The Impact of Using Serious Games as a Learning Tool in Higher Education

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Abstract. *In order to address current challenges in higher education, innovative teaching approaches have to be introduced. They can aid in increasing student motivation, their course involvement and engagement. At the same time, they can also boost students' learning outcomes. Our previous research studied the impact of implementing a business simulation into a study course. We explored students' knowledge acquisition and their future engagement, assessed after the introductory simulation. The study involved two demographic groups of students: IT oriented and business oriented. In both groups the use of business simulation resulted in positive outcomes, depicting the suitability of using a business simulation. Regardless of the rate of used gamification, we have to be aware of and address adequately existing challenges and risks, to avoid the negative consequences of gamification, which we define as overgamification. According to this, we identified and analysed the existing challenges and risks and proposed possible solutions used when implementing the business simulation game. Both research directions are presented in the paper, together with corresponding references and future work.*

Keywords. ERP systems, business simulation games, ERPsim, gamification, overgamification

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1 Introduction

The use of innovative teaching approaches [1] is a vital topic when addressing current higher education challenges, especially when teaching digital natives. Challenges connected to students' interests, motivation and course engagement have to be addressed properly in order to achieve the highest learning outcomes. Especially appropriate and helpful are approaches that require students' active participation, such as business simulations.

Business simulations are the representatives of serious games. The history of serious games dates back to 1951 [2]. Video games, aimed at training the professionals in the military domain, were, in the 1970s, widespread to the educational domain [2]. The ancestors of serious games evolved rapidly, wherein the majority of serious games before 2002 were developed for the educational domain [2]. Serious games are one of the gamification learning methods [3]. While gamification uses just some part of the game element, serious games involve the usage of the whole gaming systems [4]. Simulations that present a most common game genre within serious games [5], [6], aid learning with virtual activities reflecting the real-world scenarios [5]. The development of business simulations goes far back, wherein the growth of simulations available on the internet can be detected since 1998 [7]. Nowadays, one of the visible representatives is ERPsim [8], a business simulation game using real-life SAP ERP, which was, in recent years, replaced by SAP S/4HANA. The business simulation, aimed at teaching ERP (enterprise resource planning) concepts, is used broadly in higher education [9]. It covers different business scenarios and simulates a real business environment. The participants use a real ERP system, and have to make business decisions based on data obtained via the collaboration between various business roles.

ERPsim has evolved constantly since its introduction [10]. It now offers four groups of simulation scenarios: Distribution, Manufacturing, Logistics and Retail Game. Each of the groups includes more scenarios with increasing complexity. The most complex and advanced scenario is the Manufacturing Advanced Game, while the Distribution Game presents the introductory simulation that includes only a few ERP functionalities, namely sales, procurement and planning processes. Many research directions are connected to business simulations. In our research, we are pursuing the topics associated with introducing and using business simulations in higher education.

In the continuation of the paper we are presenting two of our research directions. Section 2 presents the research analysing the impacts of using the business simulation as an introduction to the study course. In the continuation, Section 3 presents the research of identifying challenges and risks, and their addressing when implementing the business simulations. The paper is concluded with Section 4, offering a brief overview of our future work on the outlined research direction.

2 The use of a business simulation for introducing ERP concepts

ERPsim was developed with the aim to ease the understanding of complex ERP systems thematics [10], [11], representing a possible challenge regardless of students' backgrounds

and previous knowledge. With awareness of this challenge, especially when introducing ERP concepts to IT related students, we focused our previous work [12], [13] on aiding the introduction of ERP systems with the use of ERPsim business simulation.

In our paper [12] we researched the impact of using business simulation when introducing ERP concepts to IT students. The participating students have advanced IT knowledge, wherein they did not have any previous knowledge or experience with ERP systems. The business simulation was implemented as an introduction to the study course, carried out at the very first course session. After the implemented simulation, the students' opinions were gathered using a systematically defined questionnaire. We focused on gained knowledge and skills, and the impact the introductory business simulation has on students' intent for future course engagement, one of the crucial challenges in higher education. The three-year study resulted in very positive outcomes. According to the students' self-assessments, new knowledge and skills were obtained in different knowledge areas. The details are presented in Table 1. The students assessed four statements using a five-point Likert scale, 1 standing for completely disagree and 5 standing for completely agree.

Table 1. Obtained knowledge and skills within the three-year research [12].

Year	Average	5	4	3	2	1
A simulation game contributes to the development of the technical skills necessary when using SAP ERP.						
1	**4.1**	27.78%	55.56%	11.11%	5.56%	0.00%
2	**4.4**	42.86%	57.14%	0.00%	0.00%	0.00%
3	**4.2**	23.81%	76.19%	0.00%	0.00%	0.00%
A simulation game demonstrates the need and benefits of integrating different ERP modules.						
1	**4.1**	27.78%	55.56%	11.11%	5.56%	0.00%
2	**4.5**	50.00%	50.00%	0.00%	0.00%	0.00%
3	**4.2**	38.10%	42.86%	19.05%	0.00%	0.00%
New knowledge and skills were obtained about using SAP ERP.						
1	**4.5**	50.00%	50.00%	0.00%	0.00%	0.00%
2	**4.7**	71.43%	28.57%	0.00%	0.00%	0.00%
3	**4.3**	33.33%	66.67%	19.05%	0.00%	0.00%
New knowledge and skills were obtained about collaboration and coordination between roles.						
1	**4.3**	33.33%	66.67%	11.11%	5.56%	0.00%
2	**4.7**	71.43%	28.57%	0.00%	0.00%	0.00%
3	**4.4**	47.62%	47.62%	4.76%	0.00%	0.00%

