Towards a Novel Paradigm for Educational Games:
The Augmented Learning Environment of 'Europe 2045'

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ABSTRACT
This paper introduces the concept of an augmented learning environment into the field of game-based learning. An augmented learning environment (ALE) combines principles of on-line multi-player computer games with social, role-playing games in order to facilitate the development of key skills and transfer of knowledge. Fundamental features of ALE are discussed through the educational game paradigm, *Europe 2045,* which has been developed and successfully implemented in a number of secondary schools in the Czech Republic during 2008. On a more general level this paper aims to establish a theoretical and case-study-based methodological framework for game researchers and designers, involved in similar future projects, which capitalizes on the notion of ALE.

Categories and Subject Descriptors
K.3.1 [**Computers and Education**]: Computer Uses in Education – *collaborative learning, computer-assisted instruction (CAI), distance learning*

General Terms
Design, Experimentation, Human Factors, Theory, Verification.

Keywords
Serious games, role-playing games, multi-player games, game-based learning, educational games, learning.

1. INTRODUCTION
Europe 2045 is a multi-player strategy game designed to be a supporting educational material for social science courses. It attempts to familiarise players with political, economic, and social issues in a united Europe and the present-day world. Apart from learning facts, the player should develop a range of key skills: the ability to discuss, to negotiate, to think critically, and to work in a team.

Europe 2045 features three layers of game play. In the game, each student (1) represents one EU member state and defines its domestic policy, (2) has an opportunity to present drafts for policy changes to EU institutions, and (3) faces various simulated scenarios addressing contemporary issues, such as migration, population aging, and international relations.

Concerning point (3), the players must react to all these events and, in co-operation with fellow players, seek out appropriate solutions. During the course of the game, they typically witness the short- and long-term effects of their decisions. Concerning point (2), each player (or team of players) has his/her own project to try to push through at the European level. In this respect, the game is both competitive and cooperative at the same time. The final appearance of Europe at the end of each match is thus a result of discussions, voting, and diplomatic negotiations in a given group of players. [9]

Figure 1. Flash interface of *Europe 2045*.

The most important aspect of the game is that it combines principles of on-line, multi-player computer games with social, role-playing games in order to facilitate the development of key skills and transfer of knowledge. The 'augmented learning environment' of the game features both virtual and real space. The media, through which the game is played, are both computers and social space in classrooms at the same time. The component facilitating gaming at a technical level is a social-economic simulation run on a remote server. The students control their states via the Internet through a Flash-based interface (Fig. 1).

The diplomatic part of the game takes place in the classroom, where it is moderated by the teacher (Fig. 2). Supplementary information, which helps students in discussions, is provided by the on-line, in-game encyclopedia and other materials.

Figure 2. Students' diplomatic negotiations in *Europe 2045* during a political science seminar (Gymnazium SMVV, Prague).

2. OBJECTIVES OF THE PAPER

The idea of using computer games in education is a topic that has been discussed at length over the past two decades. A number of theoretical treaties [2, 10, 3] and practical examples [1, 6] exist in the field of game-based learning. In spite of that, the number of educational games, which have been successfully implemented into formal education, remains relatively low [7, 3]. Jantke stated several requirements for educational games that most of today's game-based learning applications do not fulfil [5]. Among these the following two demands were not met in most cases:

(1) Frustration caused by a conflict between the game play and the teaching material should be avoided, e.g. interaction when learning may not interrupt the flow of the game play and disturb the player's immersion. These interactions should be supportive instead and should not hinder players from reaching their goals.

(2) In general, the playing part and the learning part of the game should form a unit. The most important criterion is that interactions when learning should appear as inherent constituents of the game. [5, 7]

From a different methodological standpoint, we can say that most of the educational games do not feature *causal links* between the game and the learning component, i.e. actions of the student in the game do not transpire in the learning component (and vice versa). The coherence and immersion of both the learning process and the gaming experience are thus fundamentally corrupted.

The main goal of this paper is to present a methodological framework for augmented learning environments (ALE), which in our opinion transcends the above mentioned problem of game-based learning. We use the educational game *Europe 2045*, which has been successfully implemented in a number of Czech secondary schools, as an example. The theoretical concept of ALE is then discussed in light of an evaluative study.

3. AUGMENTED LEARNING ENVIRONMENT (ALE)

To solve the above-mentioned problem, we need to preserve (1) the degree of immersion of classic computer games and (2) the educational potential of classic curricular learning at the same time. This section provides an overview of the ALE framework, which addresses these points, and elaborates on its features.

