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Implementation of Gamification Principles into Higher Education

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Abstract: The field of education was distinctly affected by the development of information and communication technologies, as they can make education more efficient, interactive, and available. Today's students call for new innovative educational approaches. Digital communication technologies are the organic part of their life and they are group-oriented and experienced users of these technologies. Information and communication technologies must be used in a new and more interactive way to motivate this new generation of students. One of the ways might be gamified learning. The gamification of education is an approach, which uses game practices and elements in a process of learning. Its main objective is to increase students' interest in learned topics and to motivate them to endure in learning. The gamification of the educational process is introduced in the curricula of several courses at our faculty. The paper aims to give a short overview of tools and methods of gamification of the education process. In addition to that, the implementation of gamification in our learning management system Moodle-supported business informatics course is presented.

Keywords: *Gamification, innovative teaching methods, learning motivation enhancement, learning management system Moodle, higher education.*

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Introduction

Information and communication technologies (ICT) play important role in many areas of human society, including education. The young generation is considered digital natives, born into the world with omnipresent ICT. The number of young people who use ICT on daily basis continuously increases (in 2019 represented 94 % of young people in the EU-27 made daily use of the internet). The access and active use of ICTs are common for children from a very young age (Eurostat, 2020). Therefore, they expect the heavy usage of ICT also in the process of their education (Roberts et al., 2013). Information and communication technologies are a component part of their identity and lifestyle (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2019; European Network of Education Councils, 2014). This leads to changes in the relation between lecturer and students. Lecturer or teacher is not the only authority passing information and knowledge towards students, but now he/she is the guide during students' process of acquiring new skills and knowledge. The new role of educators seems to be teaching students how to acquire reliable information and understand it using critical thinking (Schola Europaea, 2018).

The youth spend an average of around 7 hours using ICT, for example by using multimedia, retrieving new information, playing video games, or creating web content (International Education Advisory Board, 2007; Nagata et al., 2022; Vahlberg, 2010). Therefore, it might be challenging to compete with such attractive stimuli and to motivate students to involve actively in the education process in the desired educational field. Students from the young generation like the possibility to choose, the want to be in control, they are more social (mainly using ICT) and group-oriented, more risk-taking, and experienced with digital technology (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2019; International Education Advisory Board, 2007). These characteristics must be taken into account when setting up the educational process, to have a chance to succeed in promoting students' engagement in this process.

Therefore, educators need to set clear expectations of students' achievements before proceeding with the course. This might allow learners to manage their learning process using different internal, external information resources, accomplishments, and collaborations within the class (Chasse, 2014). Furthermore, it is important to analyze the activity of students to gain a detailed overview of their educational needs. These analyses represent a valuable resource for

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further improvement of the educational process in the course (Kiryakova et al., 2014). In addition, educators need to choose a suitable mixture of modern practices and technologies (such as gamification, augmented reality, virtual reality, etc.) to increase and retain learners' activity in the educational process. In this case, the big challenge is to provide education natively in smart devices (not only via PCs) for learners' convenience and its seamless availability. This might result in students' participation in the educational process even besides their presence in the classroom (Tham, 2019).

One of the major trends in education is gamification, made possible by modern technologies. The gamification within the educational process might contribute to the raising of motivation, engagement, and performance of learners. It might result in higher and longer involvement in education followed by higher knowledge and improved skills.

Literature Review

The idea of gamification in education is not a complete novelty. For the first time, the gamification of education was mentioned in the 1980s (e.g., Bowman, 1982; Malone, 1980, 1982). Later, Chapman and Rich (2018) characterized gamified education as a collection of activities taken in reality (but supported by the ICT system) to discover and validate activities, view progress, and communicate and collaborate with other players. Generally, gamification can be understood as an integration of game elements and game thinking in activities that are not games (Kapp, 2012; Kiryakova et al., 2014).

Games have typical characteristics which are vital in gamification and which are used to motivate and facilitate educational process, namely:

- Narrative and users – constituted by all course participants;
- Player control – participants control the pace of the study consecution;
- Immediate feedback – users get an evaluation of performed task instantly;
- Challenges – tasks performed consecutively towards defined objectives or goals;
- Progress mechanism – a process of accomplishing tasks and acquiring amounts of points for them. After reaching a predefined level of points users are rewarded with various rewards such as badges of accomplishment for completing certain actions. This can be repeated multiple times to promote the reaching the goal of the study and supported by the publishing of users' ranking according to their levels of achievement;
- Social contact – allows competitive or cooperative problem-solving within the process of education (Kiryakova et al., 2014; Werbach & Hunter, 2012).

The main objective of gamification of the educational process is to support the students' attention, promote continuity of their learning and attract them to fulfill learning goals (Borys & Laskowski, 2013). The suitable structure of tasks allows learners to assess their chances of successfully reaching their learning goals. Also, simplifying and dividing difficult tasks into simpler and easier sub-tasks assist them in dealing with harder more complex tasks.

When introducing gamification into a course, its structure must be changed. For example, the roles of teachers, learners, and the learning environment and its content have to be adopted to the need of a new way of education. Avatar (as an icon or figure representing a particular person) might be introduced as part of the gamification of roles. Lecturers, as the course managers, are responsible for introducing game dynamics into the course, designing the gamified course curricula, and creating motivating rewards for students (Kim, 2015). All of these purposes for motivating learners to actively participate in the educational process and to raise their interest in course content and learning activities.

At the university education level, but not only there, it is a common practice that the classical full-time form of education is supplemented by the use of Learning Management System (LMS), through which the self-education of students within the individual subjects of study is ensured. LMS Moodle is one of the most frequently used LMSs (Fenton, 2018). Moodle is an open-source initiative. Therefore, it is available a wide range of different interoperable plug-ins and commercial and non-commercial projects that provide full customization of LMS to the educational institution's needs. The advantage is a wide supporting community of educators, learners, and developers, that allows Moodle to be used in various areas of education. It represents a dynamically developed system available in more than 120 language localizations, compatible with every major browser and device offering responsive interface and apps for iOS, Android, and Windows Phone (Moodle Community, 2020). Alongside groups and roles, Moodle supports blended and online courses with nearly two dozen course-related “Activities” motivated us to use LMS Moodle at our faculty as a supportive education platform, where students have all necessary information for the practical study of the subjects.

In an effort to increase the attractiveness of our (not very popular) subject among students of our faculty, we decided to analyze the students’ activity during face-to-face classes (and later online classes through MS Teams) and their way of working with LMS Moodle. As the result, several gamification methods were introduced into the subject, to bring different ways for both forms of the educational process - how to revive the Face-to-Face (F2F) lessons and also the course materials within the LMS Moodle.

