USING PLAYER TYPES TO DEVELOP IMPLEMENTATION OF EDUCATIONAL GAME

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Abstract

Using educational and simulation games in teaching has been shown to have many benefits. In general, people of all ages like to play games, so using games can make learning more fun and engaging. Games also support our natural tendency to learn through inquiry. In addition to subject based content, games also foster learning of such important work-life competencies as collaboration, communication, and problem solving.

We have inquiry-based approach at the core of our pedagogy in Haaga-Helia University of Applied Sciences Porvoo Campus. This approach creates a great basis for using different educational games in our course implementations. One of the types of educational games is simulation games, which we have now implemented for several years in our courses. Until now, the game implementations have been developed using PDSA-cycle based on feedback from participants. However, we acknowledge that even though gaming might be engaging for many, not everyone is the same. Different people get motivated by different elements and aspects of gaming: some like to learn and explore, some like the social elements of gaming, and for some it is all about winning the game. Hence, we have need to pay attention to these different player types in our development process.

Different player types (e.g., Bartle's player types, Hexad model) have been widely discussed in the context of game design, and they have also been used to analyse players of different educational games at various levels of education. In this paper, we build on this research, and we use taxonomies of players when developing our implementation of business simulation games in higher education. We start by studying if these player typologies can be applied to business students from Haaga-Helia University of Applied Sciences. For this we analyse feedback, reports, and surveys from previous implementations. After this we are going to suggest how to develop business simulation game implementation to better serve the needs of different participants. These recommendations can later be used to increase both engagement and entertainment factors, as well as pedagogical and educational aims of implementing a simulation game.

Keywords: educational game, player types, business simulation, course development, inquiry-based pedagogy.

1 INTRODUCTION

Several studies have shown that using game-design principles in educational contexts increases motivation, interest, and engagement in learners at different educational levels. (e.g. [1], [2], [3]) This engagement and motivation can be fostered by personalising the game according to the players and their preferences. [4], [3] Personalisation can be made by using player types, which can be recognised as generalisations and individual players might represent several different player types depending on situation. We could still assume that majority of players have one type that is the most dominant or typical to them. [4], [5], [6] Literature presents many different player typologies. Players can be segmented on demographic basis, psychographic basis (attitudes, values, interest, lifestyles) or behavioural basis. [6] In context of educational games we are trying to influence behaviour of the students, by encouraging them engage more in the learning activities. Therefore, we are here concentrating on the player types that are based on behavioural differences, even when acknowledging that for example psychological aspect could be interesting in this same context.

One of the most cited player typologies is presented by Richard Bartle in the late 1990's concerning different player types in multi-player real-world virtual games. According to his findings, there are typically four things that people enjoy in these games: achieving goals, exploration, socialising, and imposition upon others. Bartle suggests that players can therefore be categorised as achievers, explorers, socialisers, and killers. Usually, players might show characteristics of several types, but they tend to have one that is dominant and most common to them. Achievers get motivated by pursuing to reach certain goals, for example gathering points or levelling up in the game. They thrive if they can

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show others who well they are ranked in the game hierarchy and in how brief time they managed to reach that status. Explorers want to find out how the game works and try different approaches to see how the game mechanics react to their trials. They want the game to surprise them. Explorers also enjoy when they are acknowledged for their knowledge of the game. For socialisers it is all about the people in the game and the possibility to cooperate and communicate with others. They enjoy forming relationships and being able to influence through these relationships and contacts. Killer-type of players enjoy when they can express their superiority compared to other players and they concentrate on eliminating all the others in the game. [5]

Bartle [5] introduced four-field graph to show the source of each player type's interest in the game (Fig. 1):

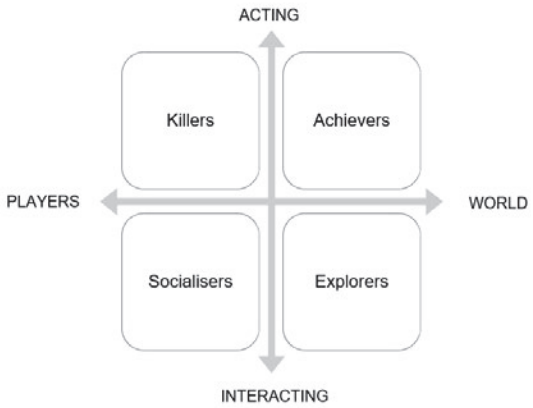

Figure 1. Bartle's player types by sources of interest.

