CORVINUS UNIVERSITY of BUDAPEST

DOCTORAL SCHOOL OF BUSINESS INFORMATICS

THESIS SUMMARY

Balázs Barna

EXAMINATION OF THE EFFECT OF GAMIFICATION IN CORPORATE AND EDUCATIONAL FIELD

SUPERVISOR:

Szabina Fodor, Ph.D. habil.

associate professor

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INSTITUTE OF INFORMATION TECHNOLOGY

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1. RESEARCH GOALS, RESEARCH QUESTIONS

One of the most popular buzzwords of the last decade is gamification, which tries to make “gray”, “serious” work and tasks more enjoyable. It is often used for marketing purposes, but it is also suitable for developing the specific skills of target people, changing employee and student attitudes, and transferring knowledge. In the course of my research, I examined the exploitation of the opportunities provided by gamification in the corporate and educational environment, in this way I carried out my work in two different areas. I begin my dissertation by going around and clarifying the concept of gamification, covering its reception and related disciplines, and showing a comprehensive picture of its situation.

In my research, my primary general goal was to investigate cases and electronic solutions that can strengthen the motivation in a given user with the help of gamification elements and thus contribute to the main goal of the application, which can increase employee engagement or strengthen the willingness to learn. My work took two directions.

In the first topic, I focused on the examination of the possibilities applied and applicable in the corporate environment. The researches mostly cover Hungarian companies, but foreign organizations are also significantly included in the surveyed population. In terms of the nature of the employees, office workers were the subjects of the investigations. Since it is important for an organization to be able to retain the workforce in the medium term (~ 3-4 years), the main goal was to examine employee satisfaction with their workplaces, and I also aimed to analyze the complexity of employees with the help of a software, called Battlejungle. Complexity analysis can help an organization discover hidden capabilities in a company. The first set of questions consists of:

- Q_C1 (K_V1): Can the gamified online service under study contribute to employee engagement?
    - Q_C1_A (K_V1_A): Can the gamified online service under study contribute to improving the workplace atmosphere?

    - Q_C1_B (K_V1_B): Does the examined gamified online service have an impact on the increase in the quality and quantity of workplace networks?

- Q_C2 (K_V2): Can the users of the examined gamified online service be grouped based on their behavior in the service?

The second line is to examine the possibility of gamification in university education in the field of information technology, in particular its impact on student motivation. As educational "projects" (such as courses) are usually short-term, lasting only 1 semester (or ~ 12 lessons / occasions), the main goal of this research is to develop student motivation, as well as continuous and effective learning skills during the course. Based on these, the studies are built around the following research questions:

- K_O1: Is it possible to increase motivation with the help of additional gamification elements built into an existing e-learning system?
- K_O2: Is there a difference between the satisfaction of students who use gamification elements and those who do not?

2. METHODOLOGY

For both fields, the research, measurement, experiment, and summary of results were performed electronically using quantitative methods.

2.1.Methodology of research related to the corporate field

Regarding the steps of the research direction (Figure 1), the usable data and characteristics were collected first, followed by the identification of the users of the examined service and their descriptive statistical characterization. Studies based on user-certified behavior cover 3 sub-themes: categorizing players, examining changes in the workplace atmosphere, and examining the evolution of the network of relationships. After an analysis based on the historical data of the players, their responses to the experimental questionnaires asked during their registration period (2 sets, 5 questions of each) were compared with their actual activities, from which probable behavioral patterns are deduced in the dissertation.

