we deemed the first approach to be tricky for assessment purposes, while the third approach is quite impractical for programming units. As such, we decided to adopt the second approach by designing purpose-specific games ourselves and integrate these games into our teaching material. The details of our approach are as follows:

i. *Lectures* – instructors deliver lectures on different programming topics with a common theme that makes use of the purpose-specific games. Our hope is that lectures with a 'games' theme would attract students' attention to a greater extent. From one lecture to another, programming concepts are illustrated in terms of how games can be constructed. Students' instinct on games would also allow them to remember the lecture material in a much better way.

ii. *Tutorials/Labs* – students will then work on (and play with) their hands-on exercises in tutorials/labs based on the same games used for illustrations in lectures. The main advantage of game-based exercises is that, unlike traditional programming tasks, games have stochastic behaviours which do not necessarily be solved from one step to another. This allows students more flexibility in attempting their exercises.

iii. *Assignments* – instead of individual assignments with separate topics it is now a single assignment but in several stages, with a continuous game theme being introduced. The game itself is basically the problem which students need to solve. At the beginning stages, the assignment is on individual basis. When the tasks become more complex at the later stages, students are allowed to form groups and work together. This not only motivates them to keep trying, but also stirs them to think out-of-the-box.

The Results

Game-based learning for introductory programming units was first put into practice in Semester1/2007. Every semester is then a milestone for us to check and reflect on the approach, and consider how we could further improve it. At the end of Semester1/2007, we observed a slight increase in the overall passing rate but statistical tests on students' results indicated that the improvement was not significant. Subsequently, similar trends were observed in Semester2/2007 and Semester1/2008. It was not until Semester2/2008 that a significant improvement has been recorded. Between Semester2/2008 and Semester2/2009, the passing rate has improved by 15-20% compared to the years prior to the introduction of game-based learning on these introductory programming units. Due to the sensitiveness of these data, the details of these results cannot be tabularised. Figures 1 and 2 show two examples of the games created by students in Semester2/2008 and Semester2/2009.

The insignificant improvement observed during the early days of this approach has intrigued us to find a cause for it. After a thorough analysis on the feedback and comments from students, we found that this ineffectiveness is mainly because of inappropriate levels of difficulties of the games used. There were some comments from weaker students indicating that due to the complexity of the games, they just gave up. This finding tells us a great lesson that it is extremely important for the right games to be used!

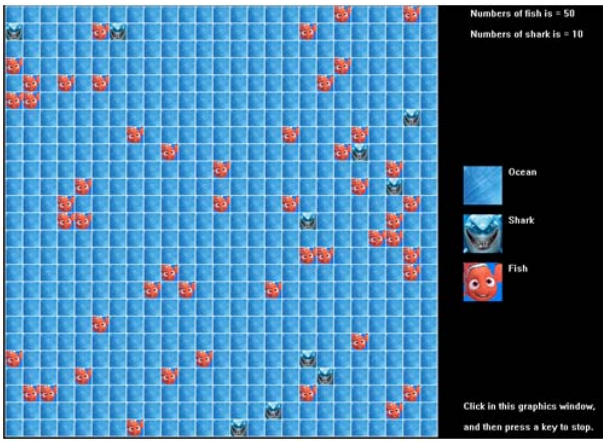

Figure 1: The Shark-Fish game.

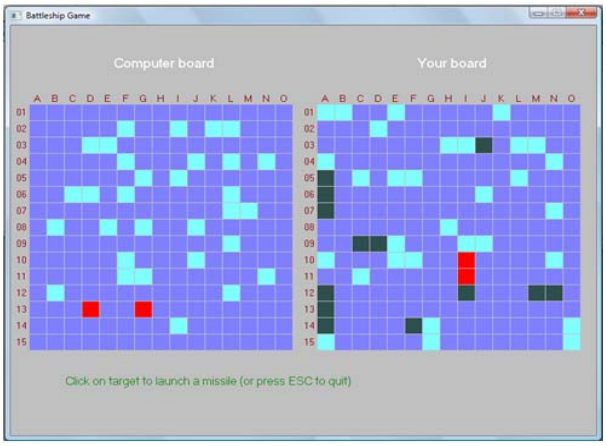

Figure 2: The Battleship game.

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Raymond Chiong
Swinburne University of Technology
Australia
rchiong@swin.edu.au

A software solution for facilitating the Beergame

The aim of this article is to introduce a software product which was developed for facilitating the well-known beergame, a role-play game for simulating supply chain inefficiencies as depicted by the so-called bullwhip effect.

The Beergame

The original beergame (or beer distribution game) was invented in the 1960s by Jay Forrester at MIT as a result of his work on system dynamics. While the original goal of the game was to research the effects that systems structures place on the behaviour of decision makers ("structure creates behaviour"), the game can be used for facilitating systemic thinking in a range of professions.

In the beergame, students enact a four-stage supply chain, the task of which is to produce and deliver units of beer: the factory produces and the other three stages deliver until the beer units reach the customer at the downstream end of the chain. In doing so, the aim of the players is rather simple. Every stage has to fulfil incoming orders of beer by placing orders with the next upstream party, thereby managing inventory. Since communication and collaboration is not allowed, the players invariably create the so-called bullwhip effect. 'Bullwhip' refers to the effect that the amount of periodical orders will swing wildly during the game and amplify upstream in the supply chain towards the production end. This causes a range of operational problems such as out-of-stock situations, inventory overflow, bottleneck situations and ultimately high total system cost. The bullwhip effect is a well-known phenomenon and a pertinent symptom of co-ordination problems in supply chains and a placeholder for similar problems in other systems (e.g. organisations).

With the beergame, students experience first hand, not only the problems of lack of information sharing and collaboration in fragmented systems (such as supply chains), but also the main causes for the creation of the bullwhip effect, such as lack of information, systems fragmentation and local optimisation thinking. Henceforth, the game can be used in a range of management educational areas: in its most general sense the game encourages systemic thinking ("outside the box") applicable in any organisation. In its most applied sense it helps educate supply chain operatives in the value of information (systems) and collaborative behaviour.

Reasons for developing the software

A range of products exists for facilitating the beergame in a classroom or workshop setting. The reason for developing a new product was to circumvent the three main shortcomings of existing implementations. Firstly, a software implementation helps to circumvent some of the problems associated with the traditional (physical) board game or table versions: a) as inventory is represented by physical tokens it is visible to other groups, thus compromising the non-information rule; b) the logistical effort needed to facilitate the game (e.g. recording order amounts and inventory data for later discussion) tends to be enormous, especially in larger groups. Secondly, existing software versions are Internet-based and thus render a fast and reliable Internet connection necessary to play the game. Also, successful facilitation depends on third party servers and thus is outside the facilitator's control sphere. Thirdly, existing implementations only facilitate the standard beergame, but do not sufficiently capitalise on the possibilities of a software rendition of the game.

Short overview of the software

Our beergame facilitation software is a cross-platform client-server application that allows setting up ad-hoc sessions in a classroom or workshop context. It runs from a USB stick and is administered using a standard web browser. The instructor simply initiates a session and hands out a URL to the students, which they use to log on to the server from their computers (e.g. their laptops in a wireless setup or from lab computers).

The software provides a high degree of freedom in setting up game sessions, as a range of settings can be customised, such as the supply chain length, shipping delay, initial values, or customer demand. Also, more than one chain can be administered at the same time. During play, the instructor is able to see the game progression in real-time (e.g. the bullwhip effect building up). After finishing the game, the data created by the players can be downloaded as an interactive excel file for immediate presentation and discussion.

An important aim in developing the software was the student experience: The frontend is programmed in Macromedia Flash and shows animations of incoming boxes and envelopes in order to make up for the lack of physical representation via actual tokens.

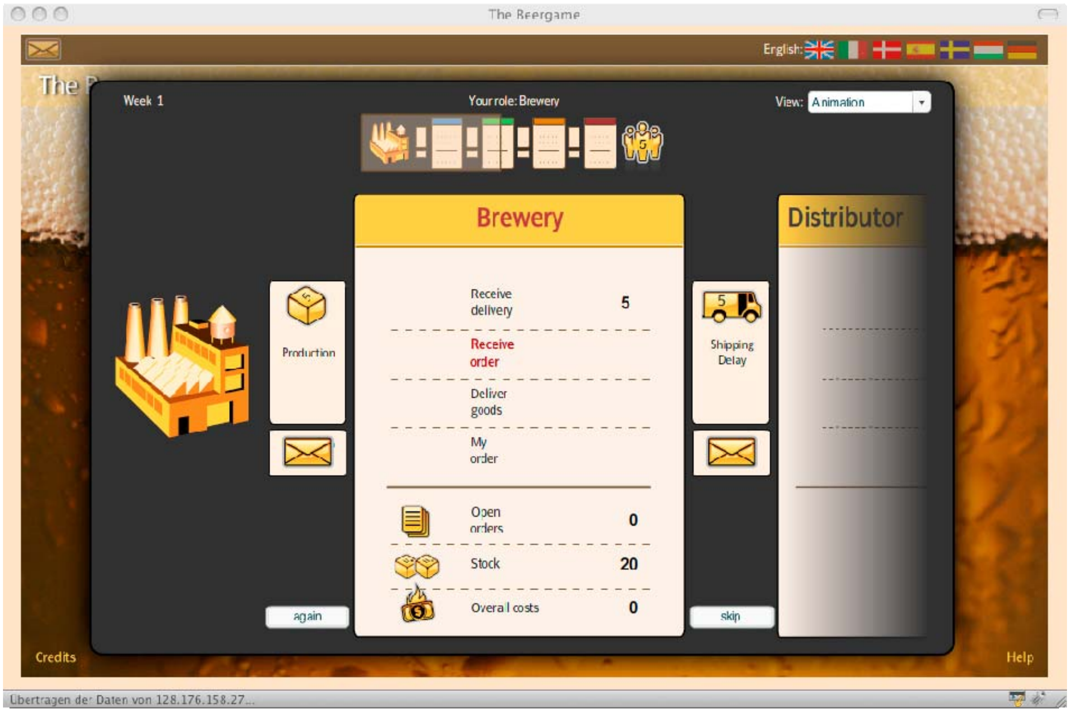

Figure 1: Player frontend (with information sharing)

One of the most powerful aspects of the software, and a main reason for its development, was to demonstrate the usefulness of typical supply chain management measures in circumventing the bullwhip effect and associated problems, such as:

- Information sharing: The game allows providing consumer demand data for all parties (e.g. POS data sharing), visibility of shippings (e.g. tracking & tracing), and visibility of inventory levels (e.g. ERP data integration).
- The software allows amending the supply chain structure by omitting one stage (e.g. disintermediation) or shortening the delivery delay (e.g. logistics optimisation).

- It allows players to communicate in order to facilitate collaborative behaviour.

Use of the software in a typical session

As the software supports the above-mentioned options it is feasible to play not just one session in the traditional setup, in which students will inevitably create and experience the bullwhip effect, but to also play a second round in which to demonstrate how to overcome many of these problems. Having experienced what it means to be controlled by the forces that unfold in an uncoordinated system, students can then be "put in charge" and experience first hand the differences, which information sharing can make in improving decision making behaviour. This powerful learning experience can help demonstrate the need for ICT-led initiatives to facilitate organisational change in a variety of organisational fields.

Information on the beergame, its background and the software can be found on http://www.beergame.org.

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Kai Riemer
The University of Sydney
Australia & Münster University, Germany
Kai.riemer@sydney.edu.au

Multimodality in Game-based Learning Environments

Game-based learning environments represents one particular type of edutainment applications that have the great potential to support learning contexts, as they provide a new form of engagement that is participatory and collaborative. In these environments, multimodal interfaces play a fundamental role for the achievement of a high degree of interactivity during the learning process. Multimodal interfaces, indeed, by enabling the combined use of speech and gesture and various physical and virtual avatars and metaphors, allows the learner to directly interact with the learning objects. This active involvement has the great potential to produce good results in terms of motivation, understanding and long-term acquisition of contents, compared to the traditional learning methods based on the passive reading of books. In fact, the use of integrated multiple input modes provides users to benefit from flexible and powerful dialogue approaches, as how an our previous work (Caschera et al., 2007) has underlined through the analysis and formalization of the main features of multimodal interaction and systems.

Nowadays, game-based learning environments have been used in many different modes for supporting learning experience (Herz, 2001). Games have been used to support learning communities by using interaction paradigms based on metaphors in order to allow people to experiment and explore real world, such as Grangeton (http://www.grangeton.com/web/) and The Sims (http://thesims.ea.com/). Moreover, games have been applied to simulate microworlds, where people can interact in the game holding roles and operating activities that can be transferred in real life contexts, for example Revolution (http://www.gamerevolution.com/).

On the other hand, games can be played on several devices, such as personal computers, game consoles, handled devices and using mixed interfaces (i.e. augmented reality and mobile devices). The use of these interactive technologies has given advantages to game-based learning due to the flexibility and the possibility to give immersive learning experience (De Freitas, 2007). In addition, some researches on game-based learning environments have been focused on the use of multimodal interaction as the medium for conveying educational material (Jovanovic et al., 2008). This approach aimed at identifying and constructing profiles of user interfaces for educational games using motivation as the key ingredient in the learning process. The investigation of existing game-based learning environments leads us to believe that a distributed architecture, networking technologies, and multimodal facilities have to be integrated into this kind of environments in order to enable an interactive and participatory learning experience to learners. Therefore, we propose an Advanced Multimodal Platform for game-based LEarning (AMPLE), which enables the interaction in a gamed-based learning environment through a multimodal interface. This platform allows efficiently managing multimodal communication between people participating in the virtual learning environment.