Gamification Options in LMS Moodle

LMS Moodle belongs to the most popular platforms for education. It provides a collaborative environment for education, allowing cooperation and communication of students, teachers, and other participants in the educational process. In addition to that, it includes several features for gamification in educational courses. Furthermore, it allows tracking of learners' progress and results. Students are also stimulated to contribute to the learning content within the particular courses using blogs, forums, discussions, or wiki pages.

Gamified courses have the potential to bring more fun into their learning process (Gotarkar, 2018). Over 80 percent of students stated that gamification might improve their productivity and they have a positive attitude towards gamified education. In addition, they adduced that gamified LMS environment is more competitive and engaging (Apostolopoulos, 2019).

Learning management system Moodle allows using multiple integral options for gamification of the educational process. For example, users might define their avatar and upload it to their profile's photo. Educators are allowed to define learning path for students which leads them through multiple actions to access the specific activity. Competitiveness among the learners can be supported by publishing top rankings in the quizzes (or other activities). Students might collect the badges as rewards for achieving a certain level of knowledge. The motivation of students might be increased by instant feedback on their activities, assignments, and tests and also the progress of learners might be visible in form of a progress bar to let them know their progress in the course (Kiryakova et al., 2014).

The LMS Moodle's built-in options of gamification can further be extended by multiple modules or plugins that support principles of gamification in a given course. For example, the module Activities: Game allows creating games (like crosswords, hangman, Sudoku, Snake, etc.) from glossaries, quizzes and questions within the Moodle course. The learners' scores from these games are included in the grade book. This fact might push students to study the available materials more to achieve better scores in games. Another LMS Moodle module Quizventure enables to load quiz questions from the course. The options of answers fly down as spaceships and users need to shoot the correct answer. This module can motivate students for learning also during their free time. Stash is the LMS Moodle block that allows educators to create and deploy collectible items around the course. When students collect them, these items appear in their stash, which encourages learners to interact with all study materials and activities. Another block for LMS Moodle, called “Level up!” enables the teachers to assign the amounts of experience points for students' progression through the activities and materials within a course. Learners can see their achieved level and progress towards the next level (Gotarkar, 2018).

Gamification Tools Beyond LMS Moodle

Alongside the gamification tools for LMS Moodle, there also exist options for the motivation of learners during face-to-face learning classrooms, seminars or lectures. Those can be used to attract students' attention to study during the lessons.

Firstly, sli.do (available at https://www.sli.do/) can be mentioned. It is an online tool allowing learners to ask questions, access simple Q&A, and vote in real-time polls. Live polls might start up the activity or conversation, gather quick feedback, or test knowledge. Educators can use it to entertain or test the event attendees, catch the audience's attention early, or recap the content (Slido, 2021).

Another online tool is Mentimeter (available at https://www.mentimeter.com/) lets educators create interactive presentations using the easy-to-use online editor. Besides the creation of presentations, it allows to create quizzes, polls, ask questions, publish images and slides. During the educator's presentation participants can connect to the presentation (using smart devices) and give feedback, ask questions, vote in polls, etc. their interaction can be made visible in real-time by the presenter (Mentimeter, 2021).

For gamification, purposes can be used also Kahoot! (Available at https://kahoot.com/). It is a learning platform, that provides educational games (e.g., multiple-choice quizzes, trivia quizzes). Kahoot! might be used for checking learners' knowledge, assessment of their learning progress, or diversifying traditional teaching activities (Kahoot!, 2021).

Methodology

Societal and technical development let out into Industry 4.0. Adapting to automation, the use of AI in decision-making and management processes also requires a change in the knowledge and skills of university graduates, while these changes affect not only technology-oriented fields of study but also those in the humanities. Present labor market asks for digitally literate employees specialized skill Internet of Things, data science, artificial intelligence, programming, for the needs of science, technology, engineering and mathematics, teamwork and collaborative and co-creative procedures employable in creative designing and trading (Ministry of Investment, Regional Development and Informatization of the Slovak Republic, 2019). The education process at the faculty is aimed to accomplish the mentioned requirements as objectives of the European Union's European Digital Competence Framework for Citizens as well.

A Brief Overview of the Business Informatics Course

Business Informatics course is designed for and learned by students of the first year of bachelor study of the study branch Finance, Banking and Investments provided by Faculty of Economics, Technical University of Košice (FoE at TUKE). Attendees are introduced to the fundamentals of business informatics, what means that brief history and future trends of business informatics, different kinds of data and information systems used in the enterprise, and main principles of information strategy management, achieved data analysis are presented. In addition to basic terminology in the field of business informatics, students are introduced to important Business Process Modelling (BPM) and Business Process Re-engineering (BPR) principles. In parallel with their theoretical knowledge, we also build their practical skills in the field of process modeling, data processing, and data analysis using ARIS Express, MS Excel, and MS Access applications.

The course realization respects the traditional way of university education determined by the university regulation (i.e., full-time teaching is divided into lectures and practical exercises in PC labs of the faculty) but is widely updated and supported by different innovative teaching methods. During the whole course, the blended learning models – like the flex model or flipped classroom model are implemented (Clayton Christensen Institute, 2021). The main principle of blended learning is to combine traditional F2F classroom education with online materials and interactions (Friesen, 2012). Within the Business Informatics course, we realize the online learning via LMS Moodle and MS Teams.

By implementing blended learning into our education process, we wanted to increase students' interest and reach more active participation in their education. During F2F lectures students are introduced to particular topics connected to business informatics. Following are asked to use LMS Moodle and study the published study materials, news and to do self-test and practical exercises, to prepare the questions and project proposal for the PC Labs. This part could be done at home, at the own pace of the particular students. Using LMS Moodle we provide to students the space for online testing, chatting, feedback, etc. which ensures two-way communication between the participants in the education process. Their online activity is mixed by the F2F PC Labs where the teacher presents and is prepared to discuss the main issues of the current topic.

After graduating from the course, students are asked to give us feedback on the course content and the style of realization as well. Because the main content of the course (study materials, activities, assignments, etc.) is published in the LMS Moodle, the regular use of LMS Moodle by the students is crucial to successfully passing the course. One of the questionnaire's questions is therefore concerned about the frequency of LMS Moodle during the semester.

Nevertheless, that the students know about the content of the course in the LMS Moodle, just 31% attend the online course daily in 2020, and what is important to note, that a surprisingly low percentage of them do it just more than once a week (58%) or even just once a week or less (11% of students). These numbers are alarming because, by this disinterest in the online course content, students miss an overview about the topics, activities needed to be done and so often they lose deadlines, which finally influence their final course results. Due to our objective to enhance the active participation of students in the education process, we related questionnaire results with the LMS Moodle data (frequency of access to the system and particular course parts, types of logs, etc.).

