ADeAPTIVE

Advanced Design of e-learning Applications
Personalizing Teaching to Improve Virtual Education

O1 (A11-A27)

GAMIFICATION TECHNIQUES AND TOOLS FOR E-LEARNING PLATFORMS

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A11: Development of proficiency evaluation tests applying gamification procedures

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SUMMARY

In this document we present:

- A set of methods and models to help the inclusion of information and communication technologies (ICTs) in transnational programs.
- Based on the nature of the project, the material that we are presenting takes advantage of several adaptive models that automatically react to students' activity.
- These models are optimized for environments where a huge number of very different students (such as those found in transnational programs) are enrolled in the courses or where the distance is a problem for face-to-face activities.
- We present the theoretical background, and the gamification and adaptive techniques included in the model.

1. Introduction

One of the challenges university teachers are facing nowadays is evaluating and teaching students in wide scenarios such as transnational programs within the European Union or even including third parties. In this state, the use of information and communication technologies (ICTs) are becoming extremely relevant [1,2]. It is also necessary to coordinate the classroom activities with distance and autonomous learning, becoming any new learning and teaching paradigm a non-divisible model that must include any activity within the whole learning process [3,4]. In this scenario, developing learning activities that can be easily monitored and give accurate information about students' performance is a task that must be developed carefully. A very good candidate is Computer Adaptive Testing (CAT) because of their ability to adapt the content presented to learners as a function of their responses [5], which is an extremely useful characteristic in this heterogeneous context. CAT has been used previously in a wide variety of subjects such as language [6], identification of learning styles [7] or programming [8]. However, the advantages of using CATs in learning implies also a deep

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knowledge of the theoretical models to correctly calibrate the system [9].

In this context, FRESH START (Horizon 2020, DG Grow) modeled an integration learning path for refugees through entrepreneurship. We have formulated therefore a design challenge: empowering highly-qualified refugees as co-creators of a network of welcome hosts for refugees. Entrepreneurship was defined as either starting up a business, finding your own path in the receiving society and creating value for others/other refugees through social entrepreneurship. The challenge was approached as a wicked problem as defined by Rittel: 'a class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values and where the ramifications in the whole system are thoroughly confusing' [10].

Wicked problems are indeterminate and having filled one set of details of the basic hypothesis leads to the discovery of other aspects of the problem. So far, we have designed solutions following the principles of citizen science, involving academics, agencies of entrepreneurship and integration, educators and refugees themselves in four rounds [11]:

- connect refugees and intermediaries, create fluid time schedules, bolster the refugee/co-designer identity;
- share national entrepreneurship mores, link to language courses, and explain the pedagogical approach;
- organize story-gathering sessions, define location as a sign of respect, and communicate the link to the EntreComp framework, the EU policy on migrant entrepreneurship, the Oxford model of integration levels, Unesco's SDGs;
- open the debate on the differences in work ethics, society's negative perceptions of refugees and society's intercultural vulnerability.

This document deals with the fifth round of aspects that need to be developed to have this network of welcome hosts: empower highly-qualified refugees to become coaches for all refugees into entrepreneurship.

In this document, we present several techniques that will be useful for including information and communication technologies (ICTs) in the classrooms by using different adaptive formats. These formats take advantage of the potential automatization of evaluation and self-evaluation by computers, making them adequate for many different scenarios and potential users. We opted for an online adaptive learning environment because of limited educational resources, an enormous

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diversity in beginner's level, the busy refugee time-schedules but also the expertise in the FRESH START refugee community. Some refugees have a financial background, others were entrepreneurs in their country of origin while others are marketeers, fiscalists, teachers, lawyers, gender experts, journalists, IT-specialists or architects.

In section 2 we describe the course in general terms. In section 3 we describe the gamification techniques that can be included to increase motivation. Later, in task 1.8 we describe the platform where the course will be implemented and section 5 shows the conclusions.

2. Description of the courses

We combined Bloom's taxonomy, Csikszentmihalyi's flow theory and Kapp and O'Driscoll's network learning to create an immersive learning environment.

Kapp and O'Driscoll envision a work/learn culture where learning is perceived as optimizing networks. These learning networks provide context to the content and migrate from productive learning to nurturing generative learning: "enabling human capital to develop ideas and concepts that grow revenue" [12].