There has been some critic concerning use of Bartle's player taxonomy in educational games. The typology of players was introduced in context of multi-player virtual dungeon games, and some say that the use of Bartle's player types should be limited to games of that genre. [4] Despite the critics, Bartle's player types have since their introduction been used and varied in different studies. Quite recent addition to discussion about player types in educational context is based on the idea that players differ in extent they are concerned about achievement and sociability. [7] More research should be conducted to know if for example this approach is more applicable to educational games.

Other widely used model of player types is BrainHex, which is based on neurobiological findings. This model presents seven player satisfaction archetypes, that lead to different playing styles. These archetypes are Seeker (curiosity, wondering, interest), Survivor (excitement, fear, intensity), Daredevil (thrill, risk taking, playing on the edge), Mastermind (puzzles, problem solving, devising strategy), Conqueror (defeating impossible, struggling until victory, beating others), Socialiser (people, socialising, helping others), and Achiever (long-term achievements, developing towards ultimate goals). [8] Challenge of using these player types is that it would require ability to measure neurobiological responses.

Andrzej Marczewski [9] has presented a player and user types Hexad. The basic player types of this approach are presented below (Fig. 2):

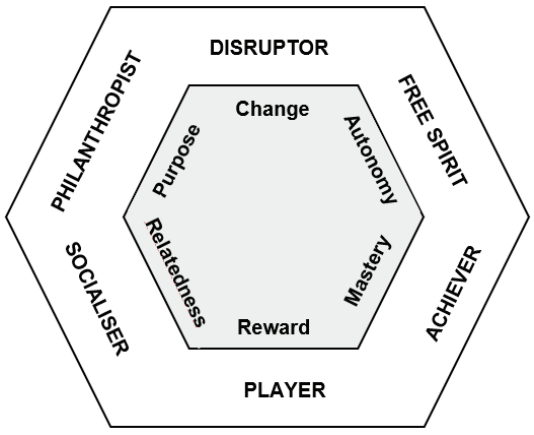

Figure 2. Marczewski's Gamification User Types Hexad [9].

The Hexad model has similarities to the previously discussed Bartle's typology of player types and BrainHex model. Marczewski [9] has presented six player types and their primary sources of motivation. Achievers are motivated by mastery, and they want to improve themselves and overcome challenges. Free spirits are motivated when they have autonomy, and they can create and explore. Disruptors seek change, either in positive or negative way. Philanthropists get motivated by meaning and purpose, and they want to help others and serve the greater cause. Socialisers need people, social connections, and interaction to thrive. Players are motivated by rewards.

According to Park, Min, and Kim [3] no single player type is more preferable or suitable for academic environment different player types as they do not differ from each other by their academic motivation. This been said, it can be argued based on the research that different types of players get engagement, satisfaction, and motivation to participate from different elements of gaming. For this reason, the gamification in academic education context should be developed in such manner that takes into consideration the preferred game elements of each player type. In Table 1 we present findings of our review of suitable game elements for each player type. We chose to include the player types by Bartle and Marczewski due to their suitability in this context.

Table 1. Game elements positively impacting Bartle's and Marczewski's player types.

Player Type / Element	Bartle [5]: Killer	Bartle [5]: Socialiser	Bartle [5]: Achiever	Bartle [5]: Explorer	Marczewski [9]: Player	Marczewski [9]: Socialiser	Marczewski [9]: Philanthropist	Marczewski [9]: Disruptor	Marczewski [9]: Free spirit	Marczewski [9]: Achiever
Achievements		X [1]	X [1]	X [1]	X [4], [10]	X [10]	X [10]	X [10]	X [10]	X [4], [10]
Points	X [1], [5]		X [1], [5]		X [4]					
Levels	X [1]		X [1]	X [1]	X [4]					X [4], [10]
Badges, certificates		X [1]		X [1]	X [4]					X [4], [10]
Story		X [1], [5]		X [1], [5]						
Teamwork/Cooperation		X [1], [5]				X [4]				
Gifting		X [1]					X [4]			
Leaderboard	X [1], [5]				X [4]					
Communication		X [5]				X [4]	X [4]			
Exploring				X [5]					X [4], [10]	
Building, creating				X [5]				X [9]	X [4]	
Open world, free choice				X [5]					X [4], [10]	
Problem solving, puzzles				X [5]						X [4]
Detailed instructions			X [5]							
Collecting							X [4]			
Trading							X [4]			
Customization									X [4]	
Hidden features/surprises									X [4]	
Epic challenges										X [4]
Quests										X [4]
Competition						X [9]				
Voting								X [9]		
Anonymity								X [9]		