From LMS Moodle data analysis we realized, that the frequency rate stated in the questionnaire was confirmed. In addition, the attendance rate is also connected to the week of the semester. The first and three last week of the semester (including the exam period) is significant by the low activity of students. It could be described by having no information about the online course in the first week and by having a credit test already finished in the last weeks of the semester. During the semester, the attendance rate is more-less balanced.

When we are asking about the content of the course published via LMS Moodle, 100% of respondents confirmed that materials are supportive and useful. On the other hand, the students pointed out they miss more video tutorials (32%), more tasks for practicing, activities for self-assessments (9%). Lack of these kinds of materials and activities that creates dynamics and interactivity within the course they marked as the reason for less interest in the online course.

Gamification Principles Applied in Business Informatics Course

The feedback results motivated us to think about the course content and learning way innovation. Due to the fact, that students pointed out the lack of interactivity within the course, we had to think about the possibilities of how to improve the course in that way and motivate to student access the online environment more often and regularly. Based on feedback we realized, that students miss some kind of impulse that motivates them to be more interested in changes and content of the online course even outside the time when they are preparing for the F2F lectures. The gamification principle proposes a way to make the course more popular even for a student who does not like this subject. We implement the gamification elements to every part of the educational system, to F2F lectures, and the online course as well.

When a teacher decides to implement gamification models in his/her subject, it is important to take into account the age of students, their learning autonomy level, and the reasons for introducing gamification into the course. Our students are adults, so their level of autonomy is high, but their motivation level needs something to encourage. And we had to think

about the possibilities of gamification in two different ways: firstly – F2F lectures, which are often boring for the students, and secondly, online course, which is more-less ignored by the students.

One approach of gamification presents the introduction of the leaders' list. So, we decided to design such kind of list of students who intend any kind of gamified part of the course. At the university level, we have to take into account, that students are adult people, who are not oriented just on gaming aspects of the education, but also interested in the reasons and aims of the education and final results, not least. For that reason, we needed to be very clear in explaining how their participation in the gaming-oriented learning path will influence their final result of the course. During their study, students can choose whether take part in the gamification activity. The number of gained points depends on task completion (like attending classes) or actual student performance (like writing tests or completing the final project). One of the principles of gamification is, that in case of failure, students are not given negative points or some kind of penalty. It means not active students are not negatively influenced; they just lose the possible advantage of extra points. The achieved result is ranked and inserted into the leaders' list and at the end of the course, students can use these points to increase the final exam rate.

The following Figure 1 describes the tools used for gamification in our Business Informatics course.

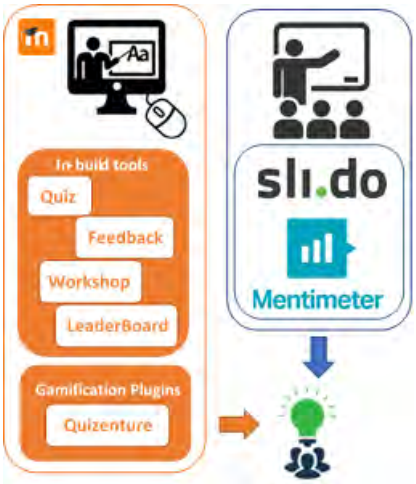

Figure 1. Gamification Tools Applied in Business Informatics Course

As was mentioned, there is a lot of different tools that are helpful in this intention, (e.g., Kahoot!, Mentimeter, sli.do, etc.). Among their benefits include the user-friendly environment and accessibility via smartphones. These applications are used for "awakening" students' attention during F2F lessons, when students often lost their concentration, especially during the lectures where the introduction to particular topics is presented by the teacher. They can be used at any time of the lectures – at the beginning for asking their feelings and expectations, during the lesson as a short quiz checking their attention, and at the end of the lecture for achieving instant feedback on the lecture.

As an example of this activity can be presented the result of cooperation with the students during the first lecture, when the students were asked to post the that best describes their feelings after this lecture. The result was then published as word cloud picture as a motivation at the beginning and during the course. We used these pictures as very simple and immediate feedback from students on the information about the subject. Students could return to these pictures at any time and tune in positively to the next stage within the subject.

The main part of the subject gamification process was done within the online course available via faculty LMS Moodle. The main objective is to increase the attractiveness and active use of the published course sources. For that purpose, we employ different tools and plugins provided by LMS Moodle itself. Within gamified learning path students have prepared a wide range of activities that can they participate voluntarily. We call them "Random activities". Information about the running activity is published by using different channels – during the F2F lectures, via MS Teams course channel, via calendar in LMS Moodle course. So, students need to actively monitor events and (gradually published) information if they want to participate in these activities. However, to make it more gamified and fun for them, random activities appeared random and just the first 30 students who completed the activity were evaluated and ranked. During the business informatics course, we implemented the following types of Moodle activities:

• Hangman – students have to search for appropriate keywords and subsequently can use this word as a password for the partitioning test.

• Quizventure – specialized LMS Moodle plugin that offers different types of games. By playing these games, students can check their knowledge and learn from mistakes at the same time.

Figure 2. Example of the Quizventure Game

• Solve the puzzle – the game aimed to find out two words based on the pictures listed below. Then the final words could be used as a password to an online test, similar to final exam one.

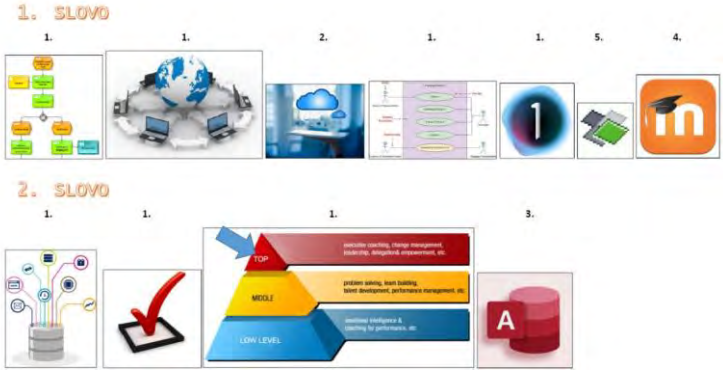

Figure 3. Example of the Picture Puzzle

• Online tests – online tests are a standard activity of the self-evaluation or evaluation of the students' knowledge. We use them regularly at the end of every topic in the course. By publishing the general feedback after every question, students can come back to their weak topics and re-read, re-study them again.

• Online assignments - are a standard activity, but we use them for our gamification purposes. We call them "Back to …" and are concerned about one of the topics, that we already finished (i.e., Back to Excel, MS Access, Back to Business Process Modelling, etc.). The expected knowledge and skills achieved at the end of the course are set in the faculty accreditation file, so we need to take into consideration also these course objectives. That is why most activities are oriented toward solving the practical problems implementing principles of project-based learning (Sam Houston State University, 2018). To be able to solve the problem in a more complex way, students needed to study published materials, search on the Internet, and last but not least also practically practice working with an application for a given area.