The second part of the research [12] was studying the impact that the introductory simulation had on students' future course engagement. This was also one of the research questions in our following research [13]. In the latter, we again looked into knowledge acquisition and students' engagement, however, the population of participating students differed. While in the paper [12] we focused on IT related students, in the research [13] students participated who were obtaining business and economic degrees. The difference

lies in students' previous knowledge, while IT oriented students are more advanced in the IT domain, business oriented students are more advanced in the thematics connected to ERP systems.

Figure 1 depicts the impact of the introductory business simulation on students' future course engagement. The picture shows the students' assessment of the statement, separately for IT oriented and business oriented students. As can be seen for both groups of participants and in all of the researched years, the number of students that strongly agreed and agreed with the statements was high. Even more, within IT oriented students a great progress is seen, from 39% that agreed or strongly agreed with the statement in the first year of the business economics implementation to 67% of affirmative answers in the third year.
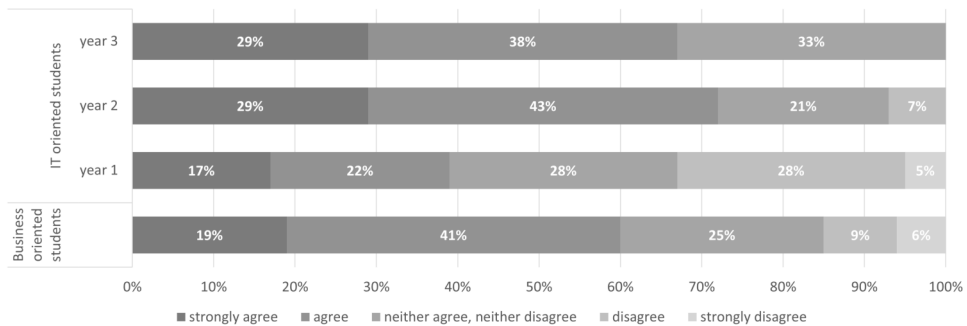

Figure 1. The impact of the introductory business simulation on students' future course engagement [12], [13].

In the paper [13] we also looked to see if there was a significant difference in student knowledge before and after the business simulation session. We addressed three domains: business process knowledge, technical knowledge for using SAP ERP and ERP transaction knowledge. Based on the statistical analysis, all hypotheses were confirmed, which offered further confirmation of the suitability of introductory ERPsim business simulation.

3   Challenges and risks within the implementation of business simulations

Although the most advanced infrastructure and tools are available and suitably refined, the introduction and use of business simulations within the educational process requires special attention. If the challenges and issues are not addressed properly, the positive effects of gamification could be nullified easily. In the paper [14] we researched what challenges and risks have to be considered when implementing gamification in higher education.

Based on the carefully implemented literature review, we identified a number of challenges and risks which we combined into three risk groups:

- Risk group 1: Game design and gamification
- Risk group 2: Introduction and application of the game

• Risk group 3: Individual differences between the participants

Together with challenges, we also proposed solutions or strategies that can be used to overcome the identified risks. The solutions were formed according to multiple years of experience with business simulations and available literature resources. An example of risk within one of the categories and the corresponding strategy to address the risk is presented in Figure 2.
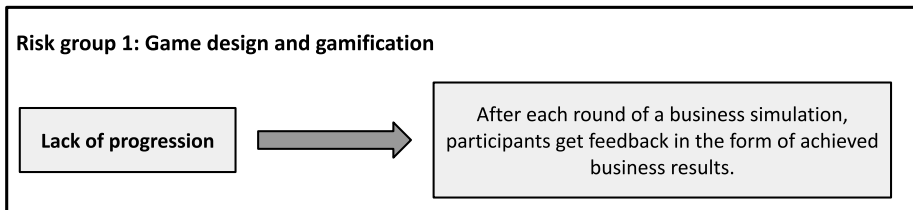

Figure 2. An example of identified challenge with the corresponding solution within business simulation implementation [14].

When implementing business simulation it is essential to avoid overgamifiaction, namely, to avoid the negative consequences of gamification. In addition, to address known challenges and risks adequately, another important aspect has to be considered to maintain a high positive gamification impact. Only an appropriate rate of gamification has to be applied to truly exploit the potential of innovative approaches.

4   Conclusion

Serious games, especially business simulations, represent a broad research domain. Our previous research covers the domain of introducing the ERP concept to ERP newcomers and looking into challenges and their appropriate addressing in order to maintain a high contribution of gamification in higher education. The obtained results are promising, therefore, we plan to proceed actively with the outlined direction as a part of our future work. We will study in depth the overgamification challenges, using the data gathered within the business simulations implemented throughout the study semester. Our final goal is to develop and validate empirically a risk management model, assuring, together with derived guidelines, the efficient establishment and implementation of gamification elements in higher education.

Acknowledgments

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