As can be seen from Table 1, there is no single element that would serve the motivational needs of all the different player types. In addition, according to the studies, there is a difference in what kind of achievements can be seen as motivating for the different player types. E.g., for Achievers it is a representation of them completing something, whereas for Explorers it means a possibility to explore something new or acquire resources.

2 METHODOLOGY

In this study we concentrated on the implementation of the business simulation game called Cesim Global Challenge and Retail. Cesim offers cloud-based simulation games with various business cases, and it is used in many institutions of higher education globally. The games have inbuilt parameters that can be used to add or remove certain topics from the simulation, and the basis of calculations can also be modified according to the needs of the simulation game instructor. [11] In our implementations students have played the game in teams which they have chosen themselves. We have implemented business simulation both in classrooms and in virtual environments.

The aim for this business simulation implementation has been to help students understand the operations and processes in business, their causalities, and the financial information as a basis for decision-making. The subject has been taught in separate lectures, and the knowledge has then been applied to business simulation. In business simulation students have had freedom to choose their methods of teamwork and communication. They have reported each round (8 rounds) of their game,

reflecting it upon given theories. Students have had access to the financial results of other teams, so they have been able to compare their performance to others.

A mixed research method approach was used to understand what kind of player types we have and how we could develop our implementation to increase their motivation. First, we study if the player typologies mentioned in the theory can be applied to business students from our institution. To identify player types among students, a survey was used and distributed in courses where educational games were played. At Haaga-Helia Porvoo Campus there were three courses in spring 2022 with 42 students altogether, who played Cesim business simulation game. In addition to the survey, reports and feedback from previous courses were analysed.

The survey was created in Webropol and distributed to students in the beginning of April 2022. The questions were based on Bartle's player types and the player and user type Hexad introduced by Marczewski. After background questions, such as gender, age, way of studying, and how many hours respondent has played the simulation game, we presented a set of statements measuring the perception of learning using simulation games according to a 6-scaled Likert scale (shown in Table 4). These statements were created by using player type questions presented by Diamond, Tondello, Marczewski, Nacke and Tscheligi [12]. Then the students were asked to rank six statements, which all represented the most common characters of all six player types. The analysis of the survey took place in Webropol and R-studio.

In addition to the survey, we conducted content analysis of feedback and reflections on final reports from previous implementations. The analysis consisted of seven reports from two implementations in spring 2020 and feedback gathered from two implementations (with 30 students) in autumn 2021. The analysis was done first by looking at which Hexad player types could be found in text, and then second by looking at tone and content of those statements. By this analysis we aimed to increase our understanding of the player types represented in our implementations and how they describe their impressions of the business simulation game. After that we created a word cloud from the testimonials to see the most frequently used words students used, when talking about the business simulation.

3 RESULTS

In this part we present the key findings of our paper. We start by studying if we can apply typologies of different players to Haaga-Helia Porvoo Campus business students. Then we identify the player types represented amongst our students. Finally, we will suggest how we could develop our business simulation game implementation in the future to better take into consideration the needs and preferences of different player types.

3.1 Identified player types

Out of 42 students participating in business simulation games held in spring 2022, a total of 15 students answered the survey. The response rate in this survey was 35,7 %. The small number of responses limits our ability to generalise the results to concern all students in our educational institution. However, the response rate can be considered being typical for this type of voluntary survey, and therefore there is usability in the results. In table 2 background information regarding students that answered the survey is presented. One can see that different kind of students were represented.

Table 2. Background information of responders.

Gender	10 females, 5 males
Age	5 20-25 years, 5 26-30 years and 5 > 30 years
Studying way	8 multiform, 7 day
Times played before	10 never, 3 2-4 times before, 2 once
Hours played	9 10-20 h, 5-10 h and 1 > 20h

Students were asked to rank the statement that they felt best described them from 1-6, where 1 is the most suitable alternative, and 6 the least suitable one. The player types were not presented to students at this point, they just saw the statements. 66.6 % of students thought that statement characterising player type Achiever described them the best. Most common second choice was statement that represented Philanthropist (46.6 %). This is shown in Table 3. Students seem to have felt that statement describing type Disruptor was not suitable for them, because majority of students chose that as one of their least suitable options.

