Engaging students through gamification: The flow perspective

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Abstract

Influencing the engagement of higher education students to maximise knowledge acquisition has been examined from various perspectives. Given the effectiveness of innovative teaching approaches, we decided to implement a business simulation game in the ERP systems course. The use of serious games, a form of gamification, has been implemented for several years in an IT-oriented master degree program, resulting in encouraging outcomes across several areas, including engagement, motivation, and knowledge acquisition. This paper presents a novel study that connects flow theory to students' engagement in serious games. The flow theory is built on a relationship between challenges and skills needed to meet them. For the flow to occur, the concentration, interest, and enjoyment in the game must be achieved simultaneously. Numerous questionnaires are available to measure the flow or the conditions that enable it. Using the available questions, we designed a questionnaire tailored to our case. The paper presents the results of a workshop implementing a business simulation game, wherein the game was played in three sequential rounds, increasing the complexity of the scenarios. The results show that the measured attributes, corresponding to original flow theory factors, remained high across all three rounds of the workshop, suggesting that the students moved efficiently towards a state of flow.

Keywords

ERPsim, serious games, educational games, engagement, flow, focus, knowledge acquisition

1. Introduction

How to efficiently engage students in higher education is a broadly researched topic. A variety of accelerations were researched and discussed in the literature, among others, including educational technology, with gamification as a notable representative [1]. As defined by Deterding et al. [2], gamification is "the use of game design elements in non-game contexts". What started as a digital media industry term in 2008 [2] now represents a well-defined domain incorporated into various areas, aiming to address existing challenges.

Our experiences with gamification in higher education began as an attempt to address challenges in maximising students' knowledge acquisition by increasing their course engagement. Student engagement for academic work, meaning the work usually provided by teachers with the goal of mastering knowledge and skills, Newman [3] specified as "psychological investment in and effort directed towards learning, understanding, or mastering the knowledge, skills, or crafts". We started implementing serious games, a form of gamification, in a course taught in an IT-oriented masters degree program. The introduction was sequential. It started with an introductory workshop [4, 5] and has since become a series of workshops incorporated throughout the semester, supplementing traditional teaching approaches in the form of lectures and lab work.

Over the years, we researched various aspects of gamification, from knowledge acquisition to overgamification. However, this paper presents a novel study that examines students' perspectives through the flow theory. Based on the available related work, we designed a questionnaire suitable for our needs and scenario, covering seven flow dimensions. With the use of the questionnaire, used at different stages of the workshop, we pursued the following research question:

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RQ - What are the students' assessments of the flow theory dimensions, and how do they change across the workshop rounds?

The paper is organised as follows. Section two describes the use of serious games in higher education, emphasising our previous work. This is followed by the presentation of the flow dimension questionnaire used and the study's implementation. Chapter three concludes with the study's results, which are then discussed in the final chapter, the Conclusion.

2. Researching the use of serious games in higher education

Serious games, games used for serious purposes, were introduced into the education domain in the second half of the 20th century [6, 2]. This is not a surprise, since games increase and promote engagement and motivation [7, 8]. One of the representatives of serious games is ERPsim [9], a business simulation presented in 2006 [10]. The game aims to facilitate understanding of enterprise resource planning (ERP) themes, built upon an SAP [10]. The simulation [9] is available in three scenarios, available in various difficulty levels depending on the features included. While the introductory scenarios cover sales and distribution, procurement and planning, the advanced scenarios also include domains of logistics and sustainability.

The introduction of ERPsim in the study course began with an introductory workshop. Before we started the lectures and lab work, we exposed the students to a real-life SAP system used by ERPsim. Of course, the number of transactions and modules was limited, but still, the ERP newcomers learned to navigate through a complex ERP solution in just a few hours. Based on this, we published a three-year study that revealed the positive impact of the experiential learning approach used. Students confirmed that the use of the simulation game for introducing the ERP concepts resulted in anticipated knowledge and skills, while increasing the students' intent for future engagement [4, 5]. The same approach was confirmed as appropriate also in a business-oriented higher-education study program [11].

After a few years, we expanded the use of serious games throughout the semester. We implemented four sequential workshops, each using a different scenario. By increasing the complexity, we offer our students an insight into different ERP topics that were further developed in lectures and lab work. However, since the impacts of gamification are not solely positive, we decided to research the topic of overgamification. We conducted a study to identify factors that could lead to a negative impact of gamification [12]. Based on this, we then conducted a survey among our students to examine the factors and research the possible negative effects of gamification.

3. An insight using flow perspective

Our most recent study focuses on the flow perspective, as it was found to play an important role in the relationship between gamification use and students' engagement [13]. Flow has several psychological and practical benefits that can positively impact different areas of life, from academics to personal development. It is defined as "the holistic sensation that people feel when they act with total engagement" [14, 15] while participating in activity. Alternatively, as summarised and derived by dos Santos [16], the term describing optimal experience acts as a factor of motivation in our activities.

