The Double-Effect Approach to Serious Games in Higher Education: Students Designing and Developing Serious Games for Other Students

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Abstract. This article introduces a student-centered, double-effect learning concept on the basis of Serious Games (SG), which has been developed and established at a higher education institution in Germany. The underlying principle of the concept is a two-tiered students-for-students-approach, which encompasses on the first level the design, development and implementation of a SG for project management by 3rd year students in Business Information Systems Engineering (BISE). The SG then gets incorporated into courses on the respective topic in other degree courses of the same institution. Given the promising potential of SGs in higher education in general and the multiple application options for Serious Games specifically in BISE, the authors argue that their concept can provide a solution for some of the limiting issues to enabling a broader application of SGs such as time-consuming and costly development or alignment of SGs to the curriculum of the target group.

1 Introduction

Current discourses on technology enhanced learning have widened the classic concepts on e-learning to the perspective of entire digital learning environments, which recur on familiar everyday life settings of the students to provide a more realistic framework for the learning contents [1]. Serious Games (SG) play an important role as an emerging paradigm in this context [2], as they enable for such a positioning of complex learning contents into a situation or setting familiar to the learners' experiential horizon.

1.1 The Double-Effect Approach to Serious Games in Higher Education

Taking that proposition into practical contexts of knowledge transfer in higher education, this article introduces a student-centered, double-effect learning concept on the basis of SGs, which has been developed and established at the Baden-Wuerttemberg Cooperative State University Mannheim (Germany). The underlying principle of the concept is a two-tiered students-for-students-approach which encompasses on the first level the design, development and implementation of a SG for project management by

A. De Gloria and R. Veltkamp (Eds.): GALA 2015, LNCS 9599, pp. 42–50, 2016.
DOI: 10.1007/978-3-319-40216-1_5

3rd year students in Business Information Systems Engineering (BISE), which then was incorporated on the second level into seminars on the topic for their peers in other degree courses of the same institution.

Given the findings of current studies on the promising potential of SGs in higher education in general (e.g. [3, 4]) and the multiple application options for SGs specifically in BISE [5, 6], the authors of this paper argue that their concept can provide a solution for some of the limiting issues to enable a broader application of SGs such as time-consuming and costly development [7], or alignment of SGs to the curriculum of the target group [8].

1.2 Serious Games in Business Systems Engineering Studies

The use of SGs in higher education can be regarded as an innovative method of activation for teaching, provided the availability of appropriate games that are tailored to both the educational objective and the target group. While such a utilization of SGs (namely students performing the user/player role) can be carried out in most if not all higher education subject areas, the interdisciplinary nature of BISE carries the potential for more extensive application opportunities of SGs and to approach some of the challenges encountered for the application of SGs in higher education.

As the students acquire knowledge on both business management and information technology in the course of their studies, they are not only able to play, but also able to implement or even develop SGs for other faculties [5, 9]. The combination of students' expertise in the commercial and technical arena enables the students in BISE to cover all skill profiles required for the design, development and implementation of a SG, as they are not only able to provide for the technical aspect of a SG but also for the relevant learning contents.

This approach has several advantages, as the students are familiar with issues of learning strategy and also well acquainted with the motivational potential of games, often from their own experience [10]. Therefore SGs can be used in BISE as a challenging interdisciplinary topic for study projects, which have as an outcome tailor-made target group oriented SGs with most current content ready for application, which can be offered at low cost for teaching of other faculties.

2 Case Study: The Serious Game brillianCRM – Designed and Developed from Students for Students

2.1 Setting the Grounds: The Baden-Württemberg Cooperative State University Mannheim

Baden-Wuerttemberg Cooperative State University (DHBW) in Mannheim offers an attractive and unique study method by combining theoretical studies at the university with practical experience at a partner company. The Bachelor degree programs at the DHBW Mannheim are recognized as intensive study programs (3 years), which have the interplay of theory and practical experience as leading principle: the dual degree

program rotates on three month intervals, three months at the respective company and three months at the university. The regular change of location requires the students to be flexible and able to be highly engaged with individual study sections. Students from different companies, public and social institutes come together during their study periods at the DHBW Mannheim, work together in teams and implement joint projects, resulting in networks that benefit students even after they graduate.