Table 3. Students' choice of statements regarding player types.

	1	2	3	4	5	6
For me winning and success is the most important and I'm ready to work hard in order to be the best.	6.7%	13.4%	13.3%	33.3%	20,0%	13.3%
For me understanding and learning things are the most important. I want to know how things work.	66.6%	13.3%	6.7%	6.7%	0.0%	6.7%
For me it is important to get to act independently and come up with solutions by myself. I don't like following strictly rules.	6.7%	13.3%	13.3%	20,0%	40.0%	6.7%
I like to do things I consider meaningful. I want to work together with others in order to achieve the common good.	0.0%	46.6%	26.7%	20.0%	6,7%	0.0%
For me the most important thing is to cooperate with others. People and discussions are important.	13.4%	13.3%	40.0%	13.3%	20.0%	0.0%
I always want to confuse and provoke a bit.	6.7%	0.0%	0.0%	6.7%	13.3%	73.3%

However, when analysing results of this question, it is important to remember that students were asked to fill in the survey right after they had played the business simulation game. It might be that they were more oriented towards thinking of educational games, and the study might have a bit different result if this had been conducted for example before the game or they would have been asked to think gaming in general. In addition, statements describing how people see themselves might be misleading, if the respondents want to, consciously or unconsciously, give a good impression of themselves.

Based on the results, we can see where our students stand in Bartle's player types or Marczewski's player and user types (illustrated in Fig. 3). The questionnaire was conducted based on Marczewski's Hexad model. For Bartle's quadrium of players we combined Hexad model's Socializers and Philanthropists because we could see that they both represented interest towards people and interaction.

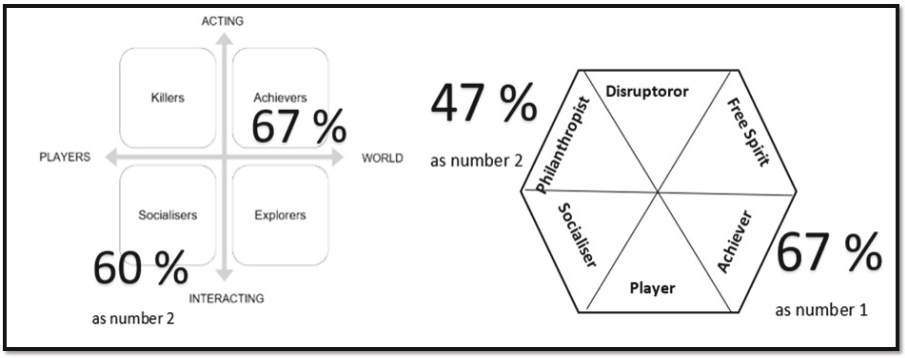

Figure 3. Identified player types based on Bartle and Marczewski.

Achiever being the most shown player type in both typologies is not a surprise, when we again highlight that this study was conducted in context of higher education where people are more likely to think of their actions in reflection to their learnings. Also, the Philanthropists being the most common second choice can again be explained by the survey linking so directly to business simulation game as learning assignment. In most cases students want to do well in teamwork to help the team and other students to succeed. They are not so interested in socialising as such, but they feel that they are obligated to perform for the other students and their grading in the course.

Analysis of the feedback and reflection chapters of reports from previous implementations are quite aligned with the results of survey conducted for students during spring 2022, even though some differences occur. If we would use Bartle's player types, the results would be the same as in the survey but using Hexad player types there are some differences. Out of the seven reports analysed from spring 2020 implementations, everyone mentioned aspects related to Achiever (learning, competence, instructions and knowing what was expected), six Player (winning, gaming strategy, rewards), five Socialiser (teamwork, doing together, communication), one Philanthropist (sharing knowledge, helping others, purpose of the game), and one Free spirit (experimenting). None mentioned aspects that could be connected to Disruptor type.

