Developing virtual simulation game for authentic learning: Realizing partnership between university and industry

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Abstract: - The paper describes the development of virtual simulation-game-based learning environment. The key objective is to offer students and lifelong learners simulation-game environment that preserves real life authenticity. Presented is a simulation-game tailored for diversified student groups in graduate courses and employees in the tourism sector, aiming at giving them competences for international and global business management. The constructivism theory provides the framework of the simulation-game pedagogical approaches: learning by doing, learning with live experiences, experiential learning, problem-based learning, and learning in safety. The paper presents the partnership between university and industry in the design process of simulation-game and virtual community for assisting collaboration among users: entrepreneurs, students, teachers and trainers. Focus groups were formed in the design process of simulation-game, engaging all relevant stakeholders, and needs assessment was performed at the beginning of the project.

Key-Words: - Virtual simulation game, Constructivism, Virtual community, Lifelong learning, Business simulation, Hephaistos simulation software, Higher education, Wiki

1 Introduction

Competitiveness of modern enterprise increasingly depends on its intellectual assets. Knowledge transfer, innovation development and their transfer into enterprise and university educational processes provide a predominant issue. Partnership of university and enterprise in knowledge management, innovation development and education and training system design are required. Present system changes within the Bologna reform are aiming at connecting the university and enterprise in redesigning university education and connecting it with lifelong learning courses for sustainable development of professionals.

Teaching and learning approaches in graduate courses are oriented towards integration of authentic working environments and practical work in diverse ways in order to support practical application of theoretical knowledge. Creative engagements in a design process of learning resources are required, and therefore, it needs to be considered, how to collaborate with experts in enterprises, and how to collaborate with innovators (in enterprise and research centres) in order to provide for knowledge transfer into teaching and learning processes. Virtual simulation-game could offer space for establishing partnership in a design process and maintain it through virtual communities.

The paper presents the design process of virtual simulation-game for graduate courses and lifelong learning in the collaboration of university and industry. Engaging in a design process, different cultural values with the climate of cultural sensitivity in the design team of designers, developers, stakeholders and players create a myriad of complications and competing desires or expectations. [40: 213].

Meeting the needs of university and enterprises in designing learning resources in the field with the collaboration of stakeholders assured the validity as a guiding principle in the design process [31:5]. Participation of expert practitioners from the domain knowledge – entrepreneurs in the design process provides higher validity – degree, to which there is correspondence between the reference system and simulated model [31:5].

In a simulation game development team collaborated experts from the fileds of tourism business, information communication technologies, and education. The multiple perspective of simulation game development consists of three main parts: game design, content design and pedagogical design. Game design concerns development of concept strategies, understanding user's interests,

contents and systems to be applied in coding process. Content design concerns business as complex field of investigation. In a selection and definition of business simulation to be played with is a task to be conducted by teachers/trainers and enterprisers. For meaningful integration of games in education games need to be developed on the basis of educational theory. Link between educational theory and the game design needs to be established [26]. The researcher's report of lack of collaboration processes with pedagogical experts in game development [17]. In game development process users need to be engaged within the whole process of development and testing the product.

2 Authenticity of learning experiences and constructivist conditions for simulation game-based learning

2.1 Applying knowledge to practice

"Applying knowledge to practice" has been considered a weakness of the traditional university courses. Traditional teaching and learning methods did not support the development of competences for applying knowledge in practical work and in real life situations, where the students' learning was de-contextualized of contents taught. This situation shows in all the disciplines of science, in technical disciplines and in humanities. University curricula consist of courses delivered without sufficient mutual interfaces. Students learn fragmented materials which cannot fully be applied in practice and in real life situations.

Complex sciences, concepts, principles and theories can be difficult to comprehend for students if they are taught in a fragmented way. Complex science, which concepts, principles and theories can be difficult to understand and conceived by students are often explained only through the long derivations of equations and formulae, which makes the lecturers' task of animating students and creating the feeling of 'being-in the-world' even more difficult [22]. The paper focuses on tourism business education. In business education, case-based learning and business simulation-games are bringing solution to this problem of successful application of knowledge in specific situations [7, 25, 28].

Learning to think like professional demands innovative methods, which can be provided by computer games. Shaffer [47] points out learning methods for real-world skills, professional values,

problem solutions which are innovative and creative and as such different from traditional university teaching.

In VIRBUS simulation-game, the topics of diverse courses are integrated in a way as to integrate courses when using them in main-stream university curricula and enterprise training, supporting students in acquiring the holistic view of business processes. Providing virtual simulation-game-based environment for university education and work-based learning assists the learning by doing, learning on live experiences, learning in safety [35].