Conceptually, ALE combines three different platforms in which the game takes place: the real space, the virtual space, and the information space. In the case of *Europe2045*, the virtual space is represented by an on-line, multi-player computer game (MMOCG) and the real space features a social, role-playing game (SRPG). Each type of game possesses its specific learning advantages. MMOCGs construct complex virtual worlds, allowing for non-linear interactions and exploration, as well as various forms of collaboration/competition among groups of players. These games have already proved successful in many instructional and educational projects [11, 8]. SRPGs enable the players to choose and customize their character and intrinsically enhance motivation and engagement in the learning activities [4, 8]. Finally, information space provides relevant, up-to-date, and factual information and real world context.

Essentially, the MMOCG (i.e. the virtual space) supports the Point (1) of the above mentioned goals. This support is further enhanced by the SRPG (i.e. the real space). However, the real space is also the space of classic curricular learning, i.e. familiar to teachers, thereby facilitating the Point (2). This facilitation is backed up by the info-space, which provides classic curricular learning materials.

These three spaces would not constitute a union of ALE, however, until *causal links between the spaces are defined*. Basically, humans tend to conceive events as effects, which have some causes. This holds for all of the three spaces as well (a student's action in the computer simulation triggers one or more events; a student's proposal in the classroom shapes the following discussion, etc.). Nonetheless, many serious gaming projects lack causal links *between* the spaces. The defining feature of the ALE is the existence of these links, which assures that actions of students in one space transcend to the other(s). These links have to be intentionally created by a game designer.
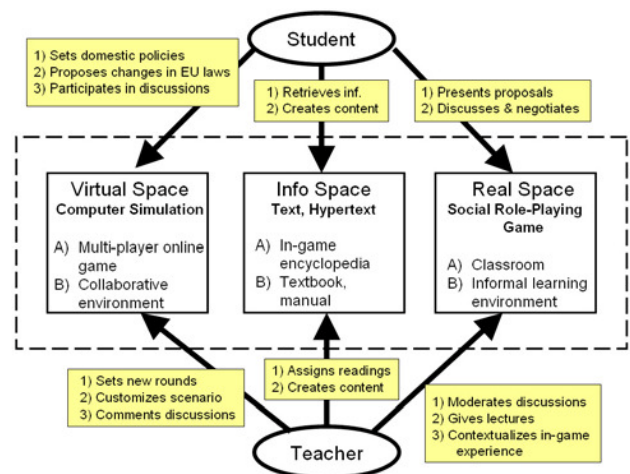

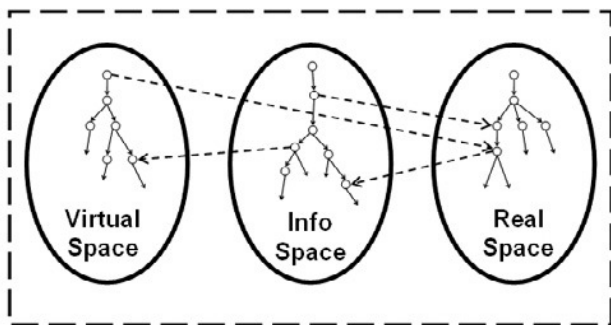**Figure 3. Concept of the ALE of *Europe 2045*.**

Figure 4. Causal links in ALE.

Fig. 3 summarizes the concept of ALE in *Europe 2045*. Rectangles represent the different spaces of ALE, ovals represent actors, whereas arrows with yellow labels describe their transactions, i.e. activities performed in the different spaces of ALE. Fig. 4 schematizes the causal links in the ALE of *Europe 2045*. The small circles represent events and the links their causal connections. The links between the spaces are represented by dashed arrows.

3.1 Virtual Space

The virtual space represents the part of ALE which is constructed via computer simulation and the Internet. A keystone of *Europe 2045'* ALE is a multi-player, on-line strategy game. An important part of the game is its economic simulation (based on real data and a multi-agent approach), which provides the player with immediate feedback of his or her domestic policies. At the same time the game features virtual storytelling, which simulates various international affairs and crises. These events are communicated to the player via TV and newspapers. The teacher has the ability to adjust the scenario to fit/suit the school's curriculum. All the game's learning elements (i.e. EU policies, simulated events, economic terms etc.) are directly linked to the in-game encyclopedia (see below).

The causal links between the virtual and the real space (V->R) are represented by students' proposals for the changes of EU policies. Based on the success of his/her domestic policies, the student is awarded so-called 'prestige points'. These points can then be invested into proposals for changes to EU policies. At the same time, the discussions and diplomatic negotiations on each proposal take place mostly in the real space (see below).

3.2 Social Space

The social space of the ALE comprises classroom and teacher lectures (i.e. a formal schooling environment) as well as informal social interaction between the students. The SRPG element is represented by a system of so-called 'projects'. At the start of the game the student has to choose his/her role, i.e. state and project. A project is basically a vision of how the EU should look in the future, i.e. a set of defined EU policies, which have to be implemented. The player represents the same project during the whole game, and his/her success in the game is evaluated in terms of how effectively the project has influenced the final appearance of the EU.