Designing the business process model was the first part of the complex task in the course. During the lecture, students are asked to think about the order delivery process, identify main activities and try to sketch it by pen. After uploading the file with their sketch, they can compare it with the model designed by the teacher and they are free to ask their questions about this topic. This random activity is concerned with business process modeling and helps them better understand the issues of modeling the processes, think about the main questions asked during the process modeling, etc.

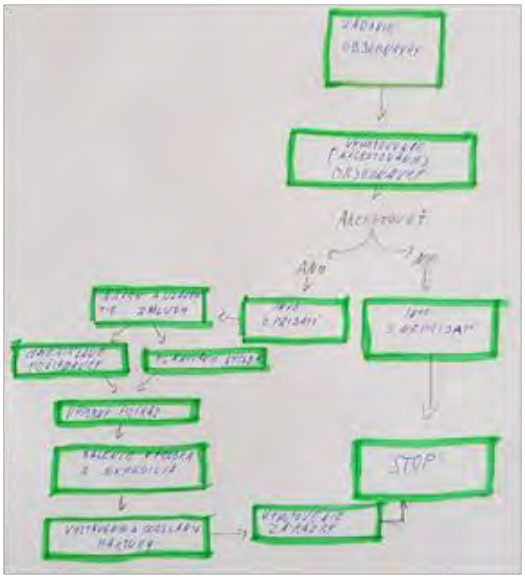

Figure 4. Example of Student's Model Design

This activity is aimed to force the students into appropriate data searching on the Internet, with is not an easy task. Based on this data they have to create a presentation by using MS Excel dynamic charts. Task seems to be easy, but by this activity, students develop their searching skills and design thinking by implementation and realization of their expectations using a spreadsheet application.

Designing a database for their business, was the activity where students (that already modeled the business process) have to think about the data needed behind the process and design a data model and implement it into MS Access small relation database. By participating in this task, students go through the whole life cycle of a business information system and are motivated to think about the topic in a more detailed way.

Creating the database was an activity that covers the active participation of the students in the learning materials development. Using this activity, students create the database of their links, study materials searched on the Internet, video tutorials, or practical explanatory exercises developed by students themselves. These materials could act as another study resource for those facing problems with the course content.

What is important to note, that except for tests, where students are provided with the right answers, the practically oriented tasks have no appropriate answer or solution; these arise up just to thank the active approach of students themselves. The list of best practices with an appropriate comment of the teacher was published every time after finishing the evaluation of the particular task, so students could use it while preparing for the credit and final exam.

Research Design

The main goal of the research was to identify the parts of the subject Business Informatics that are least interesting for students and to check in practice whether the introduction of gamification methods will increase the motivation of students to self-study.

Based on this objective, we analyzed the success of students in the framework of the achieved results in the course and the outputs obtained from the graduated students' feedback. Based on these results, we then gamified the most critical parts of the course and compared the achieved results with status before gamification. In the end, we were interested in whether gamification will bring the expected positive effect on student results.

Sample and Data Collection

To carry out such research, it was necessary to analyze the outputs available from students who completed the original version, the gamified version, and the modified gamified version of the course. We researched in the academic years 2020 and 2021 when we compared the success rates of students who completed a gamified course and their views on it. However, in comparing the results achieved by students, we also used the results achieved by students in 2019, because at that time the course did not contain elements of gamification and it was possible to examine whether the introduction of gamification methods into the subject had any effect on students' final evaluation.

For the research, the primary data from 2020 and 2021 were gathered as output from the gathering of feedback after completing the course. It was used to gain students' views on the modified form of the course. Furthermore, final evaluations of students who completed the course during years 2019 – 2021 were gathered (the total evaluations and also the individual components were monitored). Obtained data from the feedback was gathered online using

a questionnaire in the LMS Moodle environment, which was attended by all students studying the given subject. A total of 343 responses were received during the considered period, with the distribution within the individual academic years being as follows (see Table 1 below).

The survey consisted of 40 questions of different kinds (multiple-choice questions, open-ended questions, etc.). The answers were divided into the following sections aimed to map respondents' opinions on a specific part of the course. Besides demographic data, it was a group of questions focused on the respondents' attitude towards informatics, its usefulness for his/her future, general opinion on the topics covered within the course, student's preference of the type of study material (scripts, tutorials, written text, video, etc.), method of availability of study materials preferred (F2F, online, blended learning, etc.), the quality of available materials and the opinion on the gamified parts of the subject. The reliability and validity of our survey questions were tested using IBM SPSS statistics software. The reliability of survey questions was expressed by calculating overall Cronbach's alpha. Overall Cronbach's alpha for our sample was 0.879, which is above the recommended level of 0.80 for a reliable sample of data (Weiss, 2016). The validity of questions in our questionnaire was checked and approved by two experts in higher education. Where it was applicable, the questions' validity was tested by investigating if overall Pearson's correlation is higher than its critical value for our sample size (in our case: r>0.095, N=343, *df*= 341, α=0.05). Only questions considered valid were further used in our research (Weiss, 2016).

The answers of students who filled in the feedback only pro forma (i.e., instead of a verbal answer they inserted any character, they constantly chose neutral answers or "I don't know" answers, etc.) were omitted from the sample. After this preprocessing of the data, lower numbers were obtained of relevant responses (see Table 1. below), which was subjected to a more detailed analysis.

Table 1. Number of Achieved and Relevant Answers on Conducted Feedback

No of answers	**Academic year**	
	2020	**2021**
All	172	171
Relevant	167	139

The primary data were obtained through reporting tools in LMS Moodle and from the academic information system, which is used to record the study records of individual students. In total, the evaluations for 528 students (185 in the academic year 2019, 172 in the academic year 2020, 171 in the academic year 2021) were available. These data did not need to be further processed in any way as they are official evaluation scores of the students for a given academic year.

Analysis of Data

Based on the obtained data, basic outputs for individual years were analyzed and their output was visualized in MS Excel. These outputs allowed us to identify the main problems within the subject and suggested possible solutions for further improvement of the course.

Following data were specified and analyzed:

- Respondents' satisfaction with the overall course.
- The most interesting topic of the course (2020, 2021).
- Students' participation in particular random activities.
- Rate of successful and failed credit exams.
- Students' opinions about the usability of the subject as a whole in their future.
- Students' opinions about the most usable part of the course in the future.
- Students' opinions about using MS Teams helped students' during the course.

Total aggregated frequencies and percentages (where applicable) were expressed and compared for non-gamified course iteration (2019) and gamified iterations (2020, 2021) investigated to examine if the implementation of the gamification in the course improved the educational process.