AMPLE is based on a client-server architecture as depicted in Figure 1. Each person (i.e. learners and teachers) can access to AMPLE from its own device that is equipped with a multimodal interface. Therefore, an AMPLE client includes specific I/O devices, such as, for example, display, cameras, microphone, and loudspeakers, as well as the components for extracting features from the received signals. The feature extraction occurs on the client side, since it requires limited amount of memory and computational power, whilst the remaining recognition process, which consists in matching the extracted features with a predefined set of patterns, is completed on the server.

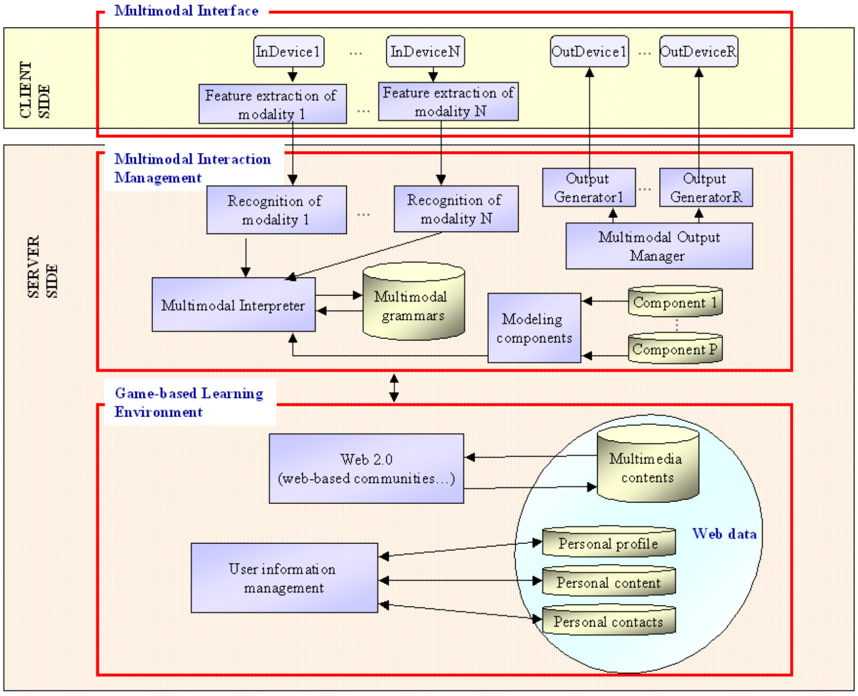

Figure 1: Architecture of the AMPLE environment

The AMPLE server consists of the *multimodal interaction management* and the *game-based learning environment*.

The *multimodal interaction management*, whose architecture has been proposed in an our previous work (D'Ulizia et al., 2008), is responsible for recognizing unimodal input coming from the features extractors of each modality, appropriately interpreting these inputs, integrating these different interpretations into a joint semantic interpretation, and understanding which is the better way to react to the interpreted multimodal request by activating the most appropriate output devices. To do that, this component includes:

- the unimodal input recognizers, such as, for example the Automatic Speech Recognizer and the gesture recognizer, and the output generators, such as the Speech Synthesizer;
- the multimodal interpreter that integrates the recognized inputs, assigning them the appropriate values for the attributes, as required by the multimodal grammar notation, and applies the production rules stored in the Multimodal Grammar Repository, to parse the multimodal input;
- the modeling components, that are aimed at capturing some information used during the interpretation phase for leading up to the most probable interpretation of the user input. Examples of modeling components that can be integrated in the framework can be the user, content and context modeling components.
- the multimodal output manager for generating appropriate output information, through the available output modalities (multimodal fission).

The *game-based learning environment* consists of two main components:

- the Web 2.0 module, that provides social networking services, such as web-based communities, for supporting online gaming of multiple players;

- the user information management, that is devoted to store and manage personal data of network members. In particular, it provides controlled access to the network and to user information, such as personal profile, contents and contacts. These data are contained in three networked repositories.

In conclusion, the use of multimodal interfaces in game-based learning environments can help to enhance learning processes as it makes the interaction with the game more easy, participative and less workload consuming than standard graphical interfaces.

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Maria Chiara Caschera
IRPPS-CNR, Italy
mc.caschera@irpps.cnr.it

Arianna D'Ulizia
IRPPS-CNR, Italy
arianna.dulizia@irpps.cnr.it

Fernando Ferri
IRPPS-CNR, Italy
fernando.ferri@irpps.cnr.it

Patrizia Grifoni
IRPPS-CNR, Italy
patrizia.grifoni@irpps.cnr.it

Designing Games for Learning

This paper assumes everyone agrees with the recent expert summaries of intellectual, social, and learning values in using games by Royle 2009 and Gee & Hayes 2009. These can be supplemented by a flexible, systematic and practical pedagogic framework that has been refined and validated over many years in the Online Education & Training course from the University of London. It is necessary to educational game design with greater input of pedagogy, while retaining the existing motivational benefits.

The system starts from the three basic elements in any learning event: the 3Ps. These generate 1000s of learning scenarios.

- **P1** = Teacher **p**resents the <u>content</u>
- **P2** = Teacher helps learners to **p**ractice the <u>activities</u> proposed by the teacher, and offers feedback.
- **P3** = Teacher asks learners to **p**erform by producing <u>evidence of their competence</u>, for which they receive feedback and/or grades.

P1, content, is always there, otherwise there is nothing to learn. Learners can become aware of content through many different media, such as the teacher's explanation, reading, audio-visual materials, the internet, or demonstration as part of a game. Whether they find the content independently through stimulating activities within a game, or have it brought to their attention perhaps by the teacher before the game, it has to be there, e.g. concepts, facts, skills, processes, attitudes or approaches. Teachers scaffold learning by packaging content in be more learnable form, e.g. sequencing from familiar to new, easy to more difficult, simple to more complex, or perhaps in a hierarchy from general to particular (or *vice versa),* or simplifying it (e.g. non-technical language). All these methods are integral to the structures of games, though normally below the level of awareness even of the designers.

Learning is always active, **P2**. Any content, however presented, becomes embedded in the learners' cognitive structures through activity. And games are the *Activity par excellence,* since they consist of a coherent bundle of activities. Again, just as the teacher's role is to organise such activities so that they lead to useful learning strategies for acquisition, understanding, and memory, games can do this by their necessarily wide range of purposeful activities.

Learners always need and seek ways of evaluating their own learning**, P3**. Success or failure in a game provides this by definition. But whereas formal assessment provides a measure of what the learner cannot do, a game can sustain motivation by encouraging what they *can* do. During conventional, or traditional teaching, the 3Ps are used in the chronological default order**:** P1 + P2 + P3, i.e.   Presentation - Practice - Performance

But there are 6 other possible orders, as shown in CHART 2. They generate 6 different modes of learning that can be transformed into 6 different educational game design modes. The chart shows a learning example from different subjects and below it are basic proposals for game applications which can be infinitely varied.

1	**Conventional**	**Presentation**	**Practice**	**Performance**
The default sequence: Give the knowledge, skills or attitudes first, arrange activities, then check.				
History:		Show facts in pictures	comprehension text	Q/A
2	**Resource/research based**	**Practice**	**Presentation**	**Performance**
Ask learners to inspect/consult sources of the knowledge, skills or attitudes, summarise the knowledge, skills or attitudes, check.				
Botany:		Plants to inspect	Explain structure	Write report
3	**Discovery based**	**Practice**	**Performance**	**Presentation**
Arrange activities through which learners to discover the knowledge, skills or attitudes, check, summarise the knowledge, skills or attitudes.				
Science:		Watch chemical reaction	Create similar one	Explanation
4	**Problem stimulus**	**Performance**	**Presentation**	**Practice**
Set a problem for the learners to solve, check and present the solution, arrange further practice.				
Geography:		Find average temperatures	Explanation	More temperatures
5	**Problem application**	**Performance**	**Practice**	**Presentation**
Set a problem for the learners to solve, ask them to apply it, check and summarise the solution.				
New language:		Oral comprehension 1 *w .picture clues to help in*	Oral comprehension 2	Language round-up
6	**Feedback responsive**	**Presentation**	**Performance**	**Practice**
Give the knowledge, skills or attitudes first, check what further practice is needed, arrange activities.				
Maths:		Demonstrate	check exercises	more exercises

As a basic starting point in educational game design:

1. **Conventional**: The game starts with presenting the knowledge required and contains no need for any more. The key focus is on embedding it through playing so as to clinch understanding and aid recollection.

2. **Resource/research based:** Players are sent to consult sources for the necessary knowledge. Their success in the game is the feedback on whether they have done this adequately.

3. **Discovery based:** Players start with activities through which they discover necessary knowledge, but if they have difficulties, they are looped back into further discovery until they demonstrate the [in-built] success level needed to start the game.

4. **Problem stimulus:** Play starts with a problem. The solution found by the players is tested in a preliminary game, and success leads into the main game. This can be an iterative process.

5. **Problem application:** As for **4.** but there is no preliminary game.

6. **Feedback responsive:** Content is given first, but before play starts there is a check to establish whether it has been properly understood [either internal or external to the game].

Whether a game is for one, two or multiple players, and whatever its moves, strategies or rules, the issues for learning are handled differently through each of the 6 patterns. The key point here is that the design of the knowledge, activities and feedback can be imaginatively varied. Games can capitalise on the full range of talk, text, multimedia, the internet - especially Web 2.0, and technologies such as mobile devices. Competition, partnering, teamwork, explanation, outcomes, inference, scoring, etc. may be included. Any choice could be either inside or else linked to the game from outside. The subject, context, and goals of the learning will determine the choices.

Therefore, readers should find this necessarily compressed demonstration a generative springboard from which to develop further ideas.

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Anita Pincas
Institute of Education
London, UK
a.pincas@ioe.ac.uk

Role Play Gaming and Learning

Currently, any reflection on education and training systems must include the analysis of the changes imposed by the use of technology, including virtual and immersive environments (Rosini, 2007), because they influence human cognitive functions, such as memory, perception, imagination and reasoning. Learning with these tools should emphasize viewing, hearing, feeling, experimenting, interpreting and deciding (Tobaldini, 2003). Since we live in a society that also demands creativity, responsibility and autonomy, Role Playing Computer Games (RPCG) may well be an answer for a new learning model.

A game can be instantiated for learning as it involves mental (and sometimes physical) stimulation and develops practical skills – it forces the player to decide, to choose, to define priorities, to solve problems, etc. Immediate reward (and feedback) is a major motivational factor, whether it is translated as game entities (more life power, access to new levels, etc.) or as neurological impulses (happiness, feeling of achievement, etc.). Games can be social environments, sometimes involving large distributed communities. They imply self-learning abilities (players are often required to seek out information to master the game itself), allow transfer of learning from other realities and are inherently experiential with the engagement of multiple senses. It is no surprise that the use of games for learning are currently under research, like in Moreno-Ger (2009), Blanco (2009), Dodig-Crnkovic G. (2005) and Eck (2006), just to cite a few.

Role Play Games (RPG) are characterized by specific strategic and action contexts of play where each player takes on a role according to the game rules. Play actions and decisions happen through a spirit of discovery and learning.

We've created a RPCG for learning, representing the setup of the city of Funchal, the capital of the Madeira Island. The city started by small settlements on the slope of the bay Funchal and gradually developed until, in 1508, it gained the royal letter of recognition. Structures of government were created, with the figure of the Main Captain (in Portuguese: "*Capitão Donatário*") as general administrator. The user/player assumes his role and interacts with other characters like peasants, fishermen, slaves, merchants, sailors, soldiers and priests. Players progress by applying and developing their knowledge in several areas, such as History (events and importance of the Discoveries, for instance), Geography, Society (social relation between actors, for instance) and Economics (process of development of colonies, for instance). This multidisciplinarity is embedded in the scenario and in the challenges. Players must understand the logic of social and hierarchical relationships, explore natural and imported resources, develop trading skills and deal with dangers (pirates, etc.) of the epoch.

The play environment represents a panoramic view of Funchal with the main dwelling areas. The construction of several historical buildings and other real elements can be determined by the player. However, to close up on the historical reality, the correct locations will give the player more points.

Fig. 1 – Game environment

A relevant aspect in the RPCG is that play is not linear so the game will not be the same every time it is played. However a grading factor was included so that players have the sensation that they could perform a task better. Therefore they are motivated to try other forms of reaching the game objectives.

The road book of the RPCG was defined with five possible campaigns in a time scope of 150 years, between 1420 to 1570. Each campaign represents a moment in the island colonization, with different intervenients and factors that influenced the evolution of the city. Objectives are defined for each campaign: for instance, in the first campaign the main objective is the construction of the essential elements for the city development (house of the captain and of the colonists, the religious chapels and sea port).

The implementation of the game with students of the secondary education in the Madeira Island was very successful (Batista, 2008). Their knowledge of the local history and the motivation behind the setup of Funchal was greatly enhanced. As a consequence we decided to further develop the project in a more ambitious scope: Europe. A new project, denominated SELEAG - Serious Learning Games, will develop an extensible, online, multi-language, multi-player, collaborative and social game platform for sharing and acquiring knowledge of the history of European regions. Initially 3 different but interrelated geographical scenarios will be used so that students/players will be involved in a play that replicates the evolution of these European places over the last 600 years in social, cultural, economic, resources and military aspects. The game will emphasize the cooperation between European countries to strengthen the notion of European citizenship.