In the classroom the students present their classmates proposals for changes to EU policies. These are proposals that they made in the virtual space. Each proposal is then discussed and contextualized by a short lecture from the teacher. The discussion is moderated by the teacher, who ensures that appropriate space is given for both the proponents and opponents of each particular proposal. A short amount of time for informal and private diplomatic negotiations is given in every round. During the lectures the teacher has the opportunity to comment on the in-game development, the above-mentioned proposals, and the events taking place in the virtual scenario and thus to contextualize them into a real-world framework. It also gives him/her the possibility to adapt or adjust the predefined scenario if needed. The last two aspects are often missing in most educational games.

The causal links between the real and the virtual space (R->V) are personified (1) by voting on the changes to EU policies (which takes place in the virtual space), and (2) by the impacts of these changes, which are simulated in the computer game later on.

The links between the two spaces (R->V and V->R) are in fact the most important aspect of the ALE, in that they facilitate students' immersion. They intrinsically encourage students to think about the real and in-game impacts of their politics during discussions and vice versa. In other words, something that is important in one space is rendered important in the other space.

3.3 Information Space

The information space of the ALE encompasses all information resources related to the learning topics. It preserves the educational potential of classic, curricular learning, but at the same time it evolves according to the students' actions. This facilitates both deeper understanding of the underlying logic of the simulation and real world contextualization.

3.3.1 In-game Encyclopedia

The in-game encyclopedia is structured according to the *Europe 2045* learning elements (i.e. EU member states, EU institutions, EU politics, game events, economic terms. etc.). The summary of each encyclopedia item appears directly in the game as a mouseover hint. The body of each item is then accessible as a direct link from the game. At the end of each item, links to different public Internet resources are posted. The important aspect of the info-space is that its content can be created and commented by the teachers and learners, and thus can be adjusted to the different needs of different schools. The teacher also has the opportunity to assign readings and tasks to the students for each lecture according to his/her curriculum. In order to be successful in the game, the students are actually encouraged to carry on their own additional research and develop information-seeking habits.

3.3.2 Game TV and Newspapers

For each player, specific TV news and newspaper articles are generated every round based on his/her actions and the general development of the simulation. The causal link V->I thus changes the game's information content, e.g. when the state of the game changes, new newspapers articles are introduced. This helps us to focus students' attention on relevant information. The link R->I allows students and teachers to change the information content during the course of the game; e.g. via comments in the encyclopedia or bulletin boards. Importantly, information that a student gains in the info space shapes his/her behavior during the game: this is mediated via the I->V and I->R links. Thus the R->I links presents a means by which players can influence how other players will act. The V->I link makes information from learning

resources that students are using relevant for the problems they are solving at any particular moment during the game.

4. EVALUATION

We have conducted an evaluation study based on several pilot studies that produced both qualitative and quantitative data. During these studies the game *Europe 2045* was fully implemented in 8 secondary schools in the Czech Republic.[1]

Table 1. Evaluation study of Europe 2045.

A. Overall evaluation of Europe 2045 by students:				
Excellent	Good	Average	Bad	Very bad
38%	36%	18%	4%	4%

B. The most interesting part of Europe 2045 is:		
Discussion, negotiations	Simulation	Encyclopedia
47%	33%	20%

C. I have gained most information from:					
Teacher	Simulation	(3)*	(4)*	Encyclop.	(6)*
11%	6%	11%	35%	31%	6%

D. Is it important for you to be able to choose your project?				
Yes	Probably Yes	I don't know	Probably Not	No
38%	22%	22%	10%	8%

* (3) Diplomatic negotiations, (4) Classroom discussions, (6) Additional research.

For the most part, the evaluation study has proven our concept of the *Europe 2045* augmented learning environment successful. 38% of the students evaluated the game and learning experience as excellent and 36% as good (Tab. 1, A). By integrating the computer game, discussions, teacher lectures, and negotiations into one coherent gaming and learning experience, *Europe 2045* seems to have transcended one of the fundamental problem of game-based learning. The causal links between the virtual and the real space (i.e. interaction between MMOCG and SRPG) form a unit, which ensures the player's immersion and uninterrupted flow of game play without compromising the learning aspect. Additionally, the fact that students can play the game from their homes (or outside the lessons at school) gives the teacher an opportunity to focus on key issues in his or her lectures (and discussions) and thus contextualize the learned skills and knowledge into meaningful real-world scenarios.

In general, during the pilot implementation of *Europe 2045,* the students demonstrated higher engagement and willingness to study otherwise rather complicated and unappealing issues relating to the European Union (i.e. in comparison with traditional class lectures):

"Students can test their concepts and ideas about how the European policies should be formulated in a practical manner.