It should be noted that these reports were learning assignments, and therefore many of the students might have overemphasised learning and their teamwork. For example, elements related to type Philanthropist, like serving greater purpose or helping others, were not that commonly thought of, or analysed by students. If we assume that the order of presenting things tells something about the perceived importance of certain aspects of the game, then it can be noted that only three groups started by describing their learning and growth of competence, whereas four groups started by describing the game and their results, which are things connected to type Player.

Reason for this is probably that this being an assignment where they had to play the game and describe their strategy, they reflected on their game and their performance in the game. Another explanation for this might be that students are leaning more towards Player type when they are able to express their thoughts and ideas freely, and there is no value attached to the given phrases. For example, some might want to choose "I want to help others" because it represents their values better than "I want to do everything for winning the game".

In Fig. 4 we present the most important takeaways and learnings that students described getting from the course as a word cloud conducted from feedback of implementations in autumn 2021. Most frequently used words that the students used were "game" and "cesim," showing the importance of the use of simulation games in the course to achieve the preferred outcome. "Learned," "affect," "think," "results," different," "example"," analysis" and "whole" describes the impact the game has and what kind of outcomes the students perceive it to have. These findings support the Achiever player type, being common amongst our students.

Figure 4. Feedback/learning from autumn 2021 courses.

We wanted to test if the questions and statements by player type previously suggested in the literature [12] would apply to our students. We asked students to assess their impressions whether they perceived certain statement being applicable to the Cesim business simulation game implementation they participated in. In Table 4 we have highlighted those statements that according to theory are most relevant to Hexad player type Achiever and Philanthropist. These two were chosen for closer inspection, as they were dominant in our student group in spring 2022 when we conducted the survey.

Table 4. Statements regarding perception of simulation games.

Statements	Average	Median	Achiever + Philanthropist average	Achiever + Philanthropist median
awoke my competitiveness	4,40	5	4,20	4
brings an international aspect	3,90	4	4,80	4
challenges were interesting	4,70	5	4,20	5
demanded more effort than I usually expect from a course	4,00	3	3,20	3,5
expectations were clearly stated	**3,20**	**3**	**4,70**	**3**
gave me aha moments	4,60	5	3,30	4,5
made me hesitant for fear of making mistakes that I cannot correct	2,90	2	3,80	3
objectives and procedures to be followed were clearly communicated	**3,80**	**4**	**3,30**	**4**
I wanted to do everything to beat the other teams	4,10	4	2,50	3,5
I got recognition for good performance in the game	3,30	3	4,50	2,5
gave me a possibility to challenge myself	4,30	4	2,50	4,5
I wanted to complicate others' actions	3,40	3	4,30	2
I enjoyed the possibility to work with others	4,50	4	4,20	4
provided a commonly shared experience of success in our team	4,40	5	4,30	4
I felt that I belong to the group	5,00	5	4,00	5
I got the possibility to bring out my professional knowledge	4,60	4	4,50	4
offered me a possibility to experiment and act creatively	4,20	5	3,30	5
gave a possibility to make the decisions independently	4,50	4	3,70	3,5
I had several different operating models to choose from	4,70	5	4,50	4
I constantly learned new things	**4,50**	**5**	**4,50**	**4,5**
my professional competence developed/increased during the game	**4,60**	**5**	**4,70**	**4,5**
I got to challenge myself in problem solving	**4,50**	**5**	**3,80**	**4,5**
I got to help others to succeed	**4,10**	**5**	**4,30**	**4**
I got the possibility to share my knowledge	**4,30**	**5**	**3,20**	**4**
exercised self-initiative in own learning	3,70	4	4,00	3
made exploration, and testing "what if" in decision making possible	4,30	5	4,50	4,5
adopt a culture of seeking innovative ways to solutions	4,70	5	3,70	4
enhances my team working skills	4,00	4	4,30	4
foster my creative thinking abilities	4,30	4	4,20	4
got me to transfer/share my knowledge to others in the team	**4,50**	**5**	**4,00**	**4**
made me think more critically	**4,10**	**4**	**3,70**	**4**
sharpen my practical problem-solving skills	**4,30**	**4**	**4,00**	**4**

It seems that students mostly agreed to support each of the statements. The only statement that they did not agree with was the one stating that the game would have made them hesitant making decisions because they were afraid of uncorrectable mistakes (average 2.90 and median 2). Also, statement "Expectations were clearly stated," "I got recognition for good performance in the game," and "I wanted to complicate other's actions" got a bit lower score, with averages and medians of about 3. The two latter mentioned are not that important to Achievers or Philanthropists, so we do not have to pay that much attention to that at this point. But lack of clear expectations is something that Achievers need to achieve the goals and learn what is needed. This is something that we might want to take also as feedback from the course and try to do better next time. Otherwise, this simulation game supported those aspects that according to theory these two dominant groups feel motivating.