Acknowledgements

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Ricardo Baptista
Escola da APEL, Funchal, Portugal
ricardjose@netmadeira.com

Carlos Vaz de Carvalho
Instituto Superior de Engenharia do Porto, Portugal
cvc@isep.ipp.pt

A Game Design Method Empowering Children and Adults

Abstract. Our research proposes a narrative approach based on informant design methods to build casual, educational games for children. A mobile phone game was developed and shows that the proposed method has promising potential so far. Future work will evaluate the game and refine the methodology.

Introduction

Educational digital games for children have had relatively little success. Research is looking at integrating children, the target users, into the design process to achieve more successful games. Our work explores a design procedure that maximizes both children and adult designers' contribution in casual, educational game development. Prior research suggests that children's involvement in design progresses in terms of extent and timing: from users to testers, informants and finally design partners (Druin, 2002). Informant design recognizes that children have certain knowledge, that adult developers do not possess, about what is appealing (Scaife et al., 1997). Yet, the "black box" problem has been reported: children see their ideas as going into a black box and coming out as unrecognizable design solutions (Nousiainen, 2009). Moreover, Scaife & Rogers (1999) found that "many of the kids' ideas are completely unworkable in computational terms". Conversely, positioning children as 'design partners' asks that they are continually involved in the design process (Druin, 2002) making it very resource-intensive.

Our Methodology

We propose an informant-based methodology using children in a narrative approach. Flexible in terms of time, space and resources needed, our methodology aims to produce games that are contextually relevant for kids while allowing them to feel empowered. Concurrently, it makes up for children's lack of specialized design knowledge by achieving a balance between kids' and adults' involvement. The proposed methodology consists of three major phases (Figure 1). It was tested with a game targeting lower secondary school children on the curriculum topic of 'weather', which children usually have problems understanding.

Phase I: Narrative Design

Phase I was conducted in a one-day workshop session with 23 boys, aged 13 years old, from a local school. The initial step consisted of brainstorming sessions, aimed at triggering prior knowledge via random 'weather'-related images. No images were taken from textbooks to prevent children's possible resistance to "school work". Participants wrote down their thoughts on sticky notes, upon seeing each image, and subsequently categorized these on large sheets (Figure 2). The most repeated theme, 'global warming', was identified through a process similar to 'post-it notes surveying' (Druin et al., 2009). Participants underwent a group brainstorming session on the theme. This produced a valuable vocabulary set from the children, with words like 'tsunami' and 'hot'. To level out the kids' knowledge of games, a game designer presented on common game types and elements. In their groups, children devised game narratives based on the brainstorming discussions and using low-tech prototyping materials such as paper and colored pencils (Druin, 1999) (Figures 3 and 4). A game designer, whose interference was minimal, facilitated each group.

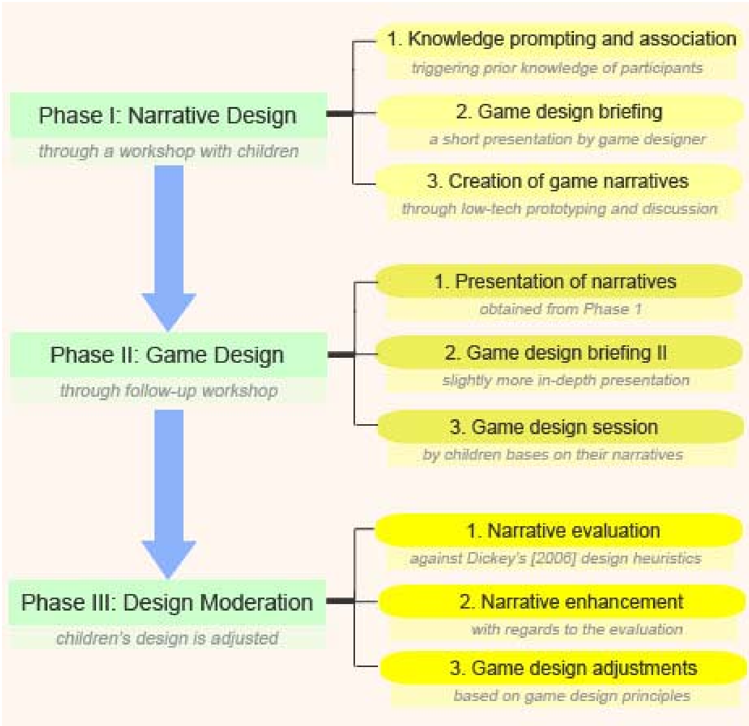

Figure 1: Narrative-driven game design process

Figure 2: Categorized Sticky notes

Figure 3: Children designing their game narrative

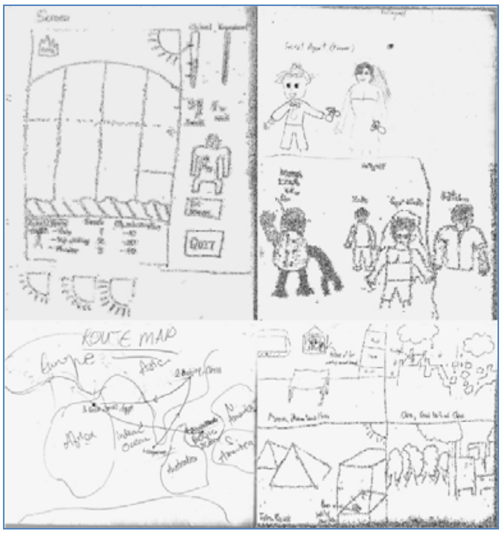

Figure 4: Illustrations drawn by the children

Phase II: Game Design

In a follow-up workshop with the same kids, we presented a summary of their game narratives, asking them to make sure we understood their narratives correctly. A game designer briefly presented on gameplay and mechanics. In groups, children worked from their own narratives to devise the framework of a game design, using low-tech tools.

Phase III: Design Moderation

Based on kids' votes and several criteria (e.g. completeness of design), one narrative was chosen. It tells the story of an orang utan who wants to save the world from global warming. The design moderation phase aims to improve the children's design while keeping its essence intact. Dickey's (2006) design heuristics for integrating game narrative into instruction was useful in gauging the suitability of the children's story for a game (Table 1).

Design Heuristics	Children's Game Narrative
Present the initial challenge	Rising sea levels around Tropic Isle
Identify potential obstacles and develop puzzles, minor challenges and resources	• Humans illegally cutting down trees on the island • World's climate is getting hotter • Carbon dioxide levels are increasing
Identify and establish roles	• **Hero:** Ah Meng, the Orang Utan • **Mentor:** None • **Threshold guardian:** Ah Meng cannot stand the heat and decides to counter the illegal tree loggers • **Herald:** He gets rewards in the form of seeds to plant trees and fruits that he likes to eat. • **Shapeshifter:** None • **Shadow:** Illegal tree-loggers • **Trickster:** None
Establish the physical, temporal, environmental and emotional, and ethical dimensions of the environment	• **Physical:** Mobile environment • **Temporal:** Urgency of reducing temperature, carbon dioxide and sea levels • **Environmental:** Fantasy characters set on an island covered with coconut and banana trees • **Emotional:** Frustration of Ah Meng • **Ethical:** None
Create a backstory	Based on the different dimensions of the environment, profile of the protagonist and central challenge stated above
Develop cut scenes to support the development of the narrative storyline *(feedback about whether learners have successfully accomplished a task)*	The more tree loggers he successfully attacks, the more rewards (e.g. seeds) he gets from the government of the island who recognizes his hard work.

Table 1: Children's narrative from workshop as mapped to Dickey's [2006] heuristics for narrative integration

The gameplay devised by the children (a tower-defense type) was not entirely clear but it gave us enough details to determine the game genre and formal elements. We filled in minor design gaps, using only materials from the kids' notes. Minor changes were made to the narrative to improve its fit with the game design. For instance, the government was eliminated as an actor in the story. The final design is an action-based game with elements of strategy and resource management. The game prototype, titled *I'm going Bananas* (Figure 5) and built on the Android platform, was published on the Android market. Feedback is generally positive so far.

Figure 5: Screenshots of the game I'm going Bananas

Conclusion

The proposed informant-based methodology showed promising potential in the development of *I'm going Bananas*, which presents children's ideas polished by experienced game designers. Future work consists of expanding the game, conducting in-depth evaluations, and refining the methodology according to feedback.

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Sharon Lynn Chu Yew Yee
Mixed Reality Lab,
National University of Singapore

Gu Yuan Xun
Mixed Reality Lab,
National University of Singapore

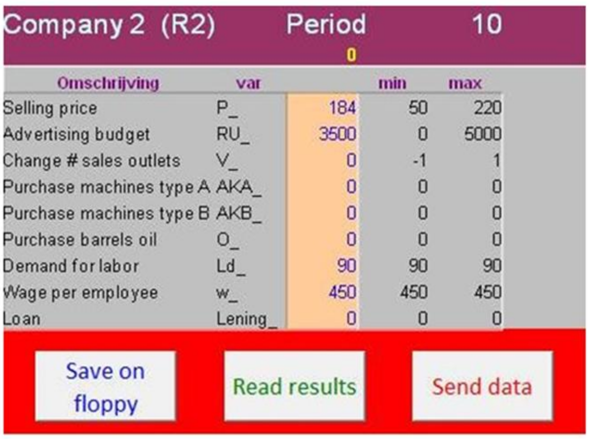
Vivian Chen Hsueh-Hua
Wee Kim Wee School of Communication and Information,
Nanyang Technological University

Henry Been-Lirn Duh
Dept of Electrical and Computer Engineering,
National University of Singapore

A Game Based Course in a Dutch University

This paper describes a course in a Dutch University that has been based on a management game. Though it was held from 1997 to 2001 it has only once been documented in the open literature (Casimir,2000). The purpose of the course was to allow students in the first year of the combined Business and Economics program at Tilburg University to integrate and practically apply their knowledge of all subjects taught in this program. Apart from business and economics subjects this included mathematics and statistics. The course would also help students to choose between Business and Economics for the remainder of their study. One of the reasons for the abolition of the course was the change to a conventional Bachelor-Master schedule by all universities in the Netherlands. A fairly simple game was especially designed by Eline van der Heijden, a recent economics Ph. D. who was especially engaged to coordinate the course. The game model was described by a set of simultaneous equations that were interpreted by a proprietary program acquired by the university. The model used well known economic principles such as the use of elasticity for the computation of sales and the Cobb-Douglas function to calculate production. Students entered and received data in an Excel spreadsheet designed by Henk Opdenbrouw, a professional Tilburg University programmer.

During each round, which represented a period, players provided input data on nine items (see figure below). When the player pushed the “send data” button, data were checked against the boundaries provided by the game administrator and subsequently saved on a local area network. When all player teams had submitted their data, the game administrator started his Excel application to compute the results that were again saved on the LAN. As all players and the game administrator were in the same computer laboratory, the players got a sign when the results were available. Subsequently they pushed “read results” and received complete results, including data on sales and production of their own company as well as all other companies. In a state of the art application built today, data would have been stored on the web instead of a LAN, but the students might still use an Excel application.



The courses were given by a group of ten assistant or associate professors from all departments involved in the program, including some of the best economics and statistics teachers. Students worked in groups of three or four. During a semester, they met once a week with their teachers to get information on new aspects of the game and came back to play 10-15 rounds of the game in the computer room. A number of assignments to report on specific aspects of the game had to be completed by the student groups and were evaluated by the teachers. In the majority of the assignments, students had to use the data from the spreadsheets. This had the additional advantage that every group used its own data so it was impossible to copy the report from another group.

Typical reports ranged from a macro-economic overview to a statistical analysis of sales. As the model contained no random factor a correct analysis would yield a correlation coefficient of 1. It was the explicit purpose of the course that students would know and understand the model; hence they could improve their results by optimizing the relation between price, number of sales outlets and advertising outlays. This was not often done as usually no more than 10 minutes was allotted for decisions in the game and hence there was no time for team discussions or calculations.

The course showed a clear difference between students in business and economics. Students with a preference for business deplored the lack of opportunities to take risks and make strategic decisions. Moreover those students often disliked a mathematical approach. Similarly, teachers from the business departments (accounting, marketing, finance and organization) did not really understand the model of the game and hence did not contribute to its improvement, though the formulation as a set of equations instead of a program was intended to allow gradual improvements. On the other hand, some proposed changes, such as payment for the delivery of additional output, were not implemented because they would demand changes in the spreadsheet as well as the model. The main opposition of the course however came from the university management, which became increasingly opposed to the high cost of courses for small groups by fully qualified staff. On the other hand, the success of the course could be attributed to the teaching to small groups as well as by the use of a management game. A typical decision that was made for organizational instead of educational reasons was the introduction of a stock exchange game that asked for investment in stocks that moved in random directions. The theory underlying this game asserted that the best policy would be to hold on to the original investment, but students wanted to execute some transactions and hence treated the game as a pure lottery. From an educational point of view it would have been better to extend the original game with a stock exchange that allowed for stock issues and mergers, but this would take more effort than introducing a ready-made game.