The Bachelor degree program "International Management for Business and Information Technology" (IMBIT) garners an internationally orientated curriculum in the realms of BISE. The six study semesters cover an interdisciplinary spectrum of computer science, professional economics, and intercultural management, which are predominantly held in English, including a summer school one of the foreign partner universities. The lectures and seminars are complemented by six internship phases at accredited industry partners both on the supplier and user side of IT services such as Accenture, DB Schenker Logistics, Hewlett Packard, IBM, or Springer Publishing, in which the students can apply their acquired knowledge directly in the business environment in Germany and abroad.

2.2 Project Set-Up

Therefore, the double-effect concept to SGs firstly draws on the interdisciplinary nature of degree programs such as IMBIT and the strategic orientation of the DHBW Mannheim to align theoretical learning phases with a structured internship program in cooperation with industry partners, allowing for a set of students with an exceptional amount of practical experience in the later phase of their studies. Secondly, the DHBW facilitates a multidisciplinary network of professors, lecturers, and academic staff across faculties, departments, and degree courses through a practice of cross-lecturing, academic research groups and education projects. These prerequisites cater for a uniquely open environment in which cross-functional and innovative study projects can be realized, such as the one discussed here.

In the first phase of the project, 3rd year students of the graduate degree program IMBIT were given the task to design, develop and implement in twelve weeks a SG on Project Management. In general, the development of an IT solution in a joint IT project is part of the 3rd year curriculum, for which the students have by then acquired the necessary knowledge in both theory and industry internships to master a broad range of challenges. In a second phase, the serious game was incorporated into the didactic methodology of courses on project management in other Bachelor and Master degree courses of the same institution with a very positive response from the students on the method. Further feedback and suggestions of the students were gathered and used as key input for a third phase, a follow-up project a year later for the next 3rd year students to pick up, resulting a matured solution, which is now ready for university-wide application.

2.3 The brillianCRM Plot – A Brief Description

Upon starting the fully web-based SG brillianCRM (www.brillianCRM.com), the student enters into the role of the project manager for an international IT project. The employer of the project manager is a German consultant firm with headquarters in Hamburg, which specializes in the implementation of software for customer relationship management (CRM). The project is to be executed in Houston (Texas) at the headquarters of the fictitious client company Concrete Machinery Inc., a manufacturer of construction equipment.

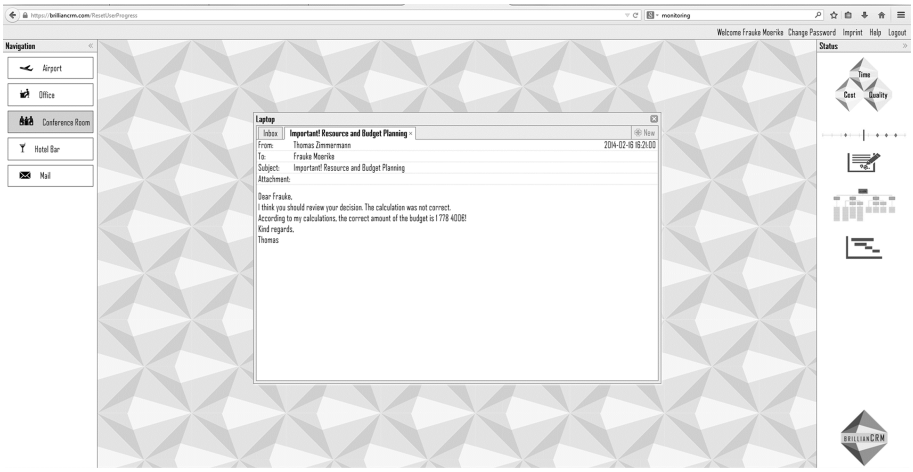

Fig. 1. The graphical user interface of brillianCRM

The project task is to adapt the standard CRM software to the specific client/user requirements, for which the player in his role as project manager has not only to deal with the different stakeholders on the client side, but also with colleagues and a development team in India. The player goes through all major phases of a project from initiation, planning and implementation through to project completion. In each of the phases the player is required to apply the various methods of project management such as stakeholder and risk analysis, work breakdown structure, budgeting and scheduling. In the implementation phase, the player is confronted with various realistic crisis situations with characters from different cultural backgrounds to which they have to react with appropriate measure and communication (Fig. 2).