3.2 Development of implementation based on player types

Player types can be used to develop implementation of educational game to make it more appealing, motivating and engaging to the students. There are vast amount of literature concerning different game elements and their applications in various contexts. Here we concentrate on how to develop implementation of educational business simulation game based on the player types of the participants. There are also other aspects than game related that effect on students intrinsic or extrinsic motivation, but we are not going to touch upon that subject in more detail here.

Development of any course implementation can be conducted in diverse ways. We writers have used PDSA (Plan, Do, Study, Act) -model in inquiry-based pedagogical approach in our previous rounds of development. [13] In this process the development begins with planning the desired outcomes and the means for reaching the goals. In this case it would mean planning the implementation of educational game so that it would serve the needs of the participants. At the same time, it is important to understand, that choosing to use educational game as tool for learning should be planned from the pedagogical

perspective, and therefore educational games should also serve the needs of the desired learning outcomes. Here we concentrate on the needs of players or learners.

For us to be able to plan our implementation based on the needs of different players, we would need to know which types of players can be found in our student population. At this paper we studied player types after the implementation, which serves as a starting point for our next round of development. This would then lead us assuming that student groups are similar from year to year concerning their types of players. If we would want to avoid bias caused by survey being conducted so that students were oriented towards answering and thinking about educational business simulation game, we could study the player types of each group before the game. At this point this would be advised, because of the small number of respondents in our study. The questions for finding out player types can be found in the literature, and one could also find some ready-made survey tools from the internet, e.g. [14].

Earlier, in Table 1, we presented the game elements that literature acknowledges to support each player type in Bartle's player types and Marczewski's Hexad model. In our case the most common player types amongst our students were Achiever and Philanthropist. Here we can further acknowledge, that the type of Achiever was confirmed in both survey and the content analysis of feedback and reports. Even we should be cautious when using these findings, they serve mainly as an example. Table 5 shows that gaming elements of using achievements or rewards, points, levels, badges, certificates, quests, challenges, tasks of problem solving, and puzzles would be considered as motivating or engaging for Achievers. It was also noted that according to the literature this group needs clear instructions and information about expected and desired goals.

After identifying those game elements that could be most suitable for the player types of the student group, we should assess if and how these game elements could be applied to the chosen educational game. Following the PDSA-method, we can start with strengthening some elements of the simulation game based on the needs of dominant player type. These changes can then be assessed, and implementation can be further developed.

Table 5. Next steps for different gaming elements.

	ALREADY IN USE	TO BE DEVELOPED FOR NEXT IMPLEMENTATION
ACHIEVEMENTS/REWARDS	Grading of the assignments	
POINTS		
LEVELS		Designing levels to the game so that they support learning the content
BADGES/CERTIFICATES		
QUESTS/CHALLENGES		
PUZZLES		
PROBLEM SOLVING		
INSTRUCTIONS	Software manual, case description available, assignment instructions in video and written format	Adding tutorials of the game to learning platform
CLEAR GOALS	Assessment criteria for course	Clarifying assessment criteria for business simulation game

Seldom games have all gaming elements as inbuild features. This does not mean that the game could not then be used for educational purposes or that it would not be useful for learning. Assessing the game and its elements in advance is important, when one wants to confirm that the game has at least some elements that are beneficial for the implementation and the learning outcomes. If it does not support needs of any of the player types at least at some level, the reasonability of using the game should be critically assessed. But if the game has at least some elements that could be valid, then there is a viable starting point for the development of implementing educational game. There is also always the possibility to add supporting elements outside the game software, if needed.

After, and even during the implementations, one should conduct assessment of effectiveness. In context of educational games, one should besides feedback from students assess how well the students learned the content of the course (overall performance, grading), and if there is an increase in engagement. For assessing changes in engagement, we could use for example the time students spent playing the game.