Flow is the state of complete absorption when completing a task. You are no longer aware of hunger, thirst nor sleep. Time flies by and you experience a deep sense of joy and satisfaction. To achieve flow, you need intrinsic motivation, a challenging task and the skills to perform it, and an active and engaging task defined by clear factors of success [13].

Bloom's taxonomy categorizes and orders thinking skills. We use Lorin Anderson's revised Bloom's taxonomy starting from remembering, understanding, applying, analyzing, evaluating to creating [14].

Our model looks as shown in figure 1. All four chapters- Well-Being (2), Starting up a business (4), Legal (2) and Financial issues (4)- are defined by challenges per Bloom's category: 6 for remember, 5 for understand, 4 for apply, 3 for analysis, 2 for evaluate and 1 for create (ordered from left to right in figure 1). Per category the questions are organized from facets to the major task which is the number 1 in the model. All learners start from the first chapter of the course, Well-Being, finding their own pitch for the future. From 'apply' onwards learners are asked to find answers between the entrepreneurial culture of their country of origin and of their host country. Thus, we create intrinsic motivation as it is about their own passions within their own contexts.

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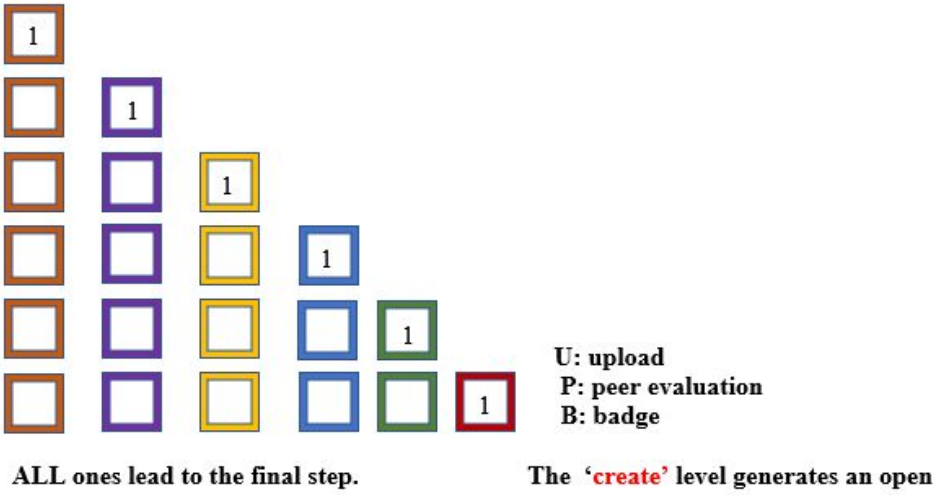

Figure 1: Schematic representation of the course

Learner A starts from the final task (task 1). Should he fail he has to answer two facets of this category before he can get to the next category. If he does not fail, however, he has a fast trajectory from category to category to the final task in 'create'.

Learner B can follow a more linear path building up to the main challenge per category from the bottom up. He does all the tasks moving from the easier questions to the final task (task 1).

In this way, we ensure the tasks are challenging and they have the skills to be doing them.

With the exception of the remember-category, all final tasks involve designing and sharing a file about their own business. These files are given feedback by their peers and by the external experts from the refugee community. Rubrics are given as a link to guide this feedback. As such, the program guarantees active and engaging tasks with clear factors of success.

The continuous feedback from peers and external refugees creates a generative learning culture resulting either in a plan for a future career, a business plan as a social or a traditional entrepreneur.

For each chapter, learners get an open badge but how to validate this and perhaps how this will be appreciated by the community and the host country, will be our next feature of creating a network of welcoming refugees integrating new refugees through entrepreneurship through citizen science.

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3. Applying Gamification

One of our aims is to apply gamification in e-learning platforms, which is a huge improvement in the particular case of the course described in this document. So far, there are rather few accounts on previous efforts to apply gamification in the context of immigrant and refugee integration (see e.g. [15,16]). However, as gamification – especially from the point of view of emotional immersion – has been found to support dialogic learning [17], it can be seen as having significant potential for an entrepreneurship course for refugees.

Gamification refers to using game design elements in non-game contexts [18]. We want to examine the ways in which gamification could respond to certain challenges related to users' behavior when using these platforms, for example in terms of enhancing users' focus on the tasks and the regular use of the e-learning system throughout the course [19].