Furthermore, the gamified study experience was compared with non-gamified within the years where it was possible (2020,2021), thus in the years where some students conducted random activities and others did not. The division of students into these two groups allowed us to find out the average results in these groups and compare them with each other. At the same time, we performed a non-parametric (as the data were not normally distributed) test using the Mann-Whitney U test to investigate if the differences in means found are statistically significant. According to Weiss (2016), the Mann-Whitney U test is suitable for comparing the statistical significance of the means' differences among two groups.

Findings

The preliminary study of gamification of the course was realized in academic years 2020 and 2021. Applying this gamification model into the Business Informatics course we were interested in the students' opinion, but also in how this approach influenced the achieved students' final results, at the same time. Within these years, the course was attended by 172 (in 2020) and 171 (in 2021) full-time students. At first, we are interested in their overall satisfaction with the course. The vast majority are satisfied with the content of the subject (Figure 5).

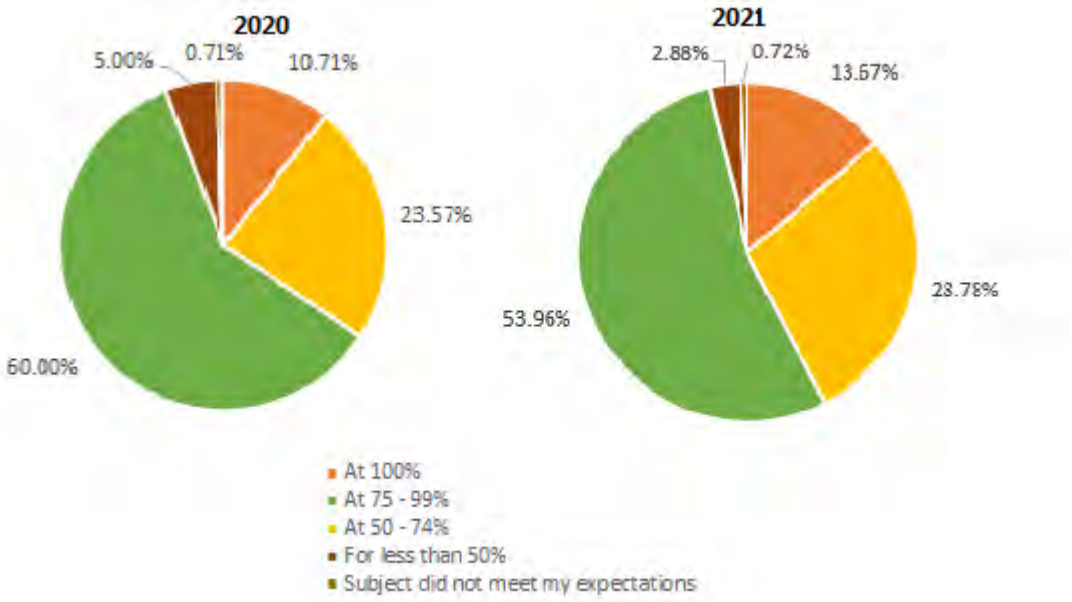

Figure 5. Students' Satisfaction Rate with the Overall Course

The content of the subject is divided into four main topics: Business Information Systems, Business Process Modelling, Data Processing with MS Excel and Relation Databases, and MS Access. The first topic is more theoretical but necessary for introducing students into the field of business informatics. The following three topics are more practically oriented, so students achieve also practical skills in data processing by using different approaches and applications. In connection with the results of satisfaction and content of the course, we investigated also the most interesting topic from the students' point of view. The young generation of digital natives is more practically oriented, so they prefer this kind of topic (see Table 2), i.e., concerned with practical application of theoretical knowledge by using real data and applications (European Network of Education Councils, 2014).

Table 2. The Most Interesting Topic of the Course During 2020 and 2021

Topic	Percentage of respondents	
	Ac. year 2020	Ac. year 2021
Data Processing with MS Excel	40.71%	36.69%
Relation Databases and MS Access	29.29%	33.09%
Business Process Modelling	25.71%	24.46%
Business Information Systems	4.29%	5.76%

As was mentioned above, to enhance students' motivation to study more actively, we included random activities into online course content. Even though students registered the existence of random activities in the LMS Moodle, only 47% of all students of the course participated in such a kind of activity. When we researched participation in different types of activities, we realized that in the opposite of results presented in Table 2, students participated most frequently in the activities like theoretical tests, search for information on the Internet, but in less frequency on practically oriented tasks (Figure 6). Random activity 1 presents defining the feeling after 1st lecture of the course and activity 6 presents the searching of password to enter the test from the Introduction to Business Informatics topic. The activities, the solution of which required a longer time, application of already acquired knowledge, and independent work, were solved less often and by a small number of students (approximately just 20%). These results confirm the problems of employers that younger employees, among other shortcomings, are not able to work independently (Lisá, 2018; Lisá & Newman, 2020).

The low participation in the solving of random activities could also be influenced by the fact that random activities never had correct solutions published. These were created thanks to the active approach of students and after the end of the

activity, the best solutions were published with the appropriate comments of the teacher in the online course environment. In this way, the educational base was expanded also for the students who did not do these activities.