In my view the main advantages of the use of the game as the base of an introductory course are the integration of knowledge on different subjects by students, the opportunity to give individualized assignments to students and the use of a game model to foster understanding of the relation between subjects by the teaching staff. The disadvantage is not the cost of the game itself, but the cost of supervision

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Rommert J. Casimir
Tilburg University, The Netherlands
Casimir@uvt.nl

A Visual Domain Specific Language for the Creation of Educational Video Games

Introduction

Educational video games and serious games are becoming more and more relevant as a complement to traditional instructional approaches. However, several barriers are in the way of the general adoption of this technology, such as the high cost or the integration of the games in the learning flow. At the <e-UCM> group at the Complutense University of Madrid we have developed the <e-Adventure>[1] platform for the creation of educational video games that addresses some of those problems. The current version of <e-Adventure> allows for the rapid creation of custom *point-and-click* adventure video games with low development costs [1].

In some cases, using COTS (*Commercial-Off-The-Self*) video games could solve at least partially some of these problems, but usually the available alternatives are very limited (e.g. using Civilization to teach History). When no COTS alternatives are found, a custom development is needed, but most educational professionals lack the necessary budget, tools and technical background. Using the <e-Adventure> platform allows educators to produce games without programming, but it is still perceived as too complex by many. According to our direct experience with educators at different levels, one of the most problematic issues is the difficulty to plan and develop a story using the system. In an effort to reduce this perceived complexity, we are creating a VDSL (Visual Domain Specific Language) to complement and enhance the creation of <e-Adventure> video games. This new approach provides a way to create games focusing first on the story behind them, which can potentially increase their educational value, as a strong narrative is one of the best game elements to support learning [2]. This story-based editor allows an educator to go from the game story flow to a working educational game without requiring technical knowledge.

Description of the Language

The new VDSL will represent the story using a graph-like structure, where the nodes represent different "points in the story" and the transitions indicate the flow. In video games, the flow of the story is driven by the interactions (i.e. actions in the game) of the user, and therefore they are represented as the transitions of the graph. The basic elements are based on the underlying <e-Adventure> model, but this approach could be applied to other tools and game genres. Many representation enhancements are used to reduce unnecessary complexity in the graph. The actions can also have consequences in the game world that do not alter the game flow and are added as properties of the graph (this includes mechanisms for tracking the performance of the students for later assessment).

This new system is created with the idea that a graphic representation, lacking some of the most complex elements of <e-Adventure>, can help teachers to acquire a better understanding of the games and increase their involvement in the development process. Applying a similar criterion, the new system is tailored into a "wizard", where all the basic information needed to create an educational video game is included so that novel users are guided though all the necessary steps.

[1] http://e-adventure.e-ucm.es

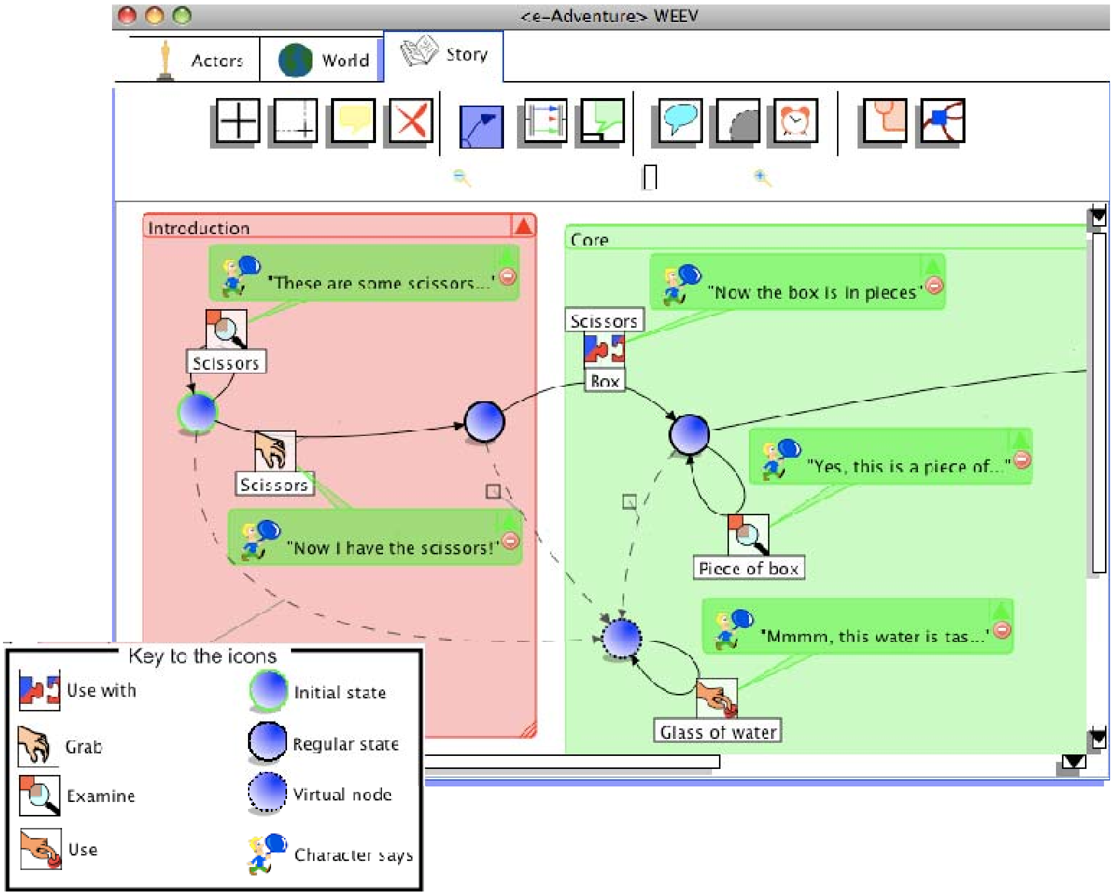

Figure 1: View of the story-flow editor, showing part of a game where the player has to grab some scissors and cut a box using them. The player can also choose to drink a glass of water at any time. Feedback is provided for the actions.

The game design process used in the wizard is based on research and real experiences on the field [3]. Besides, it borrows concepts from story writing; structural schemas will be used as a guide, to facilitate the development of the story in a meaningful way. Creating a good story is fundamental to achieve a high level of students' engagement and motivation. Even though we have no way to completely ensure a high quality of the story, this system will allow the authors to focus on its design by simplifying the rest of the development, which is a great advance.

Using a graphic representation has some other additional benefits over the traditional representation of the <e-Adventure> games. One of them is the possibility to generate recommendations for the user. These recommendations can cover the structure of the story (e.g. more o less branching, as needed) or its educational value (e.g. more assessments or more instructional content).

Besides, the new system will still have all the advantages found in the <e-Adventure> platform as the games created will be fully compatible and can be further edited using its advanced tools. These includes the possibility to export the game as Learning Objects [4] in compliance with the SCORM 1.2 or SCORM 2004 specifications.

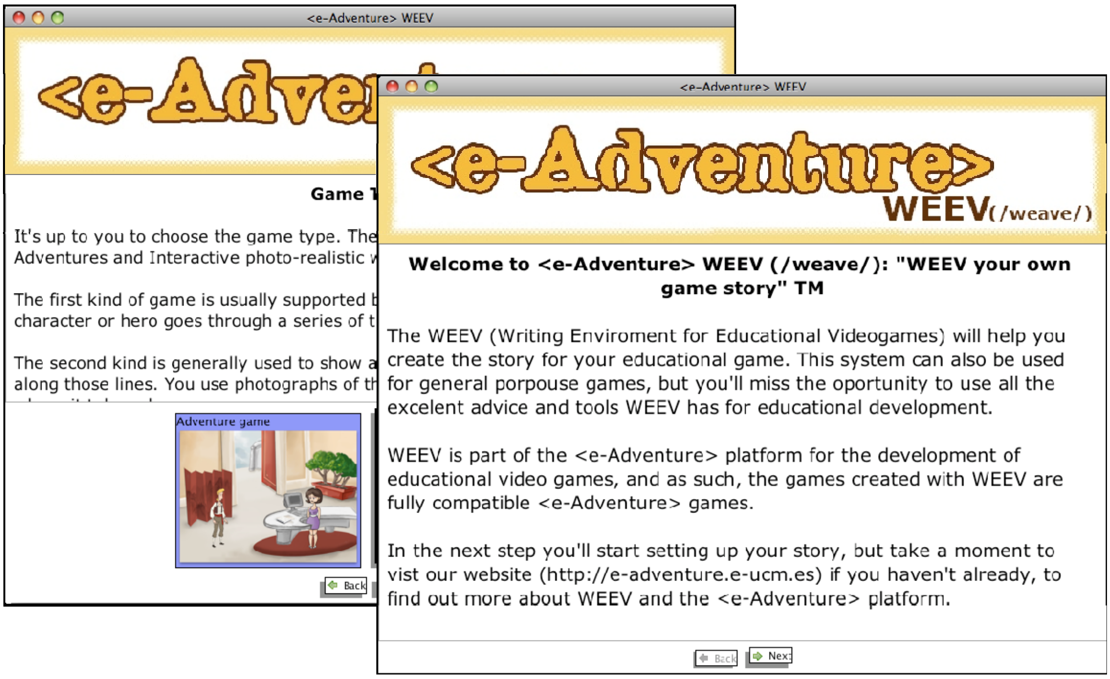

Figure 2: Some steps of the wizard

Conclusions and Future Work

We expect that this system will simplify the development of custom educational games for novices in the field and allow developers to focus on the story. We intend to have a working version along 2010 and test it to determine if it really eases the development process in a controlled environment. After that, the new system will be included as part of the <e-Adventure> platform in future releases and distributed as open source software.

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Eugenio J. Marchiori
Complutense University of Madrid, Spain
emarchiori@fdi.ucm.es

Javier Torrente
Complutense University of Madrid, Spain
jtorrente@fdi.ucm.es

Ángel del Blanco
Complutense University of Madrid, Spain
angel.dba@fdi.ucm.es

Pablo Moreno-Ger
Complutense University of Madrid, Spain
balta@fdi.ucm.es

Baltasar Fernández-Manjón
Complutense University of Madrid, Spain
balta@fdi.ucm.es

Promoting cross-cultural awareness through exposure in Game-based Learning

Introduction

With the global market constantly evolving through a globe-spanning network of communications, collaborations and immigrations, individuals are encouraged to be equipped with cultural literacy [1]. To offset cultural division, it is essential to promote "*cross-fertilisation across all boundaries, between 'majority' and 'minorities', 'dominant' and 'sub' cultures, localities, classes, faiths, disciplines and genres, as the source of cultural, social, civic and economic innovation*" [2]. Three main campaigns are:

- **Pluralism,** which aims to promote positive diversity by encouraging understanding and respect [3]. Britain, for instance, has increasingly diversified in ethnic and religious terms as a result of continued large scale immigration from a far wider set of source countries.
- **Homogenisation,** that goes beyond co-existence through tolerance by promoting one common identity based around citizenship and assimilating minorities into the society. Malaysia, for instance, is running '1Malaysia' campaign [4] to promote homogenisation while celebrating diversity.
- **Globalisation:** Awareness nurtured at the root level can be extended into a more global setting. The lack of cross-cultural awareness can be detrimental to the success of global marketing campaigns, business meetings and international relations.

Within the domain of game-based learning (GBL), this article briefly describes the attributes of the e-VITA project [5], which may be adopted by future initiatives in exploring games to support cross-cultural awareness campaigns, such as '1Malaysia' and multicultural Britain.

Learning Framework

With the advancement of game technology, individuals can practice behaviours in role-play situations within a 'safe' environment for rule learning, acclimatisation and repetition of tasks [6][7][8].

Under the e-VITA project, a set of games has been developed to promote European cultural awareness by conveying cross-border and inter-generational experiences. Aspects of Europe's socio-cultural past can be experienced in an interactive and engaging way. The four key learning parameters [9] that influence the design of e-VITA games are:

- **Context:** The key aim is adaptability in culturally-diversified conditions. The two objectives are to achieve adaptability in cross-cultural communication (verbal, non-verbal) and socio-behaviour (conscious/unconscious actions, reactions and habits). Based on the e-VITA project, cross-border and cross-cultural experiences of senior Europeans are to be conveyed to the younger generations.
- **Learner:** In accordance with the learning context, the different cultures, ethnicities and generations play key roles in the game content. Learner-centric and personalised approach is essential to ensure that the GBL will address the issues localised to the individual countries.
- **Representation:** The content should foster an attitude of acceptance and respect for the unique cultures. The strategy is to combat biases, anxieties and stereotypes

through a series of scenarios that provoke interest, emotion, and insight. Content should also preserve own set of values instead of only developing empathy and tolerance. The design attributes are thus to motivate, expose and to provide insight, which advocate experiential and narrative-based learning [10]. Life is perceived through others' eyes and a story of an experience is represented in diverse ways. In the e-VITA project, game scenarios are based on personal experiences of the older generation (Figure 1).

Figure 1: Screenshot from the e-VITA game prototype

- **Pedagogy:** To provide an engaging GBL experience, the e-VITA games incorporate four learning approaches:
    i. **Narrative-centric**, which emphasises the use of storytelling to achieve immersion, drawing on oral history [11] pedagogy.
    ii. **Experiential** [10], in which the learner is transplanted into the situations faced by the storyteller, drawing heavily on situative [12] pedagogy.
    iii. **Puzzle-based**, where the emphasis is strongly on providing effective puzzles and challenges for the learner, with the story and narrative taking a less direct role.
    iv. **Exploratory**[12], focusing on ongoing learners' development, in accordance with Vygotskyan [13] theory, by directing them to external resources in the context of challenges or problems presented by the games.