The use of games and game elements, such as badges, has potential for enhancing learners' motivation, time-on-task as well as timely and careful completion of exercises [20,21]. However, previous research suggests that the meaningful implementation of gamification is a complex process where there is usually no one-size-fits-all solution. Specific game elements can have a different impact on different individuals' motivation and performance (see e.g., [22,23,24]. Furthermore, while a specific game element fulfills a certain function, the overall experience is a result of a complex interplay of these elements [25].

To meet the needs and preferences of different players, a model of player types can be applied. The best known of them is Bartle's (1996) [26] taxonomy that classifies players into "killers", "achievers", "socializers" and "explorers" based on their main motivations and playing styles. Bartle's taxonomy has since been modified and further developed by many researchers. In their meta-synthesis of studies pertaining to the topic, Hamari and Tuunanen [27] identified five prominent dimensions of player orientations: achievement, exploration, sociability, domination, and immersion. Yee [28], on the other hand, has presented a model where the orientations are seen in terms of three main components: achievement, sociability and immersion. Thus, most of these models share the same core concepts, with some variation in their foci.

One of the e-learning platforms developed in the project, and the one to be used in this case, is based on Moodle; the implementation makes use of the standard features of Moodle enhanced with specifically designed gamification elements as shown in the following section.

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We had some specific starting premises regarding the game elements and tasks to be implemented. Firstly, from the pedagogical point of view, the features should aim to encourage the users 1) to focus on the tasks instead of going through them only cursorily and 2) to use the e-learning platform regularly instead of doing most of the work during the final days and weeks of the course. Secondly, they should provide motivating aspects to a heterogeneous group of users and respond to the needs of particular user groups (such as refugees in this case). To this end, building on previous research [29], we adopted a three-component approach to player orientations: achievement (including competition), sociability and immersion (including exploration).

From the FRESH START design days, we know that newly arrived refugees are feeling very lonely and traumatized. They quite often live in the past, processing what has happened to them. Finding a community, recreating their story and developing a possible continuation are signs of 'healing' and their future-readiness – which suggest the importance of the *immersion* aspect. We also experienced that many refugees have a fluid time concept and plenty of obligations. Thirdly, there is no such thing as a beginner's level for refugees. Thus, from the *achievement* point of view, we designed this online learning environment in such a way as to motivate refugees to focus on the tasks and on regular participation while offering a choice so they can personalize their journey to their needs. In terms of the *sociability* aspect, the course asks them quite often to connect to other participants and to involve outsiders. The welcome hosts' role is not only to guide them with the competence tasks but also to start conversations with them.

The gamification approach consists of the elements presented in Table 1. We will examine the effect of the gamified approach both based on the participants' subjective experience and usage data provided by the platform. Regarding the avatar, users cannot continue if they have not answered or uploaded tasks, the Avatar then fades when they have been absent for a while, they can create a sense of belonging and they can select chapters for a tailor-made course. However, if they want to become a welcoming host they need to have all content badges and a special one. Therefore, they need to have worked through all chapters.

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Table 1. Gamification elements of the FRESH START course

Element	Description
Storytelling	The platform has a backstory where participants become the expert-entrepreneur and joins the network of hosts for new refugees. They tell and upload their digital arrival story, their pitch, their marketing strategy, how they will address 'the pains' in the receiving country through social entrepreneurship, their business lean canvas, the reasons why they chose a particular legal and financial constructions. All 'create' activities combined design the personal story of the refugee's integration path. Owning his own story, he can become the coach/wizard for newcomers. From the feedback of the face-to-face participants of the FRESH START course, we learnt that finding your story in the receiving society is bewildering and this step-by-step approach is an intense and much appreciated guide. This element especially taps into the *immersion* and *sociability* orientations.
Avatar	Avatars allow refugees to participate in a personalized mode without having to reveal their identity. They create a starting avatar from their arrival story and further personalize it through their learning trajectory in this learning environment. Other participants can read from the avatar whether a specific participant is a fast tracker or somebody who builds up their knowledge through all steps. The avatar also reveals the special open badge the refugee is aiming at. The avatar especially addresses the achievement orientation (through making progress visible) and the immersion orientation (through the fantasy element).
Task types	Refugees have different backgrounds. Yet most course providers seem to be oblivious to this. From their feedback, we learnt that recognizing their prior expertise is vital for their engagement. Thus, we give participants a choice per chapter. They can either start from the easy questions empowering them to be able to do the final task or they can choose to start with this final task. If they have overestimated their expertise they can go back, answer two questions correctly and start with the final task again. Thus, a lawyer can fast track through the legal chapter doing only the 'create' assignment. Furthermore, at the levels of 'apply', 'analyse' and 'evaluate' participants are required to seek partners to discuss and compare their answers. The collaborative tasks address the *sociability* orientation, and the freedom of choice is expected to motivate especially the *immersion*-oriented participants who want to be able to explore the learning environment.
Points and leaderboards	The leaderboards are motivating in two ways. On a personal level, it allows refugees to keep track of their progress and to make time for the course within their many obligations. On a group level, the progress of one encourages the other to continue. It also helps them to find colleagues who are working on the same chapter so that they can team up for the collaborative tasks. Wizards need to have all five content open badges: well-being, networking, setting up a business, legal forms of a company and financial resources. Points