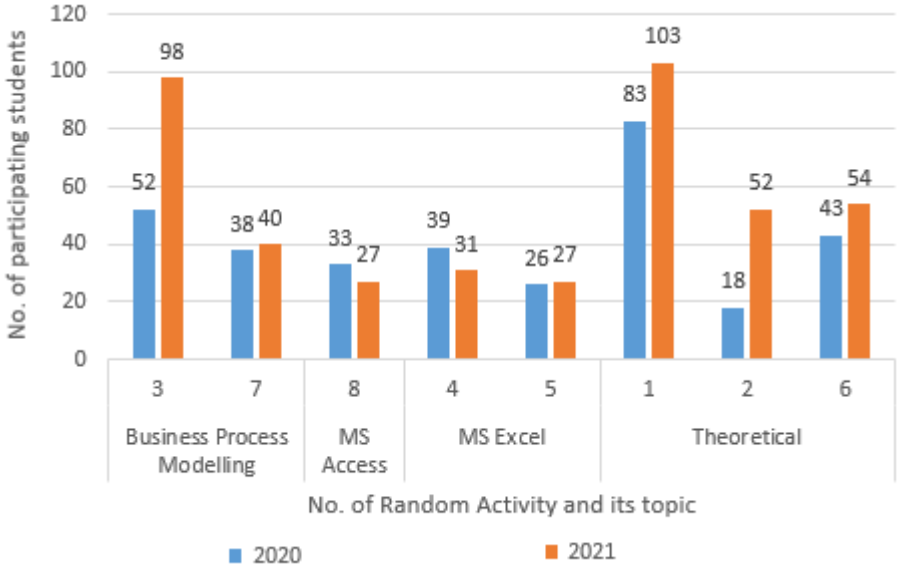

Figure 6. Frequencies of Students' Participation in Particular Random Activities

In more detailed research of the students' participation in particular random activities, we realized, that students preferred activities like theoretical tests or answering short questions during the lectures. The more practically oriented activities were solved just by the small group created by almost the same 30 students. We were interested in the reason, why students decided to participate in such kinds of activities. We can identify two main reasons: 53.49% of those who participated was motivated mostly by the possibility to reach extra points credited to final subject evaluation results and 27.91% wanted to learn something new and practice his/her skills on more complex tasks and ultimately be better prepared to credit exam. In connection with this finding, we are curious whether participation in the practical random activities positively affects the achieved result of credit exam that is more practically oriented. We compared the level of results obtained by students in the not gamified year 2019 and gamified years 2020 and 2021. In the academic year 2019 started to study the subject Business Informatics 172 students. The credit exam was passed by 137 of them. The average level of credit exam reached a stable 28% and the final evaluation rate reaches 73%, which means a C grade. The following Figure 7 represents the comparison of the success rate of two different groups of students – not participating and participating in practically oriented random activities. As can be seen, the students participating in random activities achieved almost 100% success rate in passing the credit exam.

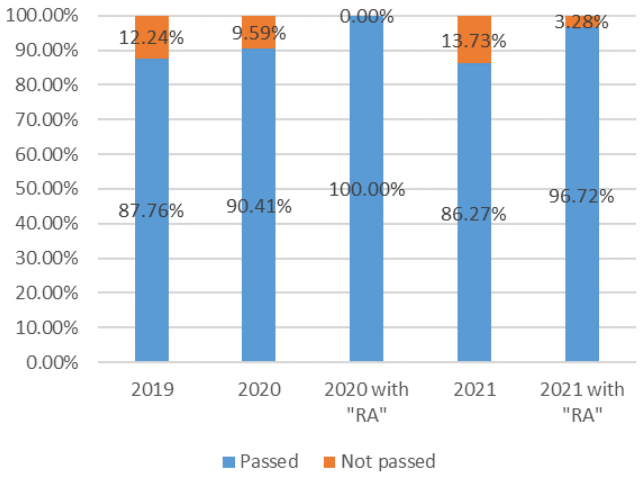

Figure 7. Percentage Rate of Successful vs. Failed Solvers of Credit Exam

As was mentioned, those students who passed the credit exam could continue with the final exam (it means about 86 – 100% of students entering the course at the beginning of the semester). The frequency of use of the LMS Moodle was not influenced by implementing random activities, but as was presented above, they are a good tool to decrease the fail during

the credit exam. That was the purpose for further research, whether participation in random activities influences the final exam results somehow.

As follows from the next figure, participation in random activities helps students to achieve better final results.

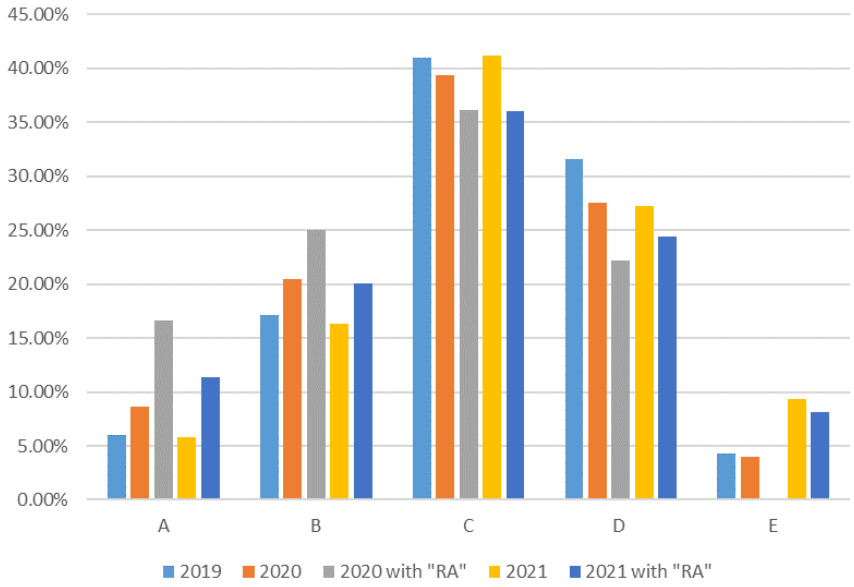

Figure 8. The Percentage Share of Particular Final Grades Including Students with Completed Random Activities

Graduation of the subject has two important outcomes and motivation factors: short-time and long-time. The short-time outcome is represented by the final results achieved by the students, but in their future life, the usability of lessons learned plays a more important role. As follows from Figure 9, students are aware that knowledge and skills learned in the Business Informatics course are important for their future, not only work, life.

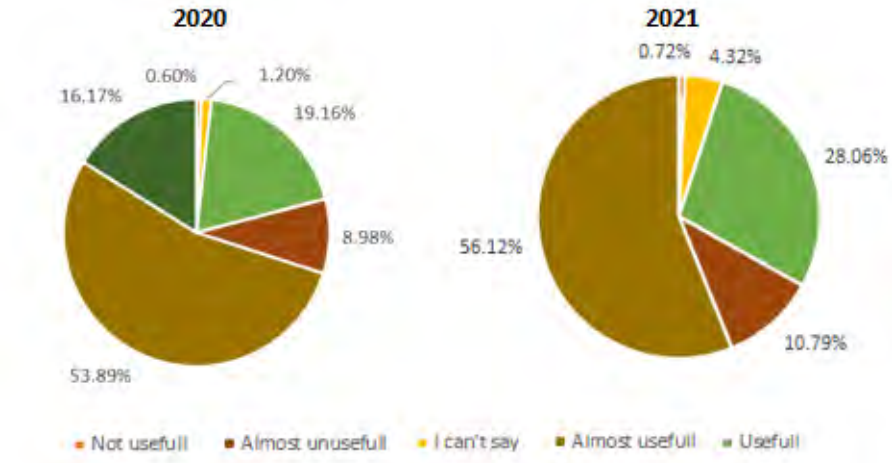

Figure 9. The Percentage Share of Students' Opinion About the Usability of the Subject in Their Future Life

In connection to the practical use of achieved knowledge and skill in the future, we asked students to define the most beneficial topic of the course. As Figure 10 presents, students consider as most important topics, the practical ones – Relation Databases and MS Access and Data Processing in MS Excel. These skills are the part of digital competence framework, that defines the main requirements of the employees in the EU labor market.