The users in their role as project manager have to correspond to both the requirements of the German boss, the stakeholders at the client's side (e.g. a very critical CFO, a sales manager, or the client's side project manager) and one's own team (e.g. project assistant and programmer). In order to successfully manage the project the user has to decide to go to different places and to use diverse forms of communication (email, phone, presentation). The users are given continually feedback on their project management performance on the three critical project dimensions time, cost and quality through a traffic light (see Fig. 1 - diamond in the top left). Overall, the students designed a SG based on both

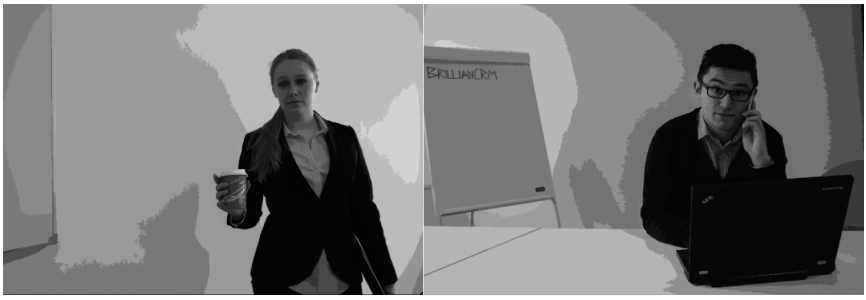

Fig. 2. Acting characters in the game (finance director, Indian developer)

current project management standard and real-life scenarios from their own practical experience, which creates the atmosphere of a quasi-realistic project environment and can foster the students' immersion into the tasks and challenges to which they can apply learned concepts and methods.

2.4 The Student Serious Game Design and Development Project

The curriculum of the IMBIT Bachelor degree programme at the DHBW Mannheim envisages in the second and third year several courses on software development, such as an IT case study, an integration seminar, an IT project and a user experience (UX)/ design thinking workshop. Together with their practical experience from the internships in the industry the students have a broad range of skills at their disposal, ranging from project management, software design, programming up to UX. In summer 2014 then, a group of hardly thirty 3rd year students was given the task to design and implemented as part of their IT project a SG. The lecturers, who acted both as project sponsors as well as academic advisors, set the objective to deliver a running prototype of a SG featuring a number of technically correct and interesting learning tasks on management of a global IT project. Further requirements were that the SG should be web-based, support current devices with touch interfaces and can be used simultaneously by thirty to fifty players in the classroom. For the entire task from initial design up to implementation the semester schedule allowed for a maximum timeframe of eleven weeks.

The course had developed a mobile device enabled tourist information system for the city of Ladenburg (m-ladenburg.de) in the previous year as part of an IT case study and could thus build on the experience gained. The students organized themselves into four teams responsible for system design and programming, UX/Interface as well as the expert contents; the student project manager had an assistant.

To cater for the tight timeframe, the only viable approach reach the objective was agile development. The development of structure and content of the SG were kept separate from the software implementation, enabling the respective teams to work in parallel from the first moment onwards. The students chose a set up for the SG with a web browser as a front end, to deploy the game structure as XML tree and to store multimedia game contents in subdirectories of the server. The control program was written in Java and a Tomcat server set up to deliver the results pages created via JSP to the client. In

addition to the Tomcat server on Ubuntu Linux several other open source components were used such as MySQL, JQuery, EasyUI and free TrueType typefaces and pictograms.

Students described the UX requirements using personas, use cases and storytelling; consistent emotional appeal was a major aspect of the game. Students who want to play the SG can simply register with an email address and no other personal information except an (alias) name is required for user management. On the user account solely a hash of the salted password and the game score is saved. Lecturers using brillianCRM can create their own course groups, send out invites for the game, check the scores of the students and if required reset the game for their group.

The personal involvement of the students into this challenging project was remarkably high and they over-delivered on the objective: On the day when their project presentation was due they did not only deliver the requested running prototype, but even a fully operational SG with a consistent look-and-feel, interesting learning tasks for the players and supporting marketing materials such as posters, slogan, jingle, video and Facebook page.

2.5 Application in the Project Management Lectures

The SG brillianCRM was then incorporated into the 2nd year lecturing sessions of two other undergraduate degree programs (International Business; Real Estate Management), as well as Master degree courses (Sales and Marketing and BISE) at the DHBW Mannheim. The SG was used as an activation method between theory-oriented lecturing phases: the students were not asked to play the entire game as a learning session on its own, but instead were asked to advance in the game only in correspondence to the topics they had just learned about. When the sequence was completed by all students, the lecture continued until the next sequence of the SG was played again to connect the learned content with a quasi-real situation. Other, more complex and reading-intense learning tasks of the game were then given as wrap-up or preparation for the next lecture.