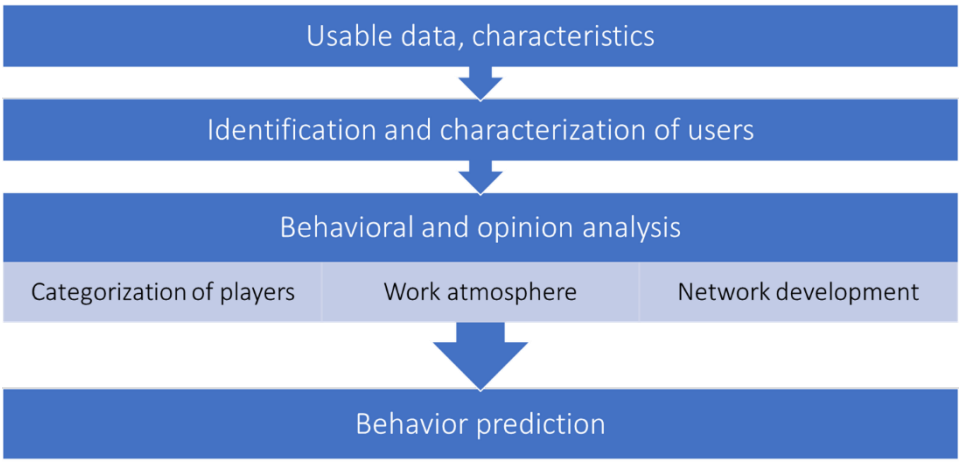

Figure 1: Steps in research related to the corporate field (Own figure)

The research basically operated on 3 types of data: descriptive, activity-based, and opinion-based. The source of research data to measure job satisfaction was provided by data provided by an online service called "*Battlejungle*" as well as data provided by "*Google Analytics*". Google Analytics was responsible for collecting descriptive data about individual users that did not include their behavior, such as age rating, gender, location, area of interest. User behavior,

activities, and opinions were analyzed based on data generated by the Battlejungle service.

Their behavior is linked to the use of service functions, such as announcing activities (which include events that simply require attendance, as well as challenges, competitions, tournaments that require activity), applying for them, performing activities required by ongoing events (applying, reporting results) and use of social features (posting, reaction to posts, commenting, profile viewing, leaderboard tracking, etc.). The opinions of the users were examined by summarizing the evaluations of the scale-based feedback questions placed at different points of the website.

In the examined service, users have the opportunity to send feedback – based on pre-defined questions and scale-based answers – to the service provider and to the people supervising the service in their organization. The questions cover the following topics: changes in the workplace atmosphere, the number and quality of contacts with members of the organization, the frequency of doing sports, the feeling after the announcement of results, the opinion about the service. The question asked is influenced by how long the user has been using the service, what sports the tournaments have in which they participated in, when they answered a similar question (Barna & Fodor, 2018b). Feedback can be made no sooner than 2 weeks after registration. The reason for the restriction is that users who are not yet familiar with the system will not be able to answer questions after 1-2 times of use to measure the change caused by the service. Questions researching the change (depending on its type) can be answered again by the user after 2-3 weeks (Barna & Fodor, 2018b). The content, answers, category, and appearance of the questions asked are listed in Table 16 in Appendix 1.

Among the many personality models, the BrainHex model was used as the basis for categorizing behavior. Users were endowed with 11 characteristics that can be divided into four categories: Frequency of Use, Achieved Results, Social Participation and Activity Participation (Table 1).

Usage	period (A1)	Number of usage days (*Time period between the date of registration and the date of last login in days*)
	logins (A2)	Number of logins
Achievement	point (A3)	The collected points
	level (A4)	The reached level
	badges (A5)	Number of collected badges
Social	like (A6)	Number of positive reactions ('like') given to posts
	post (A7)	Number of written posts
	comment (A8)	Number of written comments
Activities	individual_race (A9)	Number of individual races*
	team_race (A10)	Number of team races**
	social event (A11)	Number of organized social events (e. g. voluntary work)

Table 1: List of usage-based characteristics based on (Fodor & Barna, 2020)

In addition, opinions related to various motivations were used (in the form of 13 feedback questions) that address their relationship to player levels, badges, points, leaderboards, and player profiles in their topic.