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	and leaderboards are expected to motivate *achievement*-oriented participants in particular.
Badges	Badges are awarded for a variety of achievements and purposes, catering for *all player orientations*: community builder for those who give a lot of very good peer feedback; innovator for those whose stories show great originality; bridger for those who share an in-depth view of the differences between the receiving countries and countries of origin; adapter for those who found a diverse path from the one in his country of origin. In order to become a wizard, five badges and a special final challenge badge are required.

5. Conclusions

In this document we have described a course, used as an example, that implies students that are very different in origin, education, culture and background. For preparing a course in this scenario, we must include adaptive and gamification techniques in order to be sure that all students fit and are motivated to finish their tasks.

We have described the adaptive model that will be implemented and include tasks based on Bloom's taxonomy: remembering, understanding, applying, analyzing, evaluating to creating. We have also created an environment for including gamification techniques in the course in order to improve users' motivation. Without using adaptive models, we cannot guarantee the correct guidance of this heterogeneous group, and without including gamification, we are in danger of not having a good ratio of students finishing the course.

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A12: development of gamification techniques and tools based on general users' profiles

Contributors: JYU

SUMMARY

This deliverable presents:

- The first iteration of the literature review on gamification. In this first phase (conducted in spring/summer 2018).
- The review focused on identifying the main principles, purposes, techniques and elements relevant to gamification on a general level.
- The results of this iteration were presented to the partners in the second project meeting in Finland in June 2018.

Starting point

The purpose of this deliverable was to facilitate the partners' shared understanding of the possibilities of gamification and to lay the groundwork for the further development and application of the ideas of gamification in the particular context of the ADeAPTIVE project.

Next steps

After this phase, the work continued by gathering specific requirements based on the needs of each partner. These requirements, together with the results of initial pilots with an adaptive evaluation system, served as the basis for a more targeted review, including the development of a suggested model for gamification in the ADeAPTIVE context (see IO1 Deliverables 1.3 and 1.4).

1. METHODOLOGY

The following literature review was conducted in two phases:

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1. General review of the literature about games in education and their motivational aspect.

Keywords: **Digital learning games, e-learning, games and learning, motivational mechanisms, game-based learning.**

2. The review of case studies of the implementation of games or some of their elements (gamification) in educational settings.

Keywords: **Gamification, e-learning, game elements, game mechanisms, learning, player types.**

The studies were searched on the following databases: the University of Jyväskylä library website, Scopus, ResearchGate, SpringerLink and Google Scholar. Altogether 44 documents were selected as relevant and analysed thoroughly. The references of selected documents were also examined. Moreover, some of the documents were chosen for the review and 18 were identified as potentially relevant.

2. INTRODUCTION TO THE REVIEW

In the following document, the review and analysis of the literature regarding educational games, gamification and the utilization of game elements in educational settings will be introduced.

In the first part (Section 4), the findings are related to the different aspects of educational games and gamification with a core concept such as: theoretical underpinnings and related issues; games, learning and an essential role of balance between game design and pedagogy; games, game elements and motivation and, finally yet importantly, adaptivity was also included. The second part (Section 5) is devoted to the game design and specific game elements that were applied in previous studies. The results of the analysis of game elements are presented in the table (see, Table 1)

The Appendix A with description of some of the core studies is also included. It does not provide any conclusions, synthesis or other authors' opinions and thoughts, but it presents the summary of the key points and the main findings from the documents that are considered as relevant and important to the topic. In this part, 21 documents, their main aims and findings are presented.