The observed motivation of the students in the courses was extremely high and first unstructured feedback from the course participants very positive. The SG was assessed by the students as a useful supplement to traditional teaching methods, which helped to consolidate theoretical contents/methods and to experience their use “as in practice”. The students furthermore felt motivated to start using project management tools such as MS project through their experience with MS Project plans in the SG’s user challenges. The feedback gathered from the students using the game was then used as input for next year’s group IMBIT students to further expand and optimize brillianCRM, bringing it to the solid maturity we have today.

3 Critical Review of the Approach

3.1 SG Design by Students for Students

The approach of SG design by students certainly featured direct benefits such as the inclusion of tailor-made teaching and learning contents as circumvented by the lecturers

in their instructions to the student teams. This alignment to lecture plans was the first factor which enabled convenient integration of the SG into the teaching concept of other degree programs, while the marginal costs associated with its use both for students and lecturers clearly has to be regarded as the second factor. With regards to the application of the SG in other degree programs a crucial coefficient lays in the unique set-up of the DHBW which fosters a cross-linked teaching practice of its lecturers across different degree programs leading to a substantial flow of knowledge sharing about new initiatives and projects, such as the brillianCRM SG.

Another practical benefit of the students designing and developing the SG from scratch is its adaptability to new and/or enhanced SG contents: Apart from a planned extension of the SG brillianCRM to an application across the DHBW Mannheim, the latest IMBIT 3rd year students have just launched as their IT Project assignment a SG dealing with intercultural communication (www.brillianICM.com).

A critical aspect of this choice, however, lays in the limited scope which can be expected to be mastered by the students in the given timeframe. Consequently, the one or the other desirable game contents might not get implemented, the intellectual challenge is not completely harmonized across the tasks and the audio-visual configurations remain on a basic level.

3.2 Game Development-Based Learning as a Method for Software Development Teaching

Employing game development-based learning as a method to impart multi-dimensional skills and knowledge on software development suggests being a promising approach from various angles. The students exhibited a high level of dedication and engagement with the project due to the immediate results of their work and the direct application of it. The segmented structure of the SG design and development tasks allowed for attribution of individual performances, which is an often discussed topic on group work assignments. The costs to undertake such a project are very low, as the students utilized their own notebooks for development and collaborated via the network access of the DHBW. The budget of about fifty Euros per student was primarily allotted to the renting of a server share and usage rights/licenses for multi-media contents. Through these factors the project was independent from third party involvement and is a suitable foundation for cooperation projects with other faculties or universities, as neither royalty payments are incurred nor contractual agreements required.

The SG development required direct application of current practices in software development such as agile methods, UX/design thinking, project management, integration of multi-media contents and web-programming.

On a critical note stands the observation of the lecturers that students showed a tendency to focus on the areas they were already most familiar with and chose tasks within them rather than expanding their field of expertise to new fields. Through the subdivision into teams the organization of knowledge exchange between them beyond the direct SG design-related issues was barely possible (e.g. on new techniques discovered). Hence it is debatable, if homogeneous learning results could have been achieved.

4 Discussion

The implementation of such an ambitious task as a SG is certainly a challenge for the students as it requires the application and connection of acquired skills and expert knowledge from various multi-disciplinary fields such as project management, UX, software development, web programming as well as marketing/branding and requires a number of prerequisites on both BISE students' skill levels as well as institutional settings. The use of the concept to develop a SG by students and to use it in other courses is most primarily viable for topics which are required in the curriculum of a broad range of degree programs. For this reason "project management" had been selected as a first learning content for a SG development as it is an established subject at many German universities both in the technology and in the economic faculties. At the DHBW Mannheim the subject project management is taught in numerous degree programs as a compulsory module in a scope ranging from 2 to 4 credit points.

In summary, applying students' technical, expert and creative capabilities to develop SGs as an assignment gives them a sense of achievement with an immediate usable result and constitutes an effective solution to address some of the most common issues for SGs (Cost/Actuality/Curriculum Alignment). While a number of studies exist on the potential of game development-based learning [11], further insights into the hypotheses about SG design by students in conjunction with a more solid evaluation and measures will be needed to scale the "Serious Games from students for students"-approach with a direct application of the students' development in subsequent lectures for their peers.

Acknowledgments. Special thanks goes out to our students of the WIMBIT11B and 12C courses and their inconceivable effort to bring the SG students-for-students development concept into practical existence. We also thank the students of the WIMBIT12A + B courses for their work on the new and latest SG from the IMBIT team: brillianICM.com.

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