Simulation has to provide validity from two perspectives, corresponding to relevant phenomena outside the simulation [12, 31, 44] and corresponding to learning setting [44], aligning learning aims, methods and assessment with intended learning outcomes. Simulations are complex and challenging learning environments that pose difficulties for learners who lack a fundamental understanding of domain-specific concepts, relationships and problem solving strategies [27].

2.2 Constructivist conditions

Organisational structure of traditional universities means large classes, diversified classes in terms of student prior knowledge, ability and motivation, and differing conceptions of students and teachers as to teaching and learning. The study process is mainly designed for an average student and, as such, it is insufficient for better students and for those with poorer prior knowledge [19: 443].

Considering cognition as intrinsic in the cognitive constructivist learning theory, individuals build their new knowledge in the process of relating new information to their existing knowledge structure – teaching approach needs to support students' meaningful incorporation of new concepts, principles and theories.

Sociocultural constructivist theories emphasize that human mental functioning is inherently situated in social interaction and cultural context [39, 49]. Learning is understood as an interactive activity, taking place in social interaction [39]. The quality of learning process strongly depends on the type and intensity of teacher-student and student-student interaction.

Simulation-game working environments are frequently designed and based on constructivist theory [44], though the interpretation frameworks may differ.

VIRBUS was designed and based on constructivist theory, in the collaboration of

university and enterprises. In defining quality teaching, the constructivist theory emphasises those teaching approaches, which are not in a transmissive function, but rather in the function of encouraging students to build their knowledge by means of their own activity. Glasersfeld maintains that 'Concepts cannot simply be transmitted from teachers to students – they have to be conceived' [15: 5].

A teacher's role is supportive - he or she does not transmit his or her own ways of understanding (knowledge constructions) to students. His or her role is rather to provide guidance needed by learners in order to bridge the gap between their current and desired knowledge level. The student-centred approach is required. The teacher's role at such an approach changes, the focus is shifted to the constructive role of the learner, which differentiates it from the teacher-centred model in which knowledge is transmitted from teacher to learner.

The following learning conditions should be fulfilled: 1. Provide complex learning environments that incorporate authentic activity. 2. Provide for social negotiation as an integral part of learning. 3. Juxtapose instructional content and include access to multiple modes of representation. 4. Nurture reflexivity. 5 Emphasise student-centred instruction [11: 365-366].

Ideas and conceptions that students bring when entering the university are different from scientific view. Those ideas are strong and complex and resist change. The process of aligning students' conceptions with domain knowledge is a central problem of teaching and learning. Many researchers focus their work on this problem [1, 33, 34, 37].

Productive learning occurs when teachers pursue teaching approaches based on students' current understanding of scientific concepts. Students in the process of learning don't memorize facts but construct their knowledge. Crucial determinant is prior knowledge [1], which is related to students' approaches to learning and their achievement [37].

Biggs [4:25] describes teaching as balanced system in which all components support each other, as they do in any ecosystem'. Among them, he enumerates 1 The curriculum that we teach. 2 The teaching methods that we use. 3 The assessment procedures that we use, and methods of reporting results. 4 The climate that we create in our interaction with students. 5 The institutional climate, the rules and procedures we have to follow. All components depend on conceptions of teaching and learning of teachers and students, influencing teachers' approaches to teaching and students' approaches to learning. Students' perceptions of the

learning and teaching context are seen to be an interaction between their previous experiences of learning and teaching and the learning and teaching context itself. They approach their studies in relation to their perceptions of the context, and that approach is related to the quality of their learning outcome [38:12].

Increasing educational potential is noticed in games which include the element of simulation and in simulations that are intended to be "played with" by users [8]. Overlap of game and simulation pedagogy is applied in VIRBUS virtual simulation-game. Main characteristics of educational game can be summarised as: player engages in a game on his/her own or in a group of players to construct his/her own knowledge, using various approaches: learning by doing, learning from mistakes, goal-oriented learning, role play, and constructivist learning [35]. Characteristics of game, as educational goals, rules, competition, chance and pleasure, are applied, adding educational simulation as a model of reality defined as a system, a dynamic model, a simplified model, and a model that has fidelity, accuracy and validity [42:251].

2.3 Research design

Focus groups were used to support the development of VIRBUS pedagogy, with specific emphasis on the partnership of all the stakeholders. Qualitative research approach was selected for entering a very complex field of investigation [9]. It has been stated that a method is appropriate only if studying norms, group meanings and group processes [6]. As such, focus groups are valuable in investigating professional practices and professional development activities.