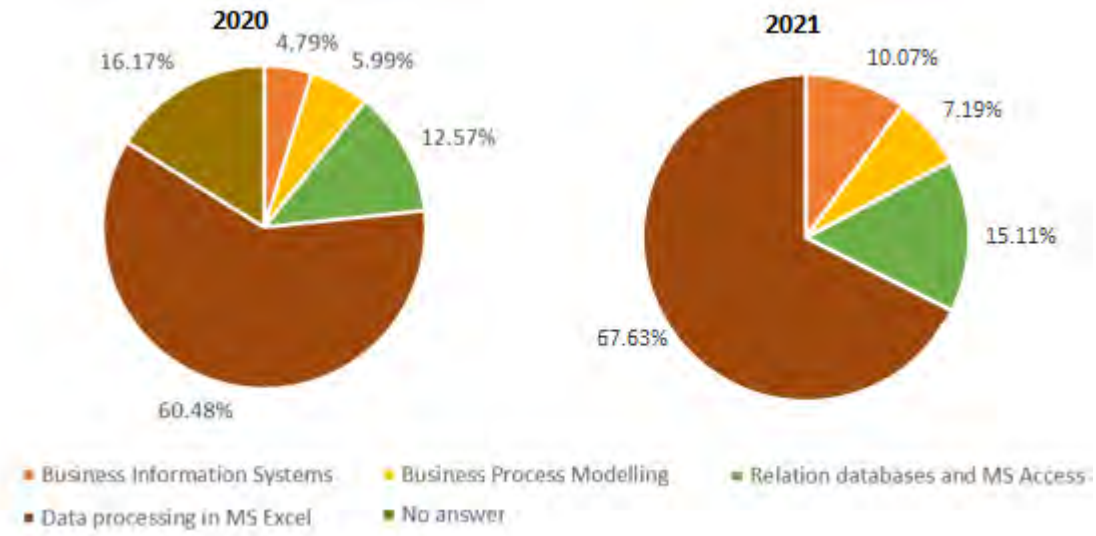

Figure 10. The Most Usable Part of the Course in Future Life

Like every year with the aim of the continuous improvement of the course, students' willingness to recommend the course to their younger colleagues was investigated. As follows from Table 3, the majority of students would recommend the course to their younger colleagues.

Table 3. Willingness to Recommend the Course to Younger Colleagues (Academic Years 2020 and 2021)

Recommendation willingness	**Percentage of respondents**	
	Ac. year 2020	**Ac. year 2021**
Definitely yes	25.00%	21.58%
Probably yes	55.00%	56.83%
Probably no	11.43%	13.67%
Definitely no	4.29%	2.16%
I do not know	4.29%	5.76%

In 2021, we started to intensively use the MS Teams application, which enabled synchronous and interactive contact with students (which is unfortunately not available just via LMS Moodle under our university policy). Its advantage is that students had it installed on their smartphones and therefore had the possibility of setting up notifications for the course's channel. Thus they could react more flexibly to current changes, whether in the organization of the study, or online discussions, etc. Therefore, we integrated several questions into the final questionnaire aimed at using this application. The conducted questionnaire shows that the MS Teams application within the subject was used daily by 19.42% of students. Over 55% of respondents used it more than once a week and irregularly it was used by a total of 25.18% of students. Everyone used the application for at least a week, as they participated in online exercises. Thanks to the support in the form of the shared videos, the majority of students confirmed the usefulness of using the application during the educational process (following picture).

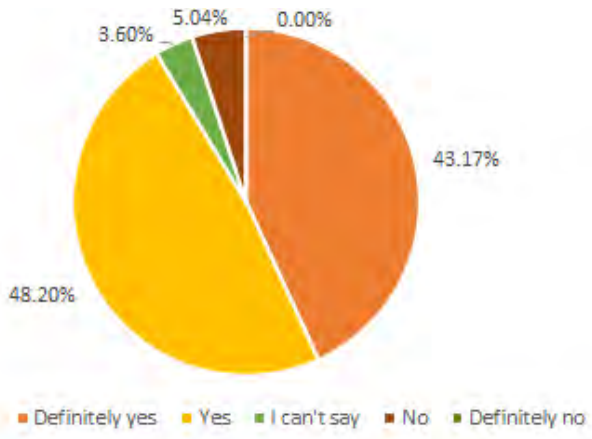

Figure 11. Answers on the Question if Using MS Teams Helped Students' During the Course

Furthermore, the comparison of students' final scores in the course in the two groups of students was conducted in the years 2020 and 2021. The first group was composed of students who experienced gamified part of the course (called random activities) and the second group included students who did not engage in random activities (and therefore did not experience the gamified part of the course). The comparison was performed in IBM SPSS using a non-parametric Mann-Whitney U test as the data were not normally distributed to proceed with the parametric test. Data in both groups were similarly distributed and therefore met the assumptions for the use of the Mann-Whitney U test. Following table 4 contains the results of this comparison in both considered years.

Table 4. Comparison of Students' Final Scores in the Course with Gamified and Non-Gamified Study Experience in 2020 and 2021

	Measure	2020	2021
Non-gamified	N	67	39
	Mean	48.45	51.18
	Median	64.00	62.00
	Std. Deviation	30.558	22.739
Gamified	N	105	132
	Mean	72.70	66.19
	Median	76.00	71.00
	Std. Deviation	17.750	20.747
Test statistics	Mann-Whitney U	1654.500	1404.500
	Wilcoxon W	3865.500	2184.500
	Z	-5.747	-4.308
	Significance (2-tailed)	0.000	0.000
	Effect size	0.194	0.109

Mann-Whitney U test showed that the means of final scores are significantly different between students' groups with non-gamified and gamified study experience in both years. In 2020 the most students (105 from 172) engaged in "random activities", and therefore their study was gamified. This group of students had significantly better results (mean of final score at the level of 72.70) than the group of students not involved in gamified random activities (mean score of 48.45). The effect size of the gamification was expressed as squared Z score divided by the number of students in the group minus one. The gamification of the educational process can explain 19.4% of the difference in the means between two groups of students in 2020.

In the academic year of 2021, even more students (N=139) engaged in random activities resulting in their gamified study experience in the course. Similarly, the group of students with gamified study experience in 2021 had significantly better final scores in the course (mean at 66.19) when compared with the non-gamified study group (mean at the level of 51.18). The effect of gamification in the educational process can explain 10.9% of this difference between these two groups of students in 2021. From these results, it can be deduced that the implementation of the gamification principles into the university course can significantly improve the study results of the students.

Discussion

Innovation of education is not a simple and easy-going process. At present, it covers technological innovation with hand-in-hand content and pedagogical approach innovation. The idea of implementation of gamification into a course is just a small, but important step. As stated by Giang, (2013); Glover (2013), and Guthrie (2014), the gamification of the education process presents a way to provide students with opportunities to act autonomously, display competence, and learn in relationship to others. Using the gaming principle in the education process teacher could motivate to more actively participate the students in the learning process (Dicheva et al., 2015). Our results are in line with the findings of recent studies analyzing the impact of the gamification on education at the higher education level.