One of the aims of the research is to examine long-term commitment, so classification requires the disconnection of committed users of the service first. As a first step, new users were disconnected from the population. Their user maturity can be traced back to the period of use since their registration, where we considered a user who had been using the service for at least 100 days when they last logged in as committed. Since the chosen boundary is contingent, we examined the excess or dropped population size associated with moving the boundary. In terms of service use, we considered long-term users who returned to the interface at least 5 times in a 60-day period to be committed. These two properties of the definition are also contingent, so we examined how the number of committed users would change for other ten-point classifications and for more frequent returns. (Fodor & Barna, 2020). After discussing and defending the limitations set by the definition, users were divided into the following 3 categories:

- "*New users*": registered less than 100 days ago.

- "*Non-engaged users*": have been registered for more than 100 days but have not actually used the service for 60 days or have returned less than 5 times.
- "*Engaged users*": registered for more than 100 days, using the service for at least 60 days, during which time they have returned at least 5 times.

The distributions of the 3 populations were subjected to statistical testing to ensure their diversity. Based on the characteristics in Table 1, it was proved by Kolmogorov-Smirnov testing that for 11 characteristics the 3 populations produced a significant difference in distribution, thus the 3 populations were statistically different, the outlined separation rules proved to be adequate. The study of behavioral patterns is further based on the members of the "engaged" group. (Fodor & Barna, 2020)

Using Agglomerative Hierarchical Clustering (AHC) - using Pearson's correlation coefficient - we searched for groups of behavioral identities for which usage-based characteristics (see Table 1) formed the input to the algorithm, which eventually distinguished 4 clusters. (Fodor & Barna, 2020)

The first cluster (*class-1*) encompasses 790 individuals, the second cluster (*class-2*) has 344 and the third cluster (*class-3*) has 40 and the fourth cluster (*class-4*) has 4 individuals. The variance decomposition for the optimal classification values are 16.8% for within class variation while 83.2% for the between-class differences and the cophenetic correlation is 0.76. (Fodor & Barna, 2020). Basic data mining methods were also used to identify and better understand the clusters.

2.2.Methodology of research related to the educational field

The bigger part of the educational research is based on the Moodle e-learning system. (Figure 2).

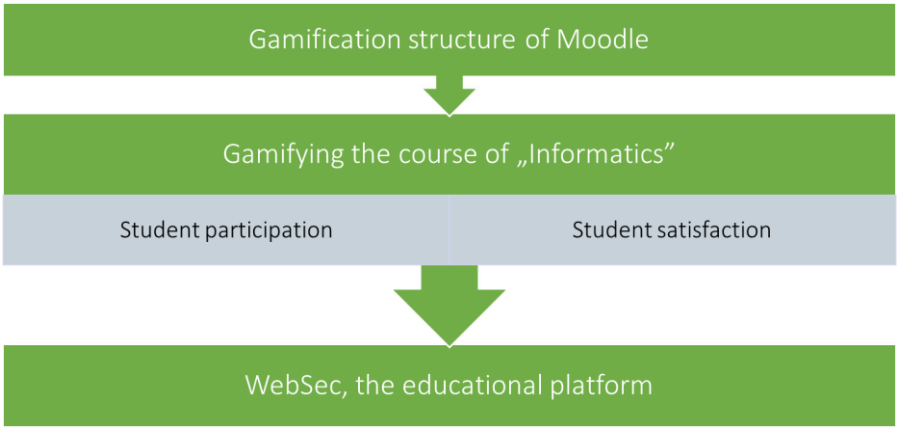

Figure 2: Steps in research related to the educational field (Own figure)

First, data was collected about the system itself and its capabilities and functions, and then the service was examined from a gamification point of view. Once the current capabilities of the Moodle system were outlined, I defined the proposed structure, taking into account educational and gamification objectives, along which structure a more effectively gamified course could be set up. The functions involved in the structure can be divided into the following four categories according to their purpose (Barna & Fodor, 2019a):

1) Serving the main goal (learn and develop)
2) Fostering the use of service (exploring)
3) Providing social connections and interactions
4) Enhancing the feel of personalization

Along these functions, the dissertation describes in detail which existing basic and additional elements (plugins) the proposed structure uses, and what new elements and improvements to propose to be created.