In the study, the main aims of the focus groups were assisting the validity [12, 31] of simulation-game, and identifying best approaches to design and appropriate teaching and learning methods for diverse users among students, and for entrepreneurs in their professional development activities. Focus groups were implemented with groups of teachers, students, entrepreneurs and experts. Special focus was on pedagogical and ICT-experts, applying in particular the game-based and simulation-based learning. Focus groups stimulate lively debates [32], where views are developed and modified. When investigating group dynamic, and professional identity development processes in a professional community, the method is most valuable. Participants in group discussions were focusing on

topics which they had previously not paid attention to.

Focus groups were formed in order to link the needs of university initial education with the continuous professional development in the field. In order to provide suitable pedagogical design of simulation-game-based virtual environment, the main aims of focus groups were identified:

- getting the agreement of general simulation-game-based virtual learning environment for the diverse user groups;
- conceptual and construction design;
- preserving the authenticity of simulation-game and its maintenance, where all the stakeholders can be actively involved;

Pedagogical design therefore needs to focus on the design of simulation-game for diverse audiences in order to provide authentic tasks, dealing with real-life data. Community of users can provide for the constant maintaining of simulation-game.

3 VIRBUS

The simulation game based virtual environment was designed in alignment with constructivist conditions for learning outlined by Driscoll [11]. Simulation game learning environment provides tools and contents for activities which are closed to real life business situations. Activities are designed in authentic environments of real life data from four countries regarding hospitality and destination management. Computer supported collaborative learning assist [20, 23] :

- collaboration when conducting activities,
- learn when comparing perspectives, attitudes, problem solving strategies of others to one's own,
- building shared knowledge and understanding,
- develop generic competences when acting in a group.

One of main challenges in a design of technology assisted learning is to provide diversity of perspectives for individual student's needs, prerequisite knowledge, and learning approaches. Addressing this learning condition simulation game has to provide multiple modes of representation for tools, contents, and activities. Various communication and presentation modes are supported in learning with business simulation. Learning process in VIRBUS is designed to foster student's metacognitive activities through the whole game providing constant reflection which activate

students in exploration of their own metacognitive strategies and processes. Individual student get insight in prerequisite knowledge, and identify needs and interests before starting the game and each round of the game. Playing the game with meaningful context created for individual student when evaluating the present state of knowledge and competences and connecting to wider student's needs and interests are provided.

VIRBUS simulation-game-based virtual environment is designed by MediaWiki [50]. Wiki is a hypertextual system for storage and transmission of information. Wikis are useful in an environment where multiple users are collaborating on a single document as in an environment where lots of information is constantly updated [45]. Wiki has been defined as the simplest online database that could possibly work [30:15]. Wikis growing influence is in community development and its operation. Wikis support constructivist approach to learning and teaching.   Learners are active constructors of their knowledge in collaboration processes in Wikis promoting cooperation and de-emphasize competition.

Figure 1: Virtual simulation game-based learning environment structure

The creative collaboration supported by wikis fosters the innovation development and implementation which is central to technological progress in general. More significant is the mode of

innovation which drive cultural developments to which are associated new demands for technological solutions [43].

VIRBUS simulation-game-based virtual environment consists of (Figure 1):

- business Planning Tool in Microsoft Excel format (Figure 3,4);
- country-specific data from Finland, Slovenia, Germany and Estonia (Figure 2);
- theories are selected from among three main topics of business management - Planning, Analyzing and Evaluation tools;
- Hephaistos simulation module (Figure 5, 6);

- VIRBUS evaluation instruments of questionnaires, for teachers and students.

Theoretic topics are structured as follows:
- Planning Tools
- Business Plan
- How to organise a company
- Human Resource Management
- Market Positioning
- Pricing Management
- Strategic Management

Analysing Tools
- Balance Scorecard
- Porter's Five Forces Analysis
- SWOT Analysis

Evaluation Tools
- Key Performance Indicators
- Financial Statement Analysis
- Service Quality Management