Conclusions

The motivation of using GBL is thus to gain insight through an engaging platform that exposes learners to culturally-diversified scenarios. The benefits include:

- Safe environment for exposure-based learning
- Narratives that elicit emotional involvement
- Fun and engaging activities
- Awareness and insights into oneself and others
- Translation of insight into daily lives

Future works include adopting this framework towards the development of a learning environment to supports campaigns, such as ‘1Malaysia’ and multicultural Britain. Awareness nurtured at the root level can be extended to a more global reach.

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Sylvester Arnab
The Serious Games Institute, UK
sarnab@cad.coventry.ac.uk

Aristidis Protopsaltis
The Serious Games Institute, UK
aprotopsaltis@gmail.com

Jacey-Lynn Minoi
Universiti Malaysia Sarawak, Malaysia
jacey@fit.unimas.my

Ian Dunwell
The Serious Games Institute, UK
IDunwell@cad.coventry.ac.uk

Sara de Freitas
The Serious Games Institute, UK
SFreitas@cad.coventry.ac.uk

Perception of the Real in Video Games: The Fear of Waking up

There is nothing either good or bad, but thinking makes it so. (W. Shakespeare, 1985, Hamlet, Act II, scene ii)

Numerous media producers, such as cinematographers, writers or artists have been creating imaginary spaces for decades where the audience negotiates the boundaries between real and unreal. So do video and computer game designers in contemporary, technology-meditated society. While in movie *The Matrix*, humans live in an artificial world of a computer program oblivious of its artificiality, or in Cronenberg's *eXistenZ*, the players cannot make a distinction between a game and real world, in virtual realities players engage in a suspension of disbelief, which, it seems, goes beyond the gameworlds.

Players increasingly spend their time in digital environments, about 20-30 hours per week according to Castronova (2005) replacing real human relationships, friendships, love and affections with virtual. This phenomenon raises a number of questions. Is real in danger to be completely replaced by unreal? Which world will we chose to live in? What can and will these worlds teach us?

The interpretations of the experiences in "other worlds" have been changing over centuries depending on the contemporary beliefs and established frameworks of understanding. Regardless of the historical period and the prevailing theory, the impetus has always been to make meaning of the world and to understand ourselves and others as living beings. Plato argues (~428-348 BC) that there is a reality that is more real than the world we can see. He uses the allegory of a cave, where humans only see the shadow of the ideal on the cave walls. Although linear-perspective painting and film, for example, may keep the viewer distant from what he views, in virtual reality the viewer steps through Alberti's window and is placed among the objects of representation (Baudrillard, 1988).

Cyberspace as a term suggests an existence of an intangible world that we cannot fully grasp or see its limits. It also means that it is elusive and escapes our control. We, however, consciously accept to neglect the obscure. We communicate and do business with people that we know only through cyberspace, i.e. email, without even questioning their identity. We gain friends online that we may never meet in our lives. We look for a 'true' love and compassion based on a given profile.

Massively Multiplayer Online Games (MMOGs) present another aspect of encompassing the unreal. They provide not only the opportunities to 'earn wealth' and 'concur the enemy', but also to meet others. Some virtual worlds, such as *Second Life*, exist purely as social spaces. Virtual worlds blur the clearly defined notions of geography and the laws of physics. The limitations of body, existing in real life environment, are disrupted in virtual worlds. To enhance navigation, the avatars in gameworlds can not only walk and run, but also fly, which does not make them less real. The existence of the avatars and players' interactions with them promotes the sense of presence, which enhances the sense of reality.

An increasing number of gamers would agree with Allegra from the *eXistenZ* that virtual worlds are better than real life. The avatars have no physical imperfections, nobody gets fat, nobody gets gray, and nobody gets sick. These worlds create their own culture and sometimes become their own reality, no longer imitating the original. Reality in these environments is subject to constant revision and re-construction (Hayles, 1991), where players rework reality and beliefs (Mackay, 2001). As Calleja would argue, alternate realities are "self-contained worlds", a combination of "artificial intelligence and human-controlled beings" (2006, p. 129). Some players reported feeling that Earth was just a place to sleep and eat, but that 'real life' was happening in their fantasy spaces (Castronova, 2005). They often talk about virtual worlds as if they were real (Crowe & Bradford, 2006), and they sometimes have to remind themselves of what is real what is not.

The theorist and researchers of video games and virtual worlds caution us that two worlds have become so similar to each other that the participants simply chose in which to live. Both those who explore virtual worlds and those who inhabit them often argue that virtual and real are not two separate realms. Mackay calls this state of accepting the unreal a "cultural illusion" (2001, pp. 90), similarly to Gibson's description of the future world as a "consensual hallucination" (1984, pp. 51).

There are numerous examples where both children and adults have neglected their real-life duties, school, work, or marriage, because of spending too much time living in an online world. However, there are other cases where living the unreal has resulted in positive change of game players' behaviour in real life (McGonigal, 2008). Serious games are often designed to deal with real world issues, some in hope to make social change. Immersed in alternate reality, players learn more about *the other*, and experience what *the other* experiences. Creating games that allow players to be lost in someone else's reality may help us build a better future.

Baudrillard's prediction that we will at the end take a representation as real, without knowing the real any more, may as well come true (1988). The question remains, however, whether it will happen by game designers creating virtual worlds to complement us as social beings, and fulfill our need for human company from which we derive protection, enjoyment, and sympathy, or by making spaces that will make us even more isolated and alone among millions of other virtual bodies.

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Natasha Boskic
The University of British Columbia
Vancouver, Canada
natasha.boskic@ubc.ca

The Self Representation of the Real Self through Humanoid Identity Immersive Expressions of Avatars in Second Life (SL)

Abstract: The virtual worlds warranted by innovative distance learning technologies are viewed as effective immersive tools for education. Second Life (SL), in this context, has emerged as a new Web-based structure, provides interactive learning space in where real selves are represented via three-dimensional (3D) images. On the immersive lands of SL, the digital personae can be represented through 3D images called avatars. While the debates are on effective individual learning in distance learning over the past decades, SL, in this regard, has been gaining a noticeable attention with its flexible form in which avatars are allowed to be active participants in individual or group forms. In order to utilize from the virtual learning systems like SL, course owners and designers should be aware of the online representation of the avatars and the analyze those driving forces results with online learning from an avatar perspective.

Figure 1: Avatar Movie (2010)

Introduction

Second Life (SL) is as an immersive space built up on digital community network represented by humanoid characters termed avatar. As it is described by Franklin (2008), an avatar is an animated character that represents the learner in an educational setting. In other words, avatars can be regarded as connecting characters that play a crucial role for enhancing interactive social network literally. To Dickey (2005), avatars are the representatives of individuals that are allowed to interact with other avatars and the immersive milieu surrounding them. For an improved online education associated with an interactive communication, individual avatar reaction toward learning should be taken into great consideration within the context of negotiating meaning based on *personal cognitive, affective and kinaesthetic experiences of a learner* (de Byl and Taylor, 2007, p.108).

The Self Representation of the Real Self through Humanoid Identity

3D platforms like SL, provides *a unique, hitherto impossible, opportunities to change the nature of learning and teaching experiences, especially for distance education students* (de Byl and Taylor; 2007, p.108). In this sense, the self representation of the learners' real selves need a close observation in order to have the best learning outcomes to be gained. As explained in the studies conducted by Ekman, the emoticons including *anger, fear, disgust, surprise, sadness, happiness and contempt are universally expressed by all cultures* (Koda and Ishida; 2006, p.2). Therefore, new researches succeeding the previous studies on avatar expression on learning should be reevaluated in order to generalize the common attitudes of all avatars for better educational results. As there is sameness in emoticons, the avatar reactions and approaches for learning should also be analyzed within multicultural 3D structure of social networking. In the network, avatars are given the possibility of creating their own fused identities within physical features to reshape their visual three-dimensional outlook. The networked platforms to which avatars belong to are built upon interactive communal system. Within that network, avatars are given the possibility for self expression and become able to (Canbek-Goksel and Kurubacak; 2009):

1. reshape their free spirited three-dimensional ideal fused identities;
2. build interactive learning based on individual and group activities;
3. learn to take part in collective practices of a virtual team;
4. experience interaction in a diversified multicultural population; and
5. express themselves freely with no societal restrictions of obedience, devotion and even classification.

Immersive Expressions of Avatars in Second Life (SL):

The ascendant 3D platform, SL, is an immersive multicultural source providing cyber interactions among avatars. A desktop collaborative virtual environment with 3D immersive expressions of the avatars (Nassiri, Powell, Moore, 2005) can be regarded as the simulations designed for genders worldwide. Within the collaborative medium, eLearners build an active communication through controlled gestures of their avatars. In other words, *the avatar becomes the player's body, for all intents and purposes, when the player is present in the virtual world* (Castronova, 2003, p. 6). The gesture of an avatar can be a remarkable clue to distinguish the learner's characteristics and skills to adapt individual and communal learning. In this connection, course owners and designers should interpret body gestures of the avatars and put forward an idea on the effectiveness of the learning by analyzing the avatars' immersive expressions.

Conclusion

eLearners embodied as avatars may have the ability of interacting with other avatars and the virtual environment around them. Second Life success, in this sense, is related to avatar interaction in which each learner has a chance to express their own identity with a communicative forthcoming attitude that is seen more affable than *e-mailing or instant messaging* (Bedford et al., 2006, p.26). In this connection, course owners and 3D media designers may assess the utility of online distance education by analyzing reactions and self representation of the humanoid identities toward online learning.

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Nil Goksel Canbek
Anadolu University, Turkey
ngoksel@anadolu.edu.tr

Gulsun Kurubacak
Anadolu University, Turkey
gkurubac@anadolu.edu.tr

Beyond Learning Objects - Dynamic adaptation in learning scenarios for lifelong learners

Systems that support lifelong learning help work-based learners to accomplish their goals and tasks while keeping abreast of ongoing changes in their fields. They can also guide the learner in improving their skills and competency levels for a particular work-based environment (Sharples, 2000: Jarvis, 2008). The notion that "what I learn in school will get me through my entire working life" no longer exists. As a consequence, work-based learners need continuous learning support to update their occupational skills and knowledge or to learn new occupational competences. For technology enhanced learning, it is a major challenge to develop learning environments that effectively enable each learner to get individualised support in filling ever-changing skills and competence gaps; i.e. to create environments for personalised adaptive learning (Aroyo et al., 2006).

Current learning management systems (LMS) are used to deliver learning content; however, they usually have limited adaptive functionality and hence do not fully consider the diversity of learners. A recent study was conducted in six European countries to gather personalization and adaption needs among corporate learners and training providers. According to that study, an adaptive learning system has an added advantage over a non-adaptive system due to its personalized nature in supporting work-based learners (Hover & Steiner, 2009). An important component of an LMS is the learning objects (LO) that encapsulate various goals. However, in order to construct an intelligent and adaptive LMS according to the needs of lifelong learners, we must go beyond the concept of the LO and consider learning scenarios in a broader vision of learning activities (Ruis et al., 2008).

The idea behind LO-based systems is to enhance the efficiency of learning processes and human performance in work-based learning. Current learning standards and specifications include IEEE LOM (Learning object metadata), which gives information about the contents or the format of the learning object, and IMS-LD (Instructional Management Systems Learning Design), which focuses on the activities. Neither approach captures sufficient information for personalization of the learning process, which requires an awareness of context. When learning content is presented to lifelong learners, many assumptions are made about the learners and the conditions of their learning, which include the experiences, skills, and competencies of the learners, their personal preferences, learning styles, goals, motivations, time availability and so on. These factors all contribute to context (Jovanovic et al., 2006), which may also include special needs, so that lifelong learners "can make the most of their talents, irrespective of their physical and mental disabilities" (Kay, 2008). Specific issues in explicitly representing context in design include the limited size and complexity of metadata: (the amount of metadata is usually small and either too open, with non-specific words such as 'Learning', or too closed, with excessively specific descriptions), prediction of information at design time and reusability of the content at different levels of granularity (Jovanovic et al., 2006). However, the concept of a learning scenario provides a model of an expected sequence of events to achieve a learning goal within the LMS (Ruis et al., 2008).

In order to achieve dynamic adaptation, we might adopt an ontology based approach for defining the behaviour of all the elements involved in every scenario (Ruis et al., 2008). One definition of ontology in the field of computer science is given by Gruber (1993), who defines ontology as "an explicit specification of a conceptualisation". An ontology provides the vocabulary for referring to the terms in a particular domain. It also defines some logical statements that describe what the terms are, how they are classified as well as some rules for combining terms and relations to define extensions to the vocabulary (Hendler, 2001). In personalised LMS, reasoning rules are used for some specific adaption purposes. These rules query learning resources and metadata, and reason over distributed data and metadata descriptions. A major step for reasoning is to get information about the learning process while applying any adaptation rule (Henze et al., 2004). Thus different types of ontologies may be used together to model a learning process across a LMS. Current literature on how ontology-based systems can possess the necessary flexibility to respond to dynamic learner activities is limited. Therefore, further study of the application of ontology to LMS is needed.

This article has presented a need to explore ontology-based systems with the aim of supporting dynamic adaptation in learning scenarios of LMS. Work is needed to identify the main concepts used in adaptive learning processes within the domain of lifelong work-based environments, which might be represented as ontologies. We may then leverage these ontologies to develop personalized and adaptive LMS environments for work-based lifelong learners.