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[1] The study was conducted between 1/2008 and 5/2008 involving 220 students (F=122, M=98, age=16-18). The study comprised pre-tests, video surveillance, field notes, post-tests, and in-depth interviews with students and teachers. For reasons of brevity we have presented only a portion of our data here.

They find out that in order to successfully realize their ideas, they have to persuade others by means which stem from real political skills, i.e. negotiations, lobbying, discussions, etc. During the course of the game they actually learn such techniques. Moreover, they immediately see the results of their actions. This effectively replaces the most commonly unappealing theoretical lectures about how the European Union works." (Social sciences teacher, *Gymnazium Omska*)

"During my previous lectures about the European Union the students were never so engaged and motivated to study this topic." (Geography teacher, *Gymnazium Sázavská*)

During the evaluation it became clear that the connection of SRPG (actions taking place in the real space) with MMOCG is more appealing to the students then the actual computer game *per se*. When they had to distribute 10 points between various parts of the game, the social role-playing game received 47%; whereas, the computer game only 33% (Tab. 1, B).

This discrepancy is far greater when it comes to the learning effect. Only 6% of the students stated that they have gained the most information from the computer simulation, while 46% voted for the social, role-playing game taking place in the classroom (Tab. 1, C). These results indicate that integrating real space activities into game-based learning (as it is the case with the ALE) is vital for successful implementation of computer games in formal educational systems.

Unlike some previous game-based learning projects, the *Europe 2045's* ALE also effectively integrates the traditional educational structures, i.e. text and teacher, into the learning process. A substantial amount of the students (42%, Tab. 1, C) stated that they had gained the most information from the in-game encyclopedia or the teacher. The teacher's reflection on the development of the game, introduction of the real world context, and moderation of the discussions proved to be a crucial factor in determining the learning outcome of *Europe 2045*.

Finally, the integration of SRPG into the ALE was based on the hypothesis that students need to have the opportunity to choose and customize their role and motivation, provided that role-playing elements are meant to be part of the learning process [4, 8]. According to the students' evaluations, this hypothesis proved to be successful (Tab. 1, D). The fact that the player's identification with his/her role is crucial became evident also during monitoring activities and in-depth interviews. When students had the opportunity to choose their roles, then their level of engagement in the game and discussions was significantly higher (than when they had to represent states and projects without the possibility to make their own choices).

5. LIMITATIONS OF EUROPE 2045

As has been demonstrated above, the *Europe 2045's* ALE generally succeeded as a learning tool in a formal schooling environment. Nonetheless, some problematic aspects and limitations remain:

(1) *Europe 2045* has been successfully implemented in a relatively small number of secondary schools, i.e. 8. We can assume that the teachers who voluntarily attended our instructional seminars and implemented the game in their courses represent a more avant-garde sample from among Czech secondary school social science teachers. Integration of the ALE

into formal educational systems on a major scale remains a future challenge.

(2) Most of the teachers (75%) opted for one-day intensive courses instead of long-term courses. Their motivation was clearly to reduce the amount of energy and work required by such efforts. A more detailed teaching methodology and a step-by-step guide for a variety of long-term courses is needed if *Europe 2045* were to become part of compulsory subject requirements in school curricula.

(3) During the instructional seminars it appeared that a substantial amount of Czech secondary teachers have no experience with computer games. This limits their motivation to introduce games into their lecture programmes. Moreover, some teachers who attended our seminars had very limited general IT skills. Many struggled hard with even basic tasks (e.g. using Internet Explorer). As a result we started to provide tutors, who helped those teachers in need to manage the first round of *Europe 2045* in their schools.

(4) With respect to the previous point; as the field of game-based learning matures, it is probably time to start calculating the per student cost of development for such educational games: in terms of money and time spent on development and on instructing teachers on how to use these specific tools.

6. CONCLUSIONS

The theoretical concept of *Europe 2045*'s augmented learning environment proved to be successful in transcending some of the most problematic obstacles to integrating game-based learning into formal schooling environments. In fact, the ALE introduces a novel paradigm in the field of educational games. The fundamental distinguishing features of ALE include the following aspects:

(1) Combination of multi-player, on-line computer games with social, role-playing games in order to create one inherently-consistent learning environment (see 3.1.1 and 3.2.1).

(2) Integration of appealing game play directly into formal lectures without compromising the learning or gaming aspects of an educational game (see 4).

(3) Utilizing role-play as a motivating factor in order to immerse learners into complicated and multi-faceted topics that are hard to comprehend through factual knowledge only (i.e. social, economic, and political issues relating to the EU) (see 3.2 and 4).

(4) Creating an functioning possibility for the teacher to adjust the game scenario, moderate students' discussions, and contextualize the learned skills and knowledge into a real-world framework (see 3.2.1).

(5) Offering students to whom computer games do not appeal as an educational tool a variety of different learning approaches, activities and materials.

7. ACKNOWLEDGMENTS

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