Figure 2: Real life data for Finland, Slovenia, Germany and Estonia

- glossary of concepts;
- VIRBUS community, which is a setting, where teachers, students and other users of VIRBUS simulation-game are able to develop their professional understanding and expertise in the field. VIRBUS community is to provide opportunities for reflection, evaluation and exploration of new ideas.
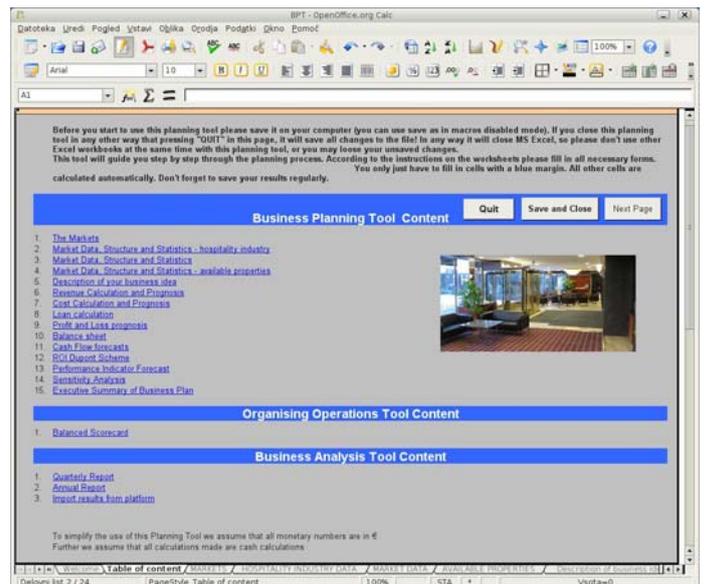

Figure 3: Business planning, organizing operations, and business analysis tools

The competition as a significant characteristic of game has in VIRBUS three major patterns: in the first phase player competes against virtual or dummy players, in the second phase player competes with other players in the virtual classroom and in the third phase player competes with players ho are distributed globally in competing tourism destinations.

Figure 4: Excel planning tool

In VIRBUS, the Hephaistos – Java-based generic simulation application, version 1.5, was used for developing the simulation module. All the information regarding business simulation market data parameters is received through XML-files, which define the simulation-game scenario. Parameters may be manipulated by teachers or trainers (Figure 5, 6).
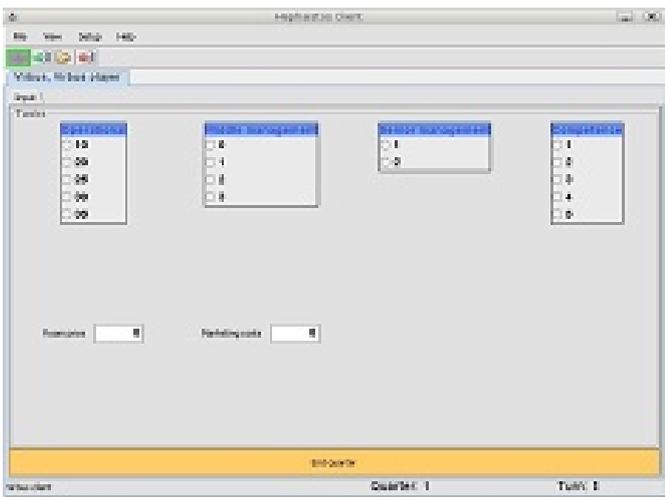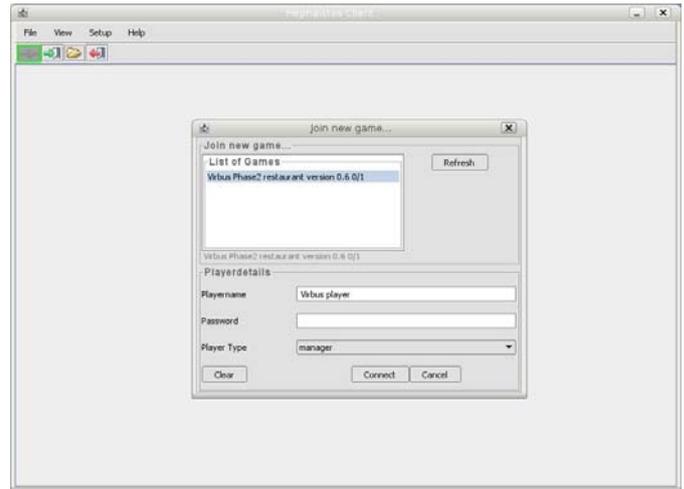

Figure 5: VIRBUS Hephaistos client

Figure 6: VIRBUS Hephaistos games

4 Virtual community: construct – share - exchange

Software development is starting process continuing in maintenance phase which is becoming major investment in terms of manpower and finances. According to Brooks 90% of cost of a typical system is maintenance phase [4]. VIRBUS virtual community has been designed as a strategy for improvement and assistance of change process in implementing VIRBUS in the mainstream curricula of tertiary education and lifelong learning. Anticipated changes will be implemented in maintenance phase.