The “Informatics” course is a compulsory one-semester course taught at the beginning of undergraduate education, which must be completed by all full-time and correspondence students of the Corvinus Business School and Corvinus

School of Economics. The course (attended by an average of 1,000-1500 students per semester) will follow a “mixed” type of instruction from the fall of 2015, taking advantage of the benefits and opportunities offered by the Internet and digital media, combining personal instruction with computer-guided guidance, all supported by gamification principles. I had the opportunity to participate in the design and operation of the latter aspect. The gamification environment was not implemented for the Business Informatics students, but the curriculum did not differ from the other groups, so they formed the control group during the analyzes.

We also mapped the gamification possibilities of the course, and then some elements were applied directly (such as alternative learning paths, access restriction, scoring, feedback), while other elements were applied by exporting and running a handwritten algorithm and re-importing its output. During the characterization of the student groups, apart from their number and class classification (full-time or part-time), no other descriptive statistical analysis was required (age is mostly given, gender grouping cannot be queried). Their performance and activity during the course could be analyzed based on the logging data provided by the Moodle system. During the completion of the tests, the research took into account the score achieved on them, the completion rate, and the number of further attempts. The collision of students' opinions is based on the results of a questionnaire conducted and published by the “Professor and Course Evaluation (HalVel)”.

Research using the Moodle e-learning system (see Chapter 6.2) has been able to show positive results (e.g. a strengthened willingness to learn on a weekly basis), although there have been limitations to using the system. One of its main problems is that the system and the tools it offers are mostly used to assess the current level of knowledge instead of effective learning support. In addition, its features cannot be sufficiently developed to enhance into a highly gamified service.

For these reasons, a decision was made in favor of an independent teaching application developed by me, which task is to help the user to arouse and maintain motivation during the acquisition of the pre-prepared curriculum by following a

topic provided by an expert or instructor. The application to be developed was expected to be able to help, guide, evaluate and give feedback to the user without the supervision of an instructor (Barna, et al., 2019), while triggering the “flow” experience in the player. (see Chapter 2.2.5.). The design and educational aspects of this educational application are discussed in the dissertation. This dissertation contains the results of small-group testing of the application after discussing the gamification-oriented structure of the application.

3. SUMMARY OF RESEARCH RESULTS

3.1. Results of research related to the corporate field

Research related to the corporate side has clustered around two major issues that have analyzed the impact of a gamified online service on the community. The first question (Q_C1 [K_V1]) deals with the possibility of two aspects of influencing employees 'behavior and commitment, on the one hand the possibility of influencing the work atmosphere (Q_C1_A [K_V1_A]) and on the other hand the influence on employees' network of contacts (Q_C1_B [K_V1_B]).

R_C1 ($\leftarrow Q_C1_A$): According to their own opinion, more than 61% of the employees using the gamified team-building online service believe that the workplace atmosphere has improved since using the service, and the positive change remains over the years (see Chapter 5.6).

This statement is supported by 1223 pieces of feedback, of which the proportion of those experiencing negative change is negligible, and almost a third felt unchanged. Examining the timeliness of the data, it can be observed that the number of feedbacks showed a decreasing trend after the 2nd month, but the periods provide an average assessment confirming a continuously positive change.

R_C2 ($\leftarrow Q_C1_B$): Using the gamified team-building online service examined, more than 84% of employees met at least 1 partially or completely unknown coworker. Nearly 31% of service users have established closer relationships with at least 6 partially or completely unknown co-workers. (see Chapter 5.7.1)

R_C3 ($\leftarrow Q_C1_B$): In using the gamified team-building online service surveyed, more than 80% of employees reported an improvement in their relationship with employees they came into direct contact with while using the service. (see Chapter 5.7.1)

The change in the habits of individuals related to exercise and sports was also the subject of analysis, examining whether the service has a motivating effect in these areas, whether it improves the willingness to increase physical activities:

R_C4 ($\leftarrow Q_C1$): When using the gamified team-building online service surveyed, 62% of employees stated that due to the motivation generated by the service, they performed several movement-related activities requested by the service several times, which means they managed to increase their internal motivation to participate. (see Chapter 5.8)

R_C5 ($\leftarrow Q_C1$): There is no significant co-movement between the satisfaction of users participating in matches hosted by the service and their experience (measured by user levels and aggregated points), so a novice user enjoys the activities as much as a more experienced one. Nearly 93% of users evaluated the matches as a positive experience. (see Chapter 5.9)

In addition to satisfaction, the analysis of employee behavior was also the subject of the dissertation (Q_C2), in connection with which the following results were obtained:

R_C6 ($\leftarrow Q_C2$): Based on user behavior, using AHC-type cluster analysis, 3 types of players that fit the BrainHex model could be delineated among users: "Conqueror," "Socializer," and "Achiever" (see Chapter 5.4.2).

In addition to these 3 clusters, a 4th was also formed, the members of which (also checked with the help of data mining tools) were the "official" organizers of the given organizations, so they were excluded from the behavioral examinations according to the type of player, but their role is by no means insignificant.

R_C7 ($\leftarrow Q_C2$): The "organizing" factor has a positive effect on the commitment rate. The examined gamified service can achieve better results if some members of the given organization perform organizational tasks (see Chapter 5.4.3).

Users completed 2 different questionnaires at their registration based on when they joined to the service. The results of these were compared by the dissertation with their actual behavior in order to determine how effective they are in predicting and grouping behaviors. The behavioral study covered the willingness to participate in activities (individual and team-based “race” and “versus” competitions, social events), the use of social functions, the number of badges collected, and the level of play achieved.

R_C8 ($\leftarrow Q_C2$): During the analysis of the series of questions, Questionnaire 2 proved to have a more effective behavior-identifying effect. It can be shown that those who already feel like a member of the team at the beginning of registration use the community functions to a greater extent, as well as show a greater willingness to participate in various activities than those who do not yet know their colleagues really well. Among those who would spend a “boring Saturday afternoon” with fun rather than productivity, they show spectacularly greater participation, regardless of type of the activities. While users who take on a complex task feel more inclined to individual and team “races” and social events, and collect more badges, those who don’t want to deal with the task prefer one-on-one (“versus”) type competitions, but still show a complete lack of interest in using social features. It is expected that a high overall willingness to participate will be demonstrated by the user answering the combination C-25 for Questionnaire 1 or choosing the set of answers C-17 or C-25 for Questionnaire 2. (see Chapter 5.5)

3.2.Results of research related to the educational field

My research on education consists of three sub-areas. First, I characterized the gamification usability of the Moodle system, which is widely used in universities. This was followed by the characterization of the steps and effectiveness of a large-scale course transformation, and finally I left the e-learning system and started to implement my own platform.

R_E1: After assessing the possibilities of the Moodle system, I set up a proposed structure (Figure 3), on the basis of which a properly gamified course can be set up within the framework of the Moodle system. (see Chapter 6.1.3)