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Sohaib Ahmed
Institute of Information & Mathematical Sciences
Massey University, Auckland, New Zealand
s.ahmed@massey.ac.nz

David Parsons
Institute of Information & Mathematical Sciences
Massey University, Auckland, New Zealand
d.p.parsons@massey.ac.nz

Hokyoung Ryu
Institute of Information & Mathematical Sciences
Massey University, Auckland, New Zealand
h.ryu@massey.ac.nz

Re/Thinking Design and Implementation of Learning Objects as Learned Objects

Introduction

Education and technology have been in strong interaction since the middle of the last century giving origin to a new study field: Educational Technology (ET) [1, 2, 3 & 4]. In the eighties a debate about ET identity took place. On the one hand it was considered as a branch of educational psychology or pedagogy; and on the other, as a branch of computer science or engineering [4, 5 & 6]. It seems that since the boom of Informatics and Communication Technologies (ICTs), ET has just followed the second path, promoting engineers work over other professionals on educational issues. Therefore we propose the necessity of guarantying an interdisciplinary view for the development of Learning Technology (LT), specifically of Learning Objects (LOs), in order to prevent the mistake of attributing intrinsic properties to new technologies. We invite to avoid the naive believe that ICTs themselves can improve, increase or accelerate learning.

Work in progress

Our research project: *Epistemological bases for science and technology education and research* joins engineers, psychologists, pedagogues and other professionals in social sciences under the leadership of an epistemologist. One of the goals: LOs development toward a new pedagogy of mathematics. We focus on mathematical reasoning in high school students where the idea is to develop not just LOs with arithmetic and algebra content, but a didactic procedure for mathematics education using ICTs based on a specific psycho-pedagogical assessment. As partial results, we got no LOs according to our assessment necessities. It is needed metadata and LOs informing the theoretical psycho-pedagogical framework of its design and possible implementation.

Likewise we realized that LOs reflects the designer’s learning instead of student’s learning. This result take us to a conceptual reflection about knowledge, learning, teaching, education, science & technology as linked concepts from different theoretical and disciplines views. According to the ISI Web of Knowledge [7] the concept of Learning Objects (LO) is used since 1960, but it’s up to the Twenty-first Century that studies about LO increases in a notable way, specifically between the years of 2000 and 2007. Nevertheless the meaning of LO not yet is clear. There are several definitions of LO, the common one is that it is an informatics digital entity developed for the generation of knowledge, skills and attitudes that have sense in function of the subjects needs and that it has correspondence with reality [8].

However most LOs have been designed and implemented focused on the role of the teacher -to help him or to replace him- not really on the student. Then we propose a new categorization for digital entities used in education: Teaching Objects (TOs) and Learned Objects (L’dOs). Our account is that TOs are those digital entities useful as support materials for teaching. TOs can be complement or substitute of blackboards and other common didactic resources. TOs as teacher’s or engineer’s products are the sort of digital entities that actually, as we said above, are erroneously called LOs. Instead, L’dOs must be student’s products: digital entities which must reflect what students have learned. This means that students must link informatics knowledge with concepts and skills about a specific subject to create their own L’dO. In this manner they would reflect their rationing.

This proposal involves a new pedagogical model constituted not just by digital entities but by an active educational model configured in an interdisciplinary framework. We think that Learning Technology may start to consider and guarantee *educational technology procedures* with interdisciplinary support; not just engineer's products applied to education. This support might be provided in a linking way by pedagogues, psychologist, engineers and subject experts. Then we can avoid digital entities as products with an excellent presentation and sophisticated technological support, but based on the implicit naive believe that ICTs by themselves can improve teaching or, increase and accelerate learning.

Conclusion

Our proposal is based on an epistemological view: an epistemology of engineering based on an epistemology of imagination [9] that considers next basic assumptions: 1) generation of new knowledge is not a social product but an individual product that is socialized. 2) It is a priority to focus on the individual cognitive development, particularly on symbolic-imagination experience and then in both, practical and formal experience. 3) Instruments have a very important role for the former three sorts of experiences. From this framework L'dOs are digital instruments as the combination of material instruments and mathematical knowledge. They are triggers, not determinants of learning, which means to understand technology as the coordination of the application of engineering as well as the application of psychological and pedagogical principles in education field. TOs (now known as LOs) in mathematics can be continuing developed as didactical digital tools but just as a part of an interdisciplinary pedagogical method. The challenge for LT then is a new kind of friendly software that allows the student to generate software (L'dOs) that could reflect his mathematical rationing.

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Carmen Patricia Rosas-Colin
Instituto Politécnico Nacional (CIECAS-IPN), México
cprosasc@yahoo.com.mx

Luis Mauricio Rodríguez-Salazar
CIECAS-IPN, México
lmrodrig@cinvestav.mx

Silverio Gerardo Armijo-Mena
CIECAS-IPN, México
sarmijo@ipn.mx

Towards Explicit Semantics in Learning Objects

Abstract. This paper describes an ongoing research that aims at creating a domain model from learning object textual content in particular and from documents in general. A domain model is represented by a set of concepts, attributes, relationships and axioms describing the domain rules and restrictions.

Key Technologies for e-Learning

There are some key areas and techniques that are necessary for the creation of such explicit semantics into learning objects: **Natural language processing** which is useful for mining learning object content and creating metadata, **Semantic Web**, which enables a formal and unified representation of this content and **Semantic Web Services** which are key components for flexible and reusable architectures.

Natural Language processing (NLP)

There are two main streams for knowledge extraction in the domain of NLP: shallow and deep syntactic methods. Although shallow syntactic methods can be of interest for information retrieval due to their speed and robustness, they remain limited and do not discover important knowledge, such as some semantic relationships. On the opposite, deep syntactic analysis requires more resources (lexicons, syntactic grammars, etc.) but they enable a deep understanding of texts. Based on previous and ongoing research [1, 2], I believe that e-Learning requires deep syntactic analysis. In fact, learning objects should be annotated with semantic knowledge that reflects their exact content in terms of concepts and relationships. Developing a semantic analyzer based on deep syntactic analysis is then a requirement. An interesting formalism for this analysis is the use of dependency grammars. A dependency-based semantic analyzer is independent of a particular domain and relies on generic syntactic patterns coupled with processing functions that map the syntactic structures to semantic representations. It can be intuitively more easily understood by non-NLP users. At this stage of the research, a semantic analyzer has been developed that covers a good set (a kernel) of the main syntactic structures of the English language and future work will enlarge the set of syntactic structures.

The benefits of this semantic analysis for eLearning are various: this enables to explicitly state the learning content in terms of concepts and relationships (concept maps). Metadata is created in a semi-automatic manner instead of being purely manual. In fact, manual annotation hinders the retrieval and reuse of learning objects as it is very often incomplete, time-consuming and it does not reflect the exact content of the learning object. Moreover, concept maps can benefit to learning as they represent a synthesized view of the knowledge conveyed by the learning objects [5]. This enables a constructivist exploration of the domain by the learner. By clicking on a concept and requesting a concept map, the learner can grasp the important relationships and related concepts of the domain. Furthermore, he can be directed towards specific portions of texts that are related to the concepts of interest.

Semantic Web (SW)

The semantic analyzer outputs semantic representations expressed as concept maps. Here concepts maps describe rich knowledge structures based on semantic concepts and relationships including attributes, hierarchical links, and conceptual links. However, such a rich and detailed representation cannot be reused in this form for indexing learning object content. In fact, the final representation should be able to insure learning object interoperability and should provide a conceptual view over the domain. SW technologies and especially domain ontologies seem to be the perfect structures for doing this. Ontologies have been widely used to annotate learning objects content. However, they are often created manually and then used to annotate learning objects. One drawback of this approach is the manual creation of knowledge but also the risk of having a conceptual mismatch between the real learning object content and the ontology. Such a mismatch could complicate the retrieval of the learning object and the comprehension of the learner regarding this content. For these reasons, I believe that a domain ontology should "emerge" from learning object content, thus creating a natural, accurate and automatic indexing of the object. Current semantic representations are converted into OWL [4] using a set of metrics and mapping rules that detect key concepts and relationships in the concept maps [1]. My current work aims at applying new metrics for ontological class mining including the page rank of a concept, its betweenness (based on the number of shortest paths that pass through the concept) and its centrality. More details on these metrics can be found in [6] for example.

Semantic Web Services (SWS)

In general, present efforts for next generation e-learning architectures aim at building dynamic educational services. This approach is also a key enabler for next generation learning objects mining. I am currently working on a service-oriented architecture that implements the semantic analyzer and the conversion of the semantic representation into a domain ontology as services. This architecture has the advantage of being modular as it tackles each ontology learning step (concepts, taxonomy, conceptual relationships, axioms) using a variety of NLP and statistical methods (also represented as services). The other advantage is that it enables combining various methods through semantic composition and orchestration and testing the most interesting combination based on tasks and needs.

Such an integrated approach based on NLP, SW and SWS would enable the management and reuse of a learning object repository content in a more efficient and automatic manner.

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Amal Zouaq
Athabasca University, Simon Fraser University
azouaq@sfu.ca

Document-centered Learning Object Authoring

Introduction

Learning Object (LO) open standards (e.g., SCORM [ADL 2004]) have achieved stable specifications, providing reliable ways for exchanging digital content and fostering environments and tools to offer support for LO storage, indexing and presentation. Relevant examples are Learning Management Systems, like Moodle (http://moodle.org) and Sakai (http://sakaiproject.org), which accept SCORM packages. This scenario motivated our initiative to build a digital content repository for storage and sharing e-learning content, fostering reuse at our university.

The process of e-learning content production at our university is guided by a workflow detailed in Figure 1. It starts up when a professor/author submits written documents by using a popular text-processing tool (content authoring). After content and style review a course goes towards the course authoring process. Course authoring addresses tasks of: systematizing the course content according to a learning design, course description using learning metadata and preparing the content to be reused.

Following this workflow the author acts in two distinct stages: content production and content authoring. These two stages can be also seen in another perspective, the former concerns mainly *data production* and the latter mainly *metadata production*. Therefore, we here consider the content authoring a kind of annotation task of the produced content. We have remarked three main practical difficulties related to the annotation process:

1. The annotation task appears as a disjoint *additional step* after the content production process.
2. The *metaphors* adopted by annotation standards and tools are distant from those adopted by content production tools to which authors are used.
3. When production+annotation tools are adopted for developing specialized content, the *lack of homogeneous content format* has hampered the content reviewing process.

The remarks above have led us to a research that issued in a methodology for content annotation, which we call *In Loco Semantics*.

In Loco Semantics

In Loco Semantics is a methodology for producing annotations linked to digital content by using interoperable semantics and ensuring semantic persistence, with the following principles:

1. *In Loco Annotation*: the annotation process occurs concomitant to the content production (in loco).
2. *Metaphor Integration*: the metaphors and models adopted in content annotation are aligned with those adopted for content production.
3. *Interoperability*: in loco annotation strategies are designed to enable automatic information extraction and conversion to Semantic Web open standards.
4. *Semantic Persistence*: in loco annotation elements are connected to unification ontologies, which will guarantee their equivalent interpretations in different contexts, subsidizing semantic persistence among transformations.

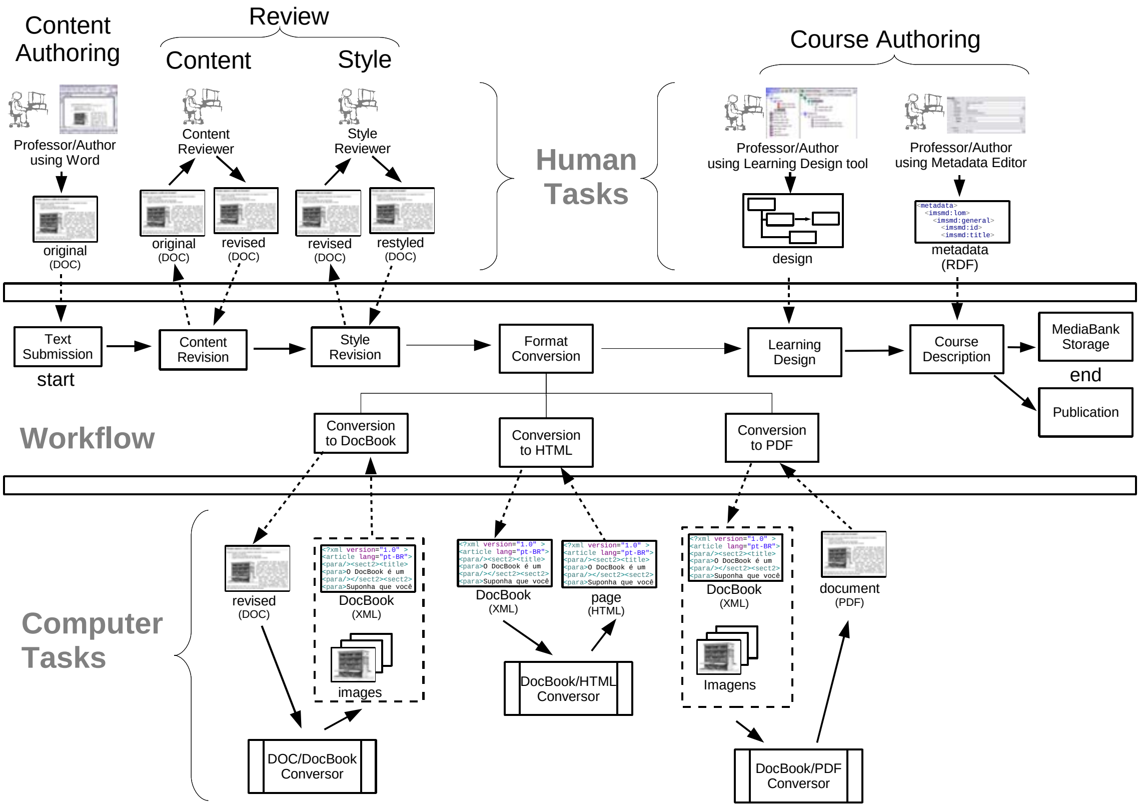

Figure 1. Workflow diagram of an e-learning course production.