There are no general rules or procedures on how to implement the gamification approach into education, it is highly dependent on the age of the participants, learned subject, and the purpose why the gamification of education needs to be implemented (Werbach & Hunter, 2012). While designing the gamification there are different kinds of tools and methods (Kapp, 2012; Zvarych et al., 2019), that are supportive in the education process. Even though gamification seems to be a very attractive and quite good tool for enhancing students' involvement in the education process, it is important to take into account also challenges and potential conflicts described by Fitz-Walter et al. (2011) or Decker and Lawley (2013). Proper implementation of the elements of gamification provides a more interesting way of knowledge transfer.

Our objective was to enhance the motivation of students to participate more actively in the education process with a side goal to help students achieve better learning results. A similar reason for introducing gamification present Zvarych et al. (2019), who decided to implement simulation as a gamification element into their education, because of decreasing of satisfaction of students and motivation of the students in the given field of study. According to the outcomes of Zvarych

et al. (2019), Ryan and Deci (2000), and Borras-Gene et al. (2019), regardless of the topic of the course, the implementation of gamification has the potential to increase the interest and participation of students in the education process.

Since we introduced the first elements of gamification in 2020 and later (based on students' comments in 2021), we supplemented and amended the course with other materials and elements of gamification and the possibility of virtual rooms in MS Teams, we were interested in how these changes will be reflected from different perspectives on the implementation and success of the course. We have identified the following areas which needed to be monitored to be able to rate the success of the gamification process: students' activity rate of using course applications (LMS Moodle, MS Teams), preferred types of study materials and platforms, the impact of the involvement of students in gamified part to their final course results.

In connection with the frequency of using the course platforms, we have achieved approximately the same numbers in the course attendance within the LMS Moodle. –Approximately 36% of students attended the online course daily, 49% attend the course more than once a week and 15% do it even just once a week or less. The same situation is similar also in the preference of study materials. Our students used mainly online video tutorials (89,93%), online practical exercises (76,26%), and online instructions prepared by the teacher (61,15%), but the difference is visible as already presented between the group of students participating and non-participating on the gamified part of the course. Students participating in the gamified part achieved better results, i.e., the difference between these groups of students is approximately 11%. Unfortunately, we did not reach the impressive value of 40% in reaching the new skills after implementing gaming elements as Zichermann and Cunningham (2011). However, we found out that the gamification of our course helped students to achieve better final results than in the case of the non-gamified version. Similar results were presented also in (Laskowski & Badurowicz, 2014).

Conclusion

The field of education is facing enormous challenges through the transformation of society and constant technological development. The innovation of educational systems across the world is inevitable. Teachers have to face the two most important challenges: changes in the labor market and the generational change of the human population. As part of the innovation of education, it is necessary to significantly change the way and content of education towards the constantly changing needs in the labor market. The whole situation is complicated by the fact that educational institutions currently do not know for which future professions they should prepare their students. The number of professions, that students will do for a living, does not exist yet (Smit et al., 2020). It is therefore really difficult to identify the knowledge and skills that will enable students to be successful in this area.

The second change concerns the change of generation, which is currently attending educational institutions. The need for change in the education of digital natives who are just coming to universities is inevitable. It is important to carefully analyze their habits, behavior, preferences, and needs (Lisá & Newman, 2020). The process of education innovation is more complicated because the teachers are representatives of a generation known as digital immigrants (Autry & Berge, 2011; Bilgiç et al., 2016;). This generation must learn to use technology as such and understand their capabilities from a completely different perspective - the perspective of the new generation. As part of the innovation of the educational process, it is necessary to look for opportunities to use the available technologies in a more creative and especially interactive way, which supports the needs of cooperation and socialization of young people (Autry & Berge, 2011; Wang et al., 2013).

The exploitation of gamification helps to create more entertaining and motivating content for the course (Sheth et al., 2012). Besides this, the skills and competencies that cannot be ignored in case of education for future jobs, especially: digital skills, digital navigation skills (what means finding information, prioritizing information, and assessing the quality and reliability of information), followed by communication skills, literacy (e.g., media literacy, digital literacy, reading), critical thinking and judgment, problem-solving, teamwork, personal resilience, and reflection are built at the same time (Grand-Clement et al., 2017).

The gamification of the course content needs to be prepared really in detail. It is important to prepare not only the course and gamification content but also teachers to be able to implement this method properly (Bencsik et al., 2021). Otherwise, the effort of the teacher does not have the expected effect. In this paper, we presented our purposes for the decision on why to implement the gamification principle into the Informatics course and achieved results. The achieved results confirmed that gamification could help increase the level of active participation in the education process and at the same time it could help to improve final results achieved by the students. But it cannot be seen as a miraculous tool that innovates education and rapidly increases the level of activity of university students. Based on the main characteristics of the digital natives, the innovation of the education process needs to be done by using an appropriate mixture of different approaches and tools, i.e., by choosing which every student could find his/her own best learning path. Our pilot test with students participating in gamified course Business Informatics proved our expectations. Despite the activity of all students was not achieved, the analysis of students' final results and their feedback, platform activity data showed us what kind of gamification is interesting for our young generation and positively influenced the final results of

participating students. The pilot testing of the course gamification is not the end, but the first step of the challenge is called education process innovation. Its main objective is to enhance students to participate in their education more actively and prepare them for the future marketplace.

Recommendations

Our results indicate that gamification might improve study experience and also study results of students at the university level of education. At the same time, gamification can also help to partially overcome the barriers to teaching evoked by Coronavirus disease (COVID-19) pandemic prevention measures. Lecturers and educators should try to implement the gamification principles into the educational process of their courses to achieve these positive effects. It would be suitable to verify the obtained results in other countries and other educational fields. Researchers might extend this research as well as use other methods of verifying the impact of gamification in the educational process (e.g., parametric statistical tests, etc.). Furthermore, it might be appropriate to carry out the same research at different educational levels.

Limitations

Our research investigated the way of implementation of gamification into the university course. Its results might not be applicable in all fields of study (other than Business Informatics) or in other ways of delivering the educational experience to the students (non-online education, etc.). Our research design and gathered data allowed us to use only a non-parametric test (Mann-Whitney U test) to verify the effect of gamification on the study results of the students involved. With other research designs and more detailed data gathered the effects of gamification at university education can be investigated from more points of view and into more detail. Furthermore, the various forms of gamification were not tested and their efficiency was not compared with each other. However, these limitations of our research could not be surpassed without an extensive expansion of the article beyond the scope and the range of this contribution.

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Authorship Contribution Statement

Paľová: Conceptualization, design, analysis, writing, editing, drafting manuscript, supervision. Vejačka: Analysis, writing, editing, funding, drafting the manuscript, final approval.

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