The summary and conclusions presented in this document are based on the reviewed documents (see references), thus, the results cannot be generalised. However, it does included various studies that were conducted in different times (1981-2018), countries and continents, with different methods (qualitative, quantitative studies, case studies, literature review, systematic literature review and

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some others) and represent diverse perspectives on the games and gamification in educational settings. The biggest amount of research, regarding the discovered topic, was conducted in the latest years (2011-2018, 30 studies), what can be explained with a tendency that innovations and technologies are becoming more affordable and common in educational settings.

Students' needs are transforming together with the development of our world, thus, their learning and education in general should be modified in order to serve students' needs. One of the possible solutions could be the utilization of the combination of educational games and/or game elements with pedagogy in e-learning environments. However, many questions need to be answered in order to employ game elements in educational settings with a positive impact on learning. Making an example, following aspects and critical points need to be considered: side effects that games and games' elements can have on students' learning, their motivation and self-efficacy; the balance between pedagogy and gameplay as well as how to make games or gamified environments adaptive to students' level of development.

We assume that the following literature review will clarify some of the questions and essential aspects related to educational games and identify some critical points for further research.

3. GAMES IN EDUCATIONAL SETTINGS: MAIN ASPECTS AND SOME CRITICAL POINTS

3.1 Theoretical underpinnings and related issues

According to the reviewed documents, some attempts were made towards providing theoretical underpinning for the utilization of games and game elements in educational settings. Notably, in many studies, researchers referred to the theory of flow, where flow can be defined as a state of complete absorption or engagement in an activity and also, refers to the optimal experience, which is a psychological state of complete absorption in the goal-driven activity when nothing else seems to be important (Csikszentmihalyi, 1991). The theory of flow and some of its elements were employed when designing game based environments or discussing games in educational setting in previous research (Kiili, 2005; Kiili, 2007; Huang, 2011). Interestingly, Kiili (2005; 2007) designed an educational game model, in which main game elements were chosen accordingly to the central concepts of the theory of flow as following:

- flow antecedents: focused attention, a clear set of goals, immediate and appropriate feedback,

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potential control, a perception of challenges that are matched to the person's skills, playfulness, speed and ease of use.

According to the theory, the above-mentioned concepts will lead to the flow experience that can be characterized as a state of concentration, a sense of control over activity (Chen et al, 1999), time distortion, and telepresence (Finneran & Zhang, 2003); and, as an outcome, in flow consequences - increased learning (Skadberg & Kimmel, 2004), increased exploratory behaviour (Webster et al., 1993), positive effect, an acceptance of information technology (Ghani, 1991), and perceived behavioral control.

In Finneran & Zhang (2003), some of the main concepts of the theory of flow were analysed and a person–artefact–task (PAT) model of flow antecedents in computer- mediated environments was designed and tested. "The importance of separating the task from the artefact within a computer-mediated environment" was identified (p. 475).

The experiential learning theory was also applied in Kiili, 2005, which includes a combination of gameplay and pedagogy. In accordance with the experiential model, "learning begins with a concrete experience followed by collection of data and reflective observations about that experience" (p.17). The continuous nature of learning and the appropriate feedback are stressed in the model.

Despite some of the attempts towards amplification of the successful utilization of games and theirs elements in educational settings, there is still remaining "the need for integration of educational theories and game design to be able to design meaningful and engaging educational games" (Kiili, 2005, p. 14). Furthermore, crucial role of theoretical background of game-based pedagogy need to be established evidently (Linehan, Kirman, Lawson & Chan, 2011; Hense & Mandl, 2012; Sailer, Hense, Mandl & Klevers, 2013).

Importantly, the objectives need to be stated precisely because "clear objectives are an essential requirement for successful gamification projects" (Morschheuser, Werder, Hamari & Abe, 2017, p. 1300; Urh, Vukovic, Jereb, Pintar, 2015) In addition, Moore-Russo, Wiss and Grabowski (2018) suggested that goal and objectives need to be clear for students and game elements have to be connected to learning goals and content in a clear way with providing some additional explanations if needed. Urh, Vukovic, Jereb, Pintar (2015), added also that rules need to be presented in a very clear way as well. According to previous research, it can help to make learning in game- based environment more meaningful for students and increase their motivation to participate and learn (Morschheuser, Werder, Hamari & Abe, 2017, p. 1300; Urh, Vukovic, Jereb, Pintar, 2015; Moore-Russo, Wiss and Grabowski, 2018).