The diagram in Figure 2 synthesizes a typical scenario of the methodology application. This scenario can be organized into three distinct activities: **(1) design** – a content profile is designed including its templates or schemas; **(2) production** – a content is produced and annotated following an *annotation pattern* and based on a template or schema; **(3) CO transformation** – the original content is transformed by an information extraction tool, which can map the content to a domain neutral complex object (CO), **(4) Domain transformation** – the domain neutral CO is mapped by a conversion tool to a domain specific representation, a LO in this context.

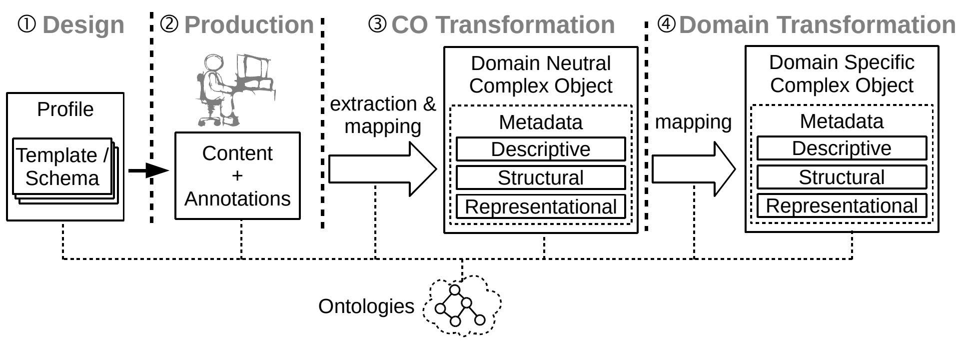

Figure 2. In Loco Semantics process diagram.

Document-centric Authoring

Even though in loco semantics can be applied to many content producing contexts, the most popular content producing tools available to end-users adopt documents as metaphors for content producing and as units of representation and distribution.

Modern word processors have the "style" feature, which enables to assign a name to a specific format configuration. Our *annotation pattern* extends its interpretation to our purposes. As shown in Figure 3, besides its formatting concerns, styles work as a semantic markup. Therefore, by marking fragments of documents using a {Title} style, for example, authors perform two operations: they apply a preconfigured format to the text and simultaneously attach a semantic annotation to the fragment.

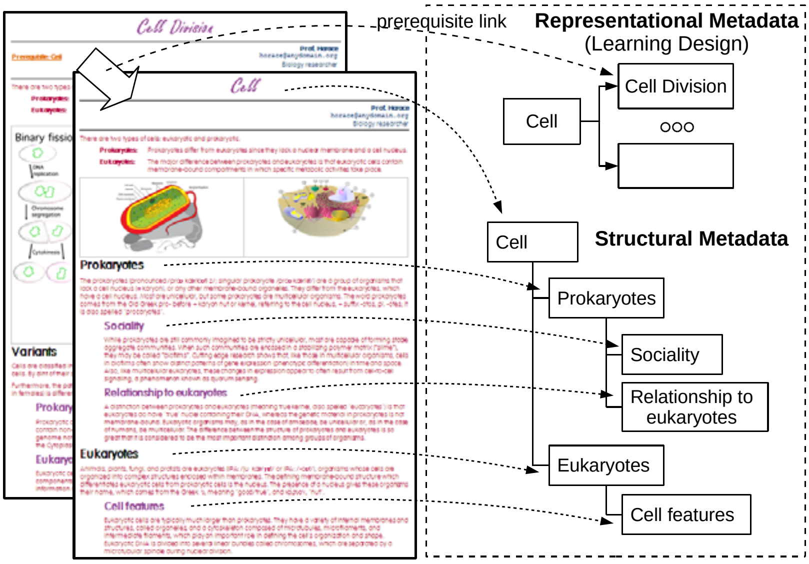

Figure 3. Converting document annotations in a LO comprising its learning design.

Figure 3 illustrates a summary index automatically extracted from e-learning content. In this case, the titles and subtitles can be straight converted to SCORM [ADL 2004] internal organization structure. Furthermore, the figure shows a link between the document entitled "Cell Division" and the one entitled "Cell" formatted using the {Prerequisite} style, indicating a prerequisite lesson. This example shows how annotation patterns are explored to infer the learning design behind the content following the IMS LD [Koper 2004].

Related Work

There are other solutions to produce LOs by using text processing tools, like GTK Komposer Suite (http://www.gtkpress.com) and Question Based Learning System (QBLS) [Dehors et al. 2006]. The main advantages of our solution lie in:

1. It is not limited to a monolithic tool: In Loco Semantics is a methodology and its tools are implementations which can be adapted and expanded.
2. Mappings from annotations to a LO structure are based on customizable XML open documents.
3. In Loco Semantics is not restricted to a text processing tool or a specific annotation pattern (e.g. style-based).

Concluding Remarks

This paper shows our document-centric approach to automatically produce LOs by means of In Loco Semantics methodology. It has been successfully applied at our University. We are expanding the methodology to other tools – e.g., spreadsheets and slide presentations have already been implemented – and other annotation patterns. Thus annotation patterns become a semantic communication strategy between humans and machines. Instead of requiring humans to learn ever increasing number of complex tools, our strategy proposes to enhance the language adopted in widespread and well known tools.

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André Santanchè
UNIFACS – Salvador University
Salvador – BA, Brazil
santanche@unifacs.br

Luiz Augusto Matos da Silva
Acre Federal University
Rio Branco – AC, Brazil
luiz.matos@ufac.br

Mission-Oriented Situated Second Language Learning in Second Life

Abstract. Typical English as second language (ESL) learning in East Asian public school systems leaves a gap in student confidence and facility in functioning with the spoken language which is a serious obstacle to participation in global society. Virtual worlds, such as Second Life, provide a strong opportunity for the students to experience situated learning. We present an outline of how to apply mission-oriented situated language learning in a virtual world game.

Keywords: *Second life, mission-oriented situated second language learning, game*

Introduction

Typical English as second language (ESL) learning in East Asian public school systems leaves a gap in student confidence and facility in functioning with the spoken language. This gap becomes a serious obstacle to participation in global society. Academics, for example, can find their research misunderstood or overlooked if they cannot present it, and themselves, effectively. Elwell, *et al*. (2009) have tested shared virtual environments complementing task achievement training in English language instruction at the graduate school level in Japan [1]. This method provided little or no scaffolding, and placed the students directly into spontaneous authentic interactions in an open social setting. The initial confidence barrier therefore remains high.

We propose a progressive task-based virtual environment game to build students' competence, confidence, and independence using spoken English to achieve functional goals, within the resources typically available at the high school and undergraduate level. The objectives are: 1) Task achievement with strong scaffolding (competence); 2) Task achievement with weak scaffolding (confidence); 3) Task achievement without scaffolding (independence).

Mission-Oriented Situated Learning

A situated environment, where learning is a social process and knowledge is co-constructed [2], is appropriate for second language learning, but physically creating such an environment is a significant challenge. Virtual worlds provide a new venue for situated learning. In Second Life, for example, the learning environment can be adjusted easily according to the situated learning objectives. Learners can interact with their peers in typed public or private chat, and even voice conversation.

The challenge of providing a situated learning environment, however, also involves the design of the curriculum and pedagogy. Mission-based learning fosters students' knowledge integration, teamwork and cooperative learning, critical thinking, complex problem solving and creativity [3]. Figure 1 shows a mission-oriented curriculum mode in which a mission is composed of several sub-tasks. The students achieve a mission by completing the sub-tasks, competing to finish in the shortest time.

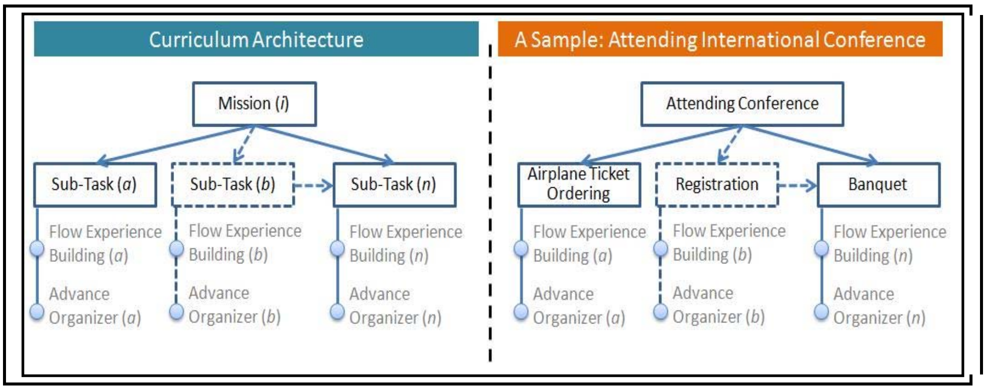

Figure 1. Sample curriculum design: Attending an international conference

The activity is designed as follows:

1) Students enter the virtual environment and complete an assigned task using assigned means
2) Students complete an assigned task with a choice of means
3) Students are given a "big task", a final game goal, for which they must choose what subsidiary tasks to attempt and then how to achieve those tasks
4) The object of the game is to complete the tasks as rapidly as possible

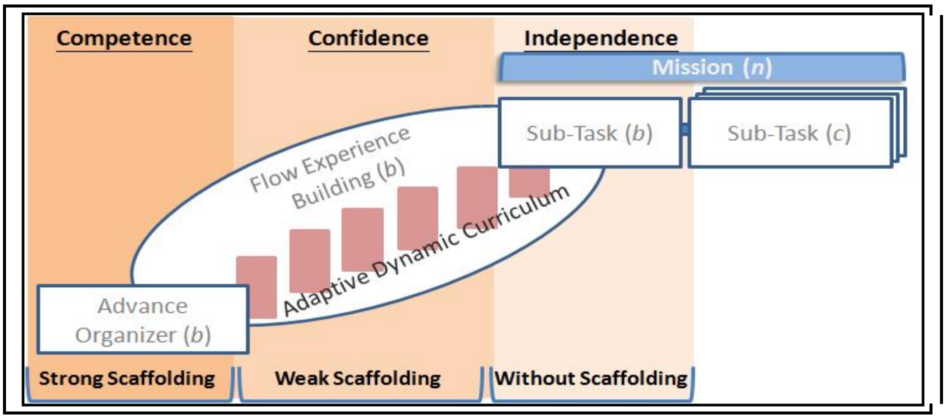

Figure 2. Sub-task design

Narrative:

1) Student A enters a prepared and bounded location in Second Life, and once familiar with avatar movement and using interactive objects, is presented with a situation and assigned a task with a tangible result. In this case, the tangible result will be a receiving a "calling card", representing pre-registration for a conference. The means for achieving the task will be provided (a suggested set of phrases), and peers and instructors in the physical classroom can offer support and guidance. When achievement of the task is verified, the student may progress to the next task.

2) Student A is presented with a new task; finding an exit from the bounded location, representing successfully traveling to the conference venue. This time, A must choose among three avatars to ask for instructions and then successfully follow those instructions for the exit to open. Each of the three instruction givers will offer a different means of achieving the task. Using the exit will demonstrate task achievement and take the student to the final, "big" task.

3) Student A's avatar is transported directly from the exit of the first location to an open location in Second Life, where the avatars present include ones operated by people unrelated to the exercise. A's big task is to be invited to join a group, representing successful participation at a conference.

4) The time taken for finishing the game is recorded and compared with other trials.

Practice Environment

The physical classroom, with its instructor and peer support, remains part of the learning environment, but the actual gameplay takes place in the shared virtual environment of Second Life. In the first two stages, learners operate within prepared locations where entry and exit is controlled by the instructor(s), and where all avatars represent instructors or fellow learners. In the final "big task" stage, the location also includes avatars representing unrelated persons elsewhere in the physical world.

Figure 3. Second life learning environment snapshot

Conclusion

We have proposed a progressive task-based virtual environment game to build students' competence, confidence, and independence using spoken English to achieve functional goals, within the resources typically available at the high school and undergraduate level. This method addresses logistic and systemic limits on authentic modeling, individual interaction, and functional practicum in school settings. With adjustments, it can be applied to other stages and forms of instruction.

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Mark Elwell
Hakusan International School, Japan
markelwell@hakusaninternationalschool.com

Ben Chang
National Chiayi University, Taiwan
ben@ncyu.edu.tw

Expanding the Idea of the Learning Object

Introduction

Initially the idea behind the computer-based learning objects was that the content of a course could be broken down into small, reusable instructional components and each addressed a specific learning objective. These components could be tagged with metadata descriptors and deposited in digital libraries for subsequent reuse into larger structures such as lessons and courses (see Cisco Systems, 2001; IMS Global Learning Consortium, 2002; Jonassen & Churchill, 2004; L'Allier, 1998; and Wiley, 2000). More recently learning objects begun to emerge within a variety of contemporary pedagogical frameworks that promote constructivist learning, e.g., problem solving, engaged learning, problem-based learning, rich environments for active learning, technology-based learning environments, interactive learning environments, collaborative knowledge building, situated learning (Churchill, 2007). Common to these frameworks, students must engage and interact with a task where knowledge is created and applied, and the learning object is seen as a tool and a cognitive supplement that facilitates completion of this task. To overcome potentially conflicting conceptualization of the learning object, there is a need for a broader definition that serves perspective of diverse communities interested in this idea (e.g., computer scientists, education professionals, and corporate instructional designers).