In the original presentation of flow theory [14], Csikszentmihalyi talks about "autotelic experience", presenting the result of a task resulting in internal motivation, rewards, or encouragement without any outside goals or rewards [16]. Throughout the years, studies introduced different approaches, measuring flow theory [17, 16]. The author of the theory envisaged evaluation along nine dimensions [15], whereas, for example, the Flow Condition Questionnaire (FQC) [18] examines seven flow conditions. The available dimensions up to 2022 were compiled by Rosas et al. [17].

In our study, we pursue seven dimensions:

- clear **goals**,
- balance between **skills** and **challenges**.

- complete **focus**,
- immediate **feedback**,
- sense of **control**,
- a pause in **time** perception and **self-awareness**, and
- **satisfaction** and intrinsic **motivation**

The presented study was conducted within the masters degree programme in informatics. We implemented the serious game ERPsim as an introductory workshop during the first lectures of the study course. We played the Maple Game scenario [9], in which participants engage in the procurement and sale of maple products. The workshop structure followed a three-round sequence in which the students, divided into teams of three or four, ran their own companies using S/4HANA. Each round consisted of predefined transactions, with additional transactions added to increase the difficulty of the simulation game. In round one, participants performed transactions related to sales and marketing, while rounds two and three added transactions related to procurement and the planning process. The only materials students received were a 1-page Job Aid covering all the important information and steps needed to perform the transactions.

After each round, the students were asked to fill out the questionnaire, which assessed their perceived assessment of seven different flow dimensions. Each question was rated using a 7-point Likert scale, ranging from strongly disagree to agree strongly. The results and detailed analysis of gathered answers are presented in Table 1 and depicted in Figure 1.

Dimension	**Round**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
We had clear goals.	1st round	3%	18%	8%	3%	**26%**	21%	21%
	2nd round	0%	0%	5%	5%	18%	**42%**	29%
	3rd round	0%	0%	0%	8%	13%	29%	**50%**
The balance between the challenge and my skills appropriate.	1st round	3%	16%	3%	3%	19%	**35%**	22%
	2nd round	0%	3%	3%	5%	11%	**57%**	22%
	3rd round	0%	3%	0%	3%	11%	**51%**	32%
I was completely focused on the task.	1st round	3%	5%	3%	0%	16%	24%	**49%**
	2nd round	5%	0%	0%	3%	8%	35%	**49%**
	3rd round	3%	0%	0%	3%	16%	27%	**51%**
I received immediate feedback.	1st round	0%	8%	8%	8%	**26%**	**26%**	24%
	2nd round	0%	5%	0%	8%	13%	**45%**	29%
	3rd round	0%	3%	0%	11%	13%	**39%**	34%
I felt in control.	1st round	5%	3%	11%	16%	21%	**29%**	16%
	2nd round	5%	3%	5%	0%	21%	**42%**	24%
	3rd round	3%	3%	8%	5%	11%	**42%**	29%
I lost track of time and my surroundings	1st round	3%	3%	3%	0%	18%	**37%**	**37%**
	2nd round	3%	3%	0%	0%	16%	**45%**	34%
	3rd round	0%	3%	3%	5%	16%	**42%**	32%
I was satisfied and highly self-motivated.	1st round	3%	3%	3%	5%	13%	34%	**39%**
	2nd round	3%	3%	0%	3%	13%	34%	**45%**
	3rd round	0%	3%	3%	5%	11%	**42%**	37%

Table 1
In-depth analysis of seven flow dimensions.

The flow is measured to provide users with insight into their tasks [17]. Since flow can improve learning and skill development [19], we wanted to investigate whether the gamification approach, namely serious games, guides students towards the flow state. We measured seven flow dimensions, focusing on their changes over time, since they could change with acquired knowledge and skills and, on the other hand, offer a challenge.

As shown in Figure 1, the average self-evaluated values were high across all flow dimensions and across all three rounds. The biggest change throughout the rounds is seen for the clear goals dimension. The value increased from 4.8 after the first round, to 6,2 after the last, third round. The evaluation was

done using a scale of 1 to 7. If we combine this with an in-depth analysis shown in Table 1, we can see that after round three, none of the participants disagreed with the statement "We have clear goals.". Tightly coupled is the dimension that examines the balance between skills and challenges, which is a minimum requirement for a person to enter a flow state [16]. We can see that the highest value was once again achieved after the third round, summing the two most positive responses to 83%. This means that students found the simulation game challenging and interesting, and that the line where the game would turn the other way was not reached.