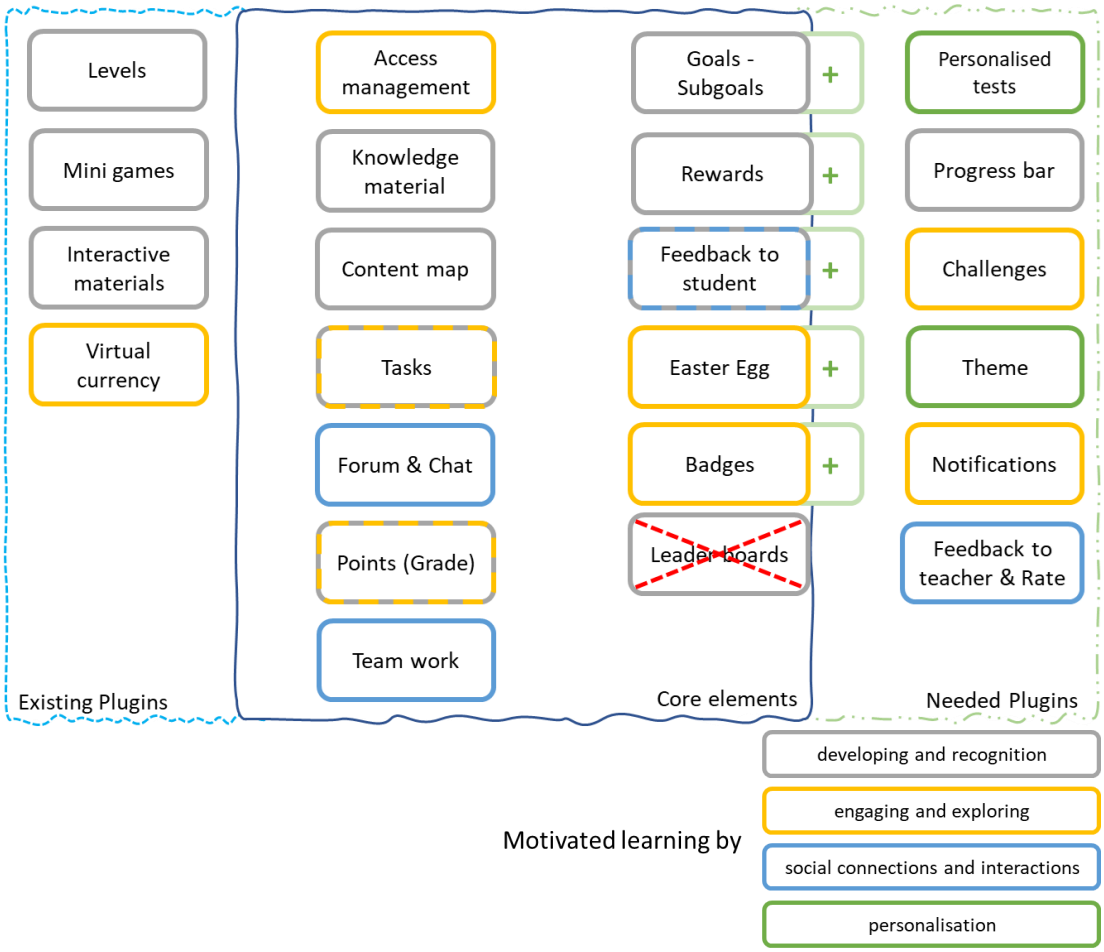

Figure 3: Proposed gamification structure with a list of basic elements present in Moodle, existing plugins and plugins considered necessary (Barna & Fodor, 2019a)

3.2.1. Results of gamifying a course in Moodle

R_E2 ($\leftarrow Q_E1$): The course has been gamified. Several game elements and game mechanics have been implemented (see Chapter 6.2.1). The reason for the changes is multifactorial, but it also shows the effects of gamification and the increase in the willingness to participate (see Chapter 6.2.3).

R_E3 ($\leftarrow Q_E2$): Regarding the assessment of the usefulness of the acquired curriculum, the students of the gamified course gave 9.9% better evaluation than the students of the non-gamified course group. (see Chapter 6.2.4)

R_E4 ($\leftarrow Q_E2$): Students in the gamified course rated 4.9% more positively for consistency between individual performance assessments by faculty and students than students in the non-gamified course group. (see Chapter 6.2.4)

3.2.2. Results of the educational platform

R_E5: I have created the first prototype of the gamified framework, which is suitable for the transfer of teaching materials on various topics after their implementation. The technical parameters were in line with the first area of use, meeting the Japanese expectations, during which Japanese students used it to master the basics of Internet security. (see Chapter 6.3.1)

R_E6: The app has become capable of playing at least 60 minutes of gameplay, and users' repeated gameplay took an average of 20 minutes longer than the previous attempt. (see Chapter 6.3.2.3)

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