Broader Definition of the Learning Object

The author describes the learning object in broad terms as a multimedia representation designed to afford uses in different educational contexts. In this context, the learning object utilizes representational capabilities of contemporary technology to deliver educationally useful displays of data, information, concepts, and ideas. Supplementing this definition is a classification of learning objects into the following types: presentation, practice, simulation, conceptual models, information and contextual representation objects (see Table 1).

Learning objects might reside in digital repositories, ready to be retrieved and utilized by those involved in generating educational activities (e.g. teachers and students). They can be tagged with suitable metadata descriptors that indicate types of learning objects, and accordingly suggest suitable reuse. Some of the learning objects from the classification can be combined with other objects into direct instruction products supporting traditional pedagogies (e.g., computer-based tutorials). Other learning objects are more appropriate in the context of student-centered pedagogical approaches as resources to be deployed in learning tasks designed by teachers. Through all these forms, representation and interaction are key attributes.

Task-driven Reuse of the Learning Object

Traditional instructivist framework assumes that learning occurs through contact with learning material, processing/internalization of principally presented content and demonstration of behavior that shows achievement of learning objectives. It is believed that multimedia messages, when effectively designed, arranged and presented, can enable learners to memorize material, while interactivity allows repetitive drill and practice until the desired performance is achieved. It is possible for reuse of the learning objects to be machine-driven based on data such as learners' pre- or post-test results. For example, Cisco's Reusable learning Objects (RLO) strategy describes such machine-driven reuse (see Cisco Systems, 2001).

Learning Object Type	*Explanation*	*Simple Example*
▪ Presentation object	▪ Direct instruction or presentation resources designed with the intention to transmit specific subject matter	▪ A presentation or an instructional sequence on classification of triangles
▪ Practice object	▪ Drill and practice with feedback, educational game or representation that allows practice and learning of certain procedures	▪ Quiz question requiring a learner to use representation of a protractor to measure angles and answer a question regarding ration between base and height of the right-angled triangle
▪ Simulation object	▪ Representation of some real-life system or process	▪ Simulation of a compass allowing learner to draw a geometric shape (e.g. equilateral triangle)
▪ Conceptual model	▪ Representation of a key concept or related concepts of subject matter	▪ Representation that allows manipulation of parameters of a triangle, which in turn changes displayed modalities such as visual representation of a triangle, and numerical values of sizes of its angles and sides, and displays a graph showing changes in relationship between sides or angles
▪ Information object	▪ Organized display of educationally useful information where the organized form assists in understanding	▪ Representations that allow learners to change angles and sizes of a triangle and, based on configuration, to obtain information such as the type of triangle illustrated, a picture showing it in real-life and a short description of its properties
▪ Contextual representation	▪ Data displayed as it emerges from represented authentic scenario	▪ Representations that show real-life examples of triangle (e.g. roof of a building) and allow a learner to use representation of a tool (e.g. tape measure) to collect data about dimensions of these triangles.

Table 1: Basic types of learning objects (from Churchill, 2007)

In contrast, the constructivist framework assumes that learning occurs within a task that results in experiences leading to knowledge construction (e.g., conceptual changes, development of coherent knowledge representations, internalization of social constructed and negotiated meanings, accommodation and assimilation of new concepts in existing knowledge). A suitably designed task is an ill-structured, dynamic and authentic engagement that requires students, for example, to solve problems, conduct inquiries, work with information and data, collaborate, deliver products and presentations and in other ways apply emerging understanding through strategic decisions, as well as engaging in meta-thinking and reflection (Churchill, 2006). Hedberg and Churchill (2008) describes four types of general tasks: (1) the learner might be practicing the use of *rules* or standard processes to achieve a solution; (2) the learner might explore a *incident* or scenario and argue for a particular course of action; (3) the task might include a new design so that the focus is built upon the *strategy* through which it is achieved; and (4) the situation might require the analysis of different perspectives and hence the challenge is seen in terms of a particular *role* that the student might take. The role of a teacher is to design learning tasks that will require students to work with material and produce artifacts that demonstrate their learning achievements. Once a learning task is planned, suitable learning objects to enable students' learning are supplied.

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Daniel Churchill
The University of Hong Kong
dchurch@hku.hk

Student modeling based on an ontology and non monotonic pedagogic diagnosis

Introduction

At the end of the 90's emerged the so-called Intelligent Virtual Environments for Training and/or Education (IVETs), combining Virtual Environments (VE) and Intelligent Tutoring Systems (ITS), two areas of great complexity. In this way, the benefits of 3D environments may be combined with those of an ITS in order to provide added value educational/training solutions.

The complexity of Student Model, core of an ITS, is even higher when the ITSs are applied on VEs because the new interaction possibilities offered by these environments must be considered as new key information pieces for SM, impacting all the educational process.

We have proposed, in the framework of a Ph. D. work, a new SM mechanism based on Ontological Engineering and inspired on pedagogical principles, with a wide and flexible data model about the student that facilitates its adaptation and extension to different ITSs and learning applications, as well as a rich diagnosis method with non-monotonic reasoning capacities. The diagnosis method is able to infer the state of the learning objectives encompassed by the ITS and correspondingly infer the student's knowledge state.

The proposed SM approach has been implemented and integrated in the student modeling agent (SMA) within an existing software platform for the development of IVET's called MAEVIF (Imbert, 2007).

Proposed Student Modeling

The development of any ITS requires an instructional design for the subject matter to be taught (X) (see Figure 1). The activities and the objectives that the student should achieve in each activity, should be initially fed into the SM ontology, together with the initial state of objectives (established as assumptions of the SM), knowledge elements involved in the learning objectives, and personal information about each student. The SM ontology also defines relationships among concepts, such as the ones between the learning objectives (meaningful for the Tutoring Agent) and the knowledge objects that the student should acquire in order to be able to reach those objectives (meaningful for the Expert Agent).

The characteristics of every action performed by the student in a learning session causes the triggering of some diagnosis rules defined in the *Pedagogic Diagnosis Agent* (PDA). In this way, the SMA can infer from the student's behavior which learning objectives have been acquired or not by the student, and the state of their knowledge, or, rather, reasonable assumptions, since some of assumed learning objectives and knowledge elements may be refused later, when more recent evidence provokes inconsistencies in the beliefs of SMA. These non monotonic reasoning capacities of method relying on an ATMS (De Kleer 1986) and a *Conflict Solver*. The pedagogic diagnosis rules have been formulated as domain independent rules, arranged in a rich taxonomy of diagnosis criteria (De Antonio, 2009a) and implemented using Jena[2] framework.

[2] http://jena.sourceforge.net/

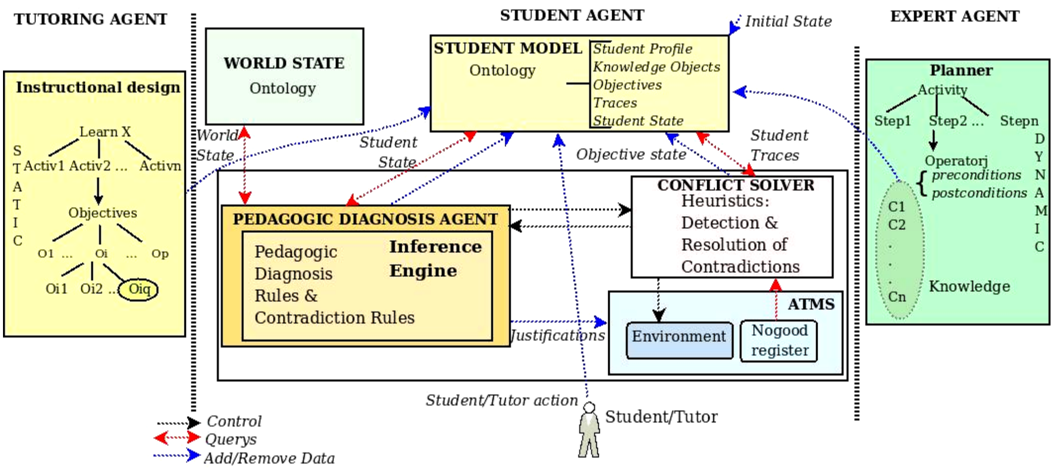

Figure 1. Diagram of the proposed student modeling.

Overview of the Ontology

The language chosen was OWL and as ontology editor Protégé was used[3].

Based on the design requirements for the student modeling agent, we have developed (Figure 2) three single student-dependent ontologies representing the following:

- **Student Profile Ontology**: the student's personal information (demographic data, preferences, physical and psychological features, etc.).
- **Student State Ontology**: the student's knowledge, the acquired learning objectives, the degree of completion of the instructional design of the course, and an assessment of the student's acting along different learning sessions.
- **Student Trace Ontology**: the temporal register of the whole student's activity.

In addition, we have built two more single student-independent ontologies[4]:

- **Learning Objectives Ontology**: the learning objectives defined in the instruccional design of the course.
- **Knowledge Object Ontology**: the knowledge elements involved in the considered learning process.

[3] http://protege.stanford.edu/

[4] Student independent ontologies in the sense that they allow defining instances of concepts that may be shared by different student-dependent concepts

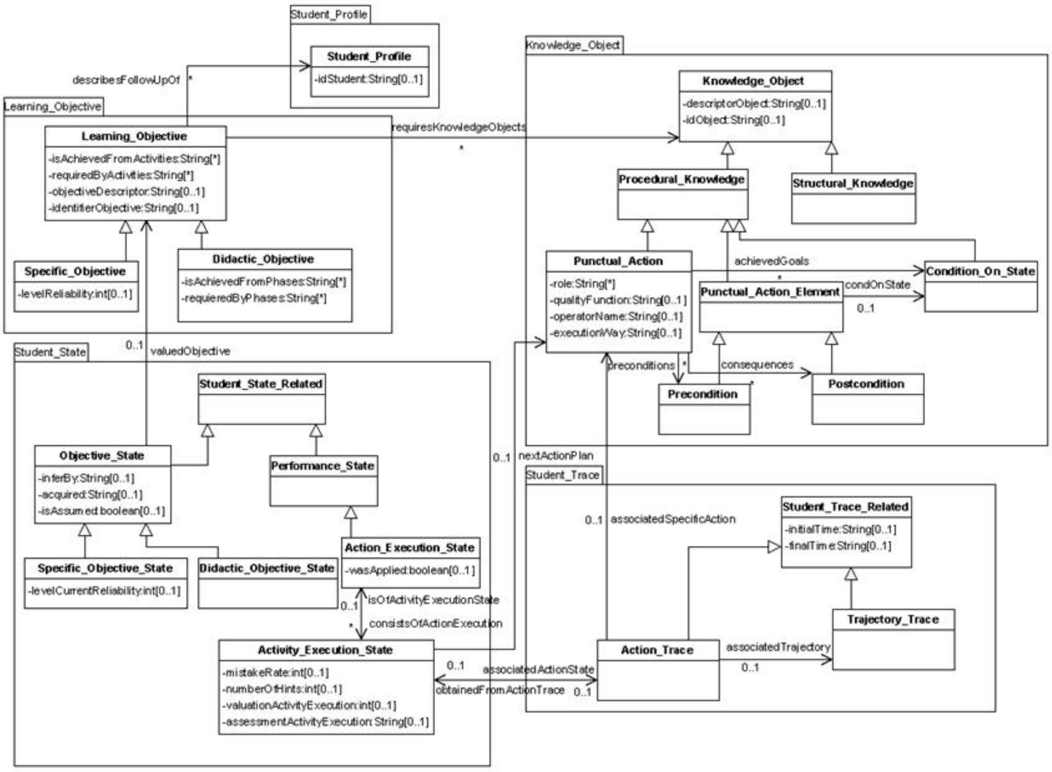

Figure 2. Overview of the student ontology.

Conclusions and future work

The proposed SM has been implemented and it has been instantiated for two types of learning environments: one for learning to use the graphical user interface of a software application (De Antonio, 2007) and a Virtual Environment for procedural training (De Antonio, 2009b). Taking into account the experience acquired in these two implementations, a methodology to guide on the application of this student modeling approach to each specific system is being developed.

We are in the course of testing, on top of MAEVIF, the proposed SM in a chemical laboratory environment where IVETs are especially suitable for learning/training purposes, since some exercises may entail a high risk. These tests will help us to tune the diagnosis rules, specially the non monotonic mechanisms, and to detect possible knowledge gaps in the student ontology.

In the short term, another challenging issue that will be tackled is the modeling of an instructional design description in ontological terms. For that purpose, the IMS Learning Design specification (IMS Global Learning Consortium, 2003) will be considered as the frame of reference, and it will be represented in the form of a new student independent ontology.

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Angélica de Antonio
Universidad Politécnica, Boadilla del Monte
Madrid, Spain
angelica@fi.upm.es

Jaime Ramírez
Universidad Politécnica, Boadilla del Monte
Madrid, Spain
jramirez@fi.upm.es

Julia Clemente
Universidad de Alcalá, Campus Universitario
Alcalá de Henares, Spain
julia@aut.uah.es