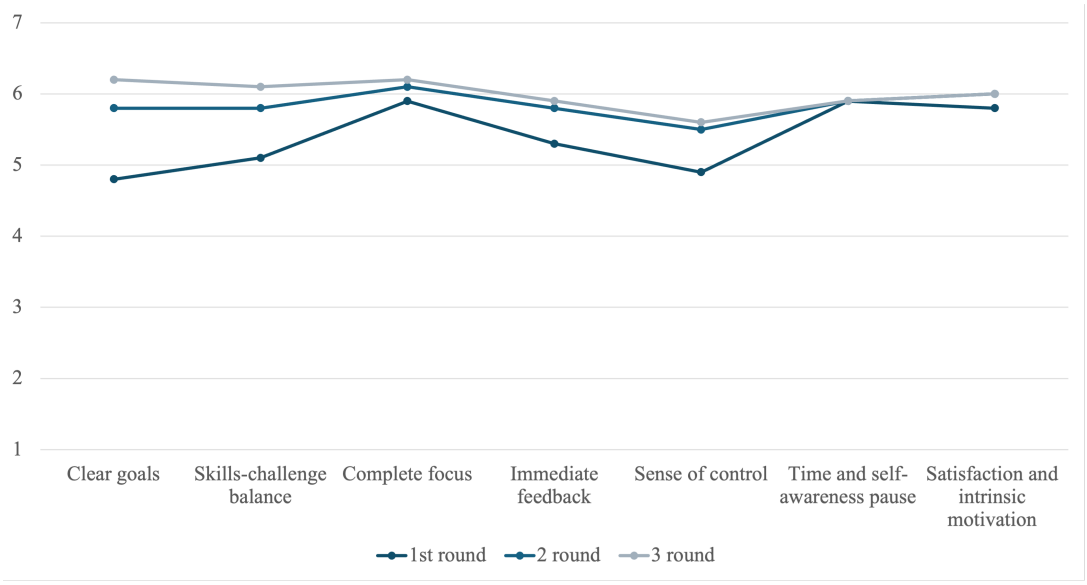


Figure 1: Flow dimensions throughout the workshop rounds.

The same average values were gathered after all three rounds for the dimensions of time perception and self-awareness. Even more, the number of positive answers also stayed the same, as shown in Table 1. The last dimension we researched was inner motivation and satisfaction, since this is yet another important result of flow. We can see that the percentage of strongly agree responses slightly declines after round three; however, the total number of positive responses remains almost the same. As depicted in Figure 1, the average values rise from 5.8 to 6.0 after the second and third rounds.

In the questionnaire, we included additional statements for each flow dimension, allowing us to examine all aspects further. Therefore, we asked them also to assess two additional statements related to a pause in time perception and self-awareness. Table 2 presents answered values, this time using the 5-point Likert scale.

Statement	Round	1	2	3	4	5
I was focused on the simulation game the whole time.	1st round	3%	3%	8%	31%	56%
	2nd round	5%	0%	5%	39%	50%
	3rd round	5%	3%	5%	51%	36%
I don't let what others think bother me.	1st round	5%	5%	18%	28%	45%
	2nd round	5%	0%	8%	44%	44%
	3rd round	5%	5%	5%	43%	43%

Table 2
Additional questions regarding the lost track of time and surrounding.

The results show that the majority of students reported being focused on the simulation game throughout the workshop, with the highest agreement recorded after the first round. Similarly, most students reported not being distracted by others' opinions, with responses remaining stable across all three rounds. The consistency of these results further supports the conclusion that the simulation game

successfully captured students' attention and promoted immersion throughout the workshop.

4. Conclusion

Numerous benefits of the flow encouraged us to research students' perceptions of different flow dimensions when playing serious games. Increased productivity, improved learning and skill development, positive emotional impact, stress reduction, are just some of the proven benefits [16, 19, 17, 14, 20]. Students were asked to self-assess statements related to different flow dimensions using a Likert scale. We used seven dimensions, focusing on aspects important to higher education and to gamification approaches. The results provide a direct answer to the research question, confirming that students' assessments of flow dimensions were consistently high across all three workshop rounds.

Notably, the progression observed in the clear goals dimension — rising from 4.8 after the first round to 6.2 after the third — suggests that students became increasingly aligned with the workshop structure as their familiarity with the simulation game grew. This is particularly relevant in the context of serious games, where the learning curve can initially hinder engagement. The balance between skills and challenges, identified as a minimum requirement for entering a flow state, was also rated highly throughout, with 83% of students providing positive responses after the third round. Together, these findings suggest that the three-round structure, with its gradually increasing complexity, was a key factor in guiding students towards a flow state. The stability of the time perception and self-awareness dimensions across all rounds further reinforces this conclusion, indicating that students remained immersed in the task regardless of the increasing difficulty.

This allows us to conclude that the ERPsim simulation game is an appropriate offering, providing a balanced mix of skills and challenges, ensuring immediate feedback, and allowing students to have a sense of control over the situation. Therefore, the implementation could bring the participants into a flow state, resulting in higher engagement, knowledge acquisition, and motivation, addressing the challenges of the higher education environment.

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Declaration on Generative AI

During the preparation of this work, the authors used Grammarly for grammar and spelling checks, paraphrasing, and rewording. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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