It has been designed to assist learners and professionals in the field: individuals, small and medium size development teams which are globally distributed. VIRBUS will connect body of knowledge of users to be shared by teachers, students and enterprisers. Wiki has been adopted as a collaborative tool which assists community at tertialy educational level for enhancing co-teaching [45].

Wiki as a source for establishing a community around a game development has been proven as successful. As an example Game Maker can be mentioned [14, 17].

Professional community facilitates learning to the participants in an appropriate sociocultural context, by the appropriate means for learning and collaboration with experts in a particular field. Professional communities of practice are more and more important in developing the web-environments for professional development [10, 28]. They act as a virtual society in a process of e-learning

deployment. Contributions of knowledge from variety of sources enhance applicable shared knowledge originating from diverse real life problems [20: 623]

A community of practice is defined, according to Lave and Wenger [29:98], as a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice. It is an intrinsic condition for the existence of knowledge, not least because it provides the interpretative support necessary for making sense of the heritage. Thus, participation in the cultural practice, in which any knowledge exists, is an epistemological principle of learning.

Wenger proposes three dimensions of the community of practice, defining the community members as "evolving forms of mutual engagement; understanding and tuning their (joint) enterprise; and developing their repertoire, style and discourse" [48: 95].

Characteristic of a community of practice is, according to Barab and Duffy [3:37], a common cultural and historical heritage, where a community is composed of individuals, who are interdependent and interconnected within the community context, which is part of a larger community; a community has an ongoing 'reproduction cycle', with new members entering, cooperating with other members of the community, and becoming its core members.

Characteristics of professional community, which are to be promoted in a VIRBUS community, include the shared mission, vision and values; collective inquiry, collaborative teams, action for continuous improvement;

Ross, Smith and Roberts [41] describe a collective inquiry process, which enables members to actively participate in a community. The "team learning wheel" consists of:

- public reflection, in which participants exchange and share their assumptions and beliefs.
- shared meaning of the community members, when they achieve common ground and shared insight.
- joint planning of action steps and initiatives in a process of developing shared insight.
- coordinated action of the team, which can be carried out independently by community members.

We refer to VIRBUS community as a professional community, promoting vision and values of a learning community. It is a setting, where teachers, students and other users are able to develop their professional understanding and

expertise in the field. Key aim of VIRBUS community is to provide opportunities for reflection, evaluation and exploration of new ideas.

Quality teaching and learning, aiming at studying objectives within the hospitality business management and destination management operations, focusing on international business management skills and competences, will be provided within the international groups of students.

The aim of VIRBUS community is therefore to stimulate and assist international teams of teachers so as to collaborate in teaching international groups of students, using VIRBUS.

Teachers may exchange good practices and critical reflections, participate in international teams of teachers for teaching international groups of students with VIRBUS, and actively participate in the further developing of VIRBUS. Teachers can exchange their lesson plans and can conduct co-teaching activities. International collaboration is the main aim of Bologna reform and Copenhagen process within the university and vocational education. Transparency of university curricula across the EU supports the implementation of VIRBUS in the mainstream courses. Students are able to find peers in the community, and to engage in the collaboration with students, experts and entrepreneurs nationally and internationally. Based on community collaboration instructional strategies of VIRBUS will be shared and constantly improved.

VIRBUS community assists globally distributed individuals and teams from diverse cultural backgrounds. Virtual organizations are often multicultural [24]. Diversity as a value has to be recognized and accepted in communication patterns and joint developmental activities since individuals from different cultural backgrounds have different communicational stiles and group behavior [16].

5 Conclusion

Application of theoretical knowledge in practice is one of most important study aims therefore diverse methods and approaches are developed to provide it. Authentic meaningful learning embedded in social experience is hard to provide within regular curricula without change process in teaching and learning approaches. Real life situations if possible to transfer at all can not be integrated in the university curricula without risks. In the paper is presented the strategy for integration of authentic working environments in order to support practical application of theoretical knowledge within teaching and learning approaches in graduate courses and lifelong learning. Simulations and games are

becoming widely spread source of authentic learning for graduate study courses as for continuous professional development. They support learning by doing, experiential learning, problem based learning, and learning without risk. The VIRBUS simulation game based virtual learning environment was developed to provide the real-world environment for business game in hospitality and destination management. Main advantage of VIRBUS is that is designed based on real life data for four countries Finland, Slovenia, Germany and Estonia. The virtual learning environment provides social learning experiences assisting individual student's needs and interests.

Validity of simulation was provided by creative engagement of experts from university and enterprise in a design process. On the basis of the partnership in a design process which will be maintained through virtual community maintenance of simulation game will be provided.

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