4 CONCLUSIONS

Based on the findings from the survey conducted and analysis of reports and feedback from previous courses, we were able to identify dominant player types amongst our student groups. Even though there are some limitations concerning the size of our sample and timing of the data collection we can say that

based on our paper Bartle's and Marczewski's player typologies can be applied to educational business simulation game. In our study we preferred Marczewski's typology of user and player types because it had stronger connection to motivation and behaviour, whereas Bartle concentrates more on interactional behaviour. Based on the identified player types and prior literature about game elements that are suitable for different types of players, we were able to see and design actions that could be done to improve engagement, motivation and satisfaction of students playing business simulation games. These results can be then applied to any implementation of gamified pedagogy.

This study can be seen as a pilot research that can and should be broadened to different implementations and all kinds of educational games. Further research would also be needed to get more reliable results, and eliminate bias caused by timing of the data collection.

REFERENCES

[1] S. A. Kocadere & S. Çağlar, "Gamification from Player Type Perspective: A Case Study," *Educational Technology & Society,* vol. 21, no. 3, pp. 12-22, 2018.

[2] J. Hamari, J. Koivisto & H. Sarsa, "Does Gamification Work? - A Literature Review of Empirical Studies on Gamification," *47th Hawaii International Conference on System Science*, pp. 3025-3034, 2014. doi:10.1109/HICSS.2014.371

[3] S. Park, K. Min & S. Kim, "Differences in Learning Motivation among Bartle's Player Types and Measures for the Delivery of Sustainable Gameful Experiences," *Sustainability*, vol. 13, no. 16, 9121, 2021. doi:10.3390/su13169121

[4] G. F. Tondello, R. R. Wehbe, L. Diamond, M. Busch, A. Marczewski & L. E. Nacke, "The Gamification User Types Hexad Scale," *CHI PLAY'16*, 2016. Retrieved from https://www.researchgate.net/publication/308083575_The_Gamification_User_Types_Hexad_Scale

[5] R. A. Bartle, "Hearts, Clubs, Diamonds, Spades: Players Who Suit Muds," pp. 1-28, 1996. Retrieved from https://www.researchgate.net/publication/247190693_Hearts_clubs_diamonds_spades_Players_who_suit_MUDs

[6] J. Hamari & J. Tuunanen, "Player Types: A Meta-synthesis," *Transactions of the Digital Games Research*, vol. 1, no. 2, pp. 29-53, 2014. Retrieved from http://todigra.org/index.php/todigra/article/view/13/20

[7] A. E. J. Van Gaalen, J. Schönrock-Adema, R. J. Renken, A. D. C. Jaarsma & J. R. Georgiadis, "Identifying Player Types to Tailor Game-Based Learning Design to Learners: Cross-sectional Survey Using Q Methodology," *JMIR Serious Games*, vol. 10, no. 2, 2022. Retrieved from https://games.jmir.org/2022/2/e30464

[8] L. E. Nacke, C. Bateman & R. L. Mandryk, "BrainHex: A neurobiological gamer typology survey," *Entertainment Computing*, vol. 5, no. 1, pp. 55-62, 2014.

[9] A. Marczewski, HEXAD: A Player Type Framework for Gamification Design, 2018, Accessed 10 May, 2022. Retrieved from https://www.gamified.uk/user-types/#intrinsic

[10] C.E. Lopez & C. S. Tucker, "The effects of player type on performance: A gamification case study," *Computers in Human Behavior*, vol. 91, pp. 333-345, 2019.

[11] Cesim, organization's webpage, Accessed 7 May, 2022. Retrieved from https://www.cesim.com/

[12] L. Diamond, G. F. Tondello, A. Marczewski, L. E. Nacke & M. Tscheligi, "The HEXAD Gamification User Types Questionnaire: Background and Development Process," in *Workshop on Personalization in Serious and Persuasive Games and Gamified Interactions*, pp. 229-243, 2015.

[13] K. Heikkinen & A. Sivonen, "Kehitä ja kehity – PDSA-syklin mukainen jatkuva kehittäminen toteutuneissa oppimisprojekteissa," *eSignals Research*, 2021. Retrieved from http://urn.fi/URN:NBN:fi-fe2021101450992

[14] Gamified UK, Marczewski's User Type Analysis Tool, Accessed 10 May, 2022. Retrieved from https://gamified.uk/UserTypeAnalysis/#.YnEYQt9RU2w