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3.2 Games, learning and an essential role of balance between game design and pedagogy

According to previous research, game-based pedagogy has a potential to influence learning and teaching positively (Nousiainen, Vesisenaho, Eskelinen, 2015). Moreover, it was assumed that proper integration of gamification in the field of e-learning into higher education can enhance education and learning processes by increasing satisfaction, motivation and greater engagement of students. Gamification can be used as a tool to increase the efficiency, effectiveness, motivation and engagement of students in e-learning (Urh, Vukovic, Jereb, Pintar, 2015). Interestingly, when discussing the possibilities to raise engagement in e-learning through gamification, Muntean (2011) made an assumption that "any application, task, process or context can theoretically be gamified" (p. 323). Nevertheless, as it was highlighted in some other studies, the balance between game design and pedagogy is crucial to the successful result, learning process and outcomes for students (Kiili, 2005; Kiili, 2007; Huang, 2011). When designing game-based learning environment (GBLE), the limitation of the processing capacity of working memory needs to be taken into consideration, otherwise, the cognitive overload can be caused and affect learning process as well as participant's emotions and motivation (Huang, 2011; Kirschner, P.A. 2002).

The balance between game design, pedagogy and education goals is extremely important, but, in the research, explanations and suggestions how it can be achieved were not clearly identified. Thus there is a need for further investigations.

3.3 Games, game elements and motivation

Games and game elements are considered as "intrinsically motivating" (Linehan et al., 2011, p. 1981). Therefore, one of the aim followed by usage of games or game elements (gamification) is often to enhance students' motivation, which is considered as a key predictor of successful educational outcome (Malone, 1981; 1987; Linehan, Kirman, Lawson & Chan, 2011). In previous studies, positive effects of game based instructional programs on learning and motivation were also noticed (Whitehall & McDonald, 1993; Ricci, Salas, & Cannon-Bowers, 1996; Hense & Mandl, 2012).

Malone (1981) concluded that challenge, curiosity and fantasy are the primary factors that have an effect on students intrinsic motivation (Malone, 1981). Games could also have an effect on enhancing students interest (intrinsic motivation) in subject matter (Druckman, 1995) and "appear to offer the potential to improve learner motivation, time-on-task and, consequently, learning outcomes" (Linehan et al., 2011, p. 1979). However, it was also highlighted that even though "single elements can help to enhance certain feelings, like feelings of competence", game elements need to be considered as a complexity because "emotions rather refer to an experience, the player undergoes within

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gamification" (Sailer, Hense, Mandl & Klevers, 2013, p.35).

When utilising games with an aim to increase students motivation, it is important to pay attention to game design and objectives as well as remember that not everything that "is called a game, or looks like a game, will have those motivating qualities" (Linehan et al., 2011, p. 1981). In addition, more empirical evidence is needed to confirm some of the theoretical underpinning and assumptions. Although some explanations were provided about motivational aspects of games and game elements as well as some mechanisms that can have an effect on students' motivation, the empirical evidences is limited and can not be generalised.

3.4 Adaptivity

In the research, it was highlighted that, in order to fulfil students' need and increase motivation, the gamified platforms or educational games should be adaptive and well balanced so that the main determining factor for the success of a player is the player's skill level" (Kiili, 2005, p. 17). The provided challenges and tasks need to be matched according to students' skills level (Kiili, 2005, p. 16), otherwise, if challenge is significantly higher than skill level, it may cause the feeling of anxiety and if challenge is lower - boredom (Kiili, 2005, p. 16). Therefore, "while a player's skills level increases the challenges also should become more difficult" (Kiili, 2005, p. 16).

Adaptivity is very important, but at the same time complex and challenging to ensure. Some effort was put into the investigation of core actions that can help to implement adaptivity in game-based learning environment. It was suggested that, for example, adaptability (which was also considered as adaptivity) can be achieved by constant monitoring and data collection about students and their activities during the process of e-learning. Moreover, "adequate data provide a basis for analysing and adapting e-learning to achieve optimal state of the entire system" (Urh, Vukovic, Jereb, Pintar, 2015, p. 395). Accordingly to Iosup, Epema, 2014 "using short end-of- lecture quizzes and continuously asking for student feedback can provide meaningful information for gaming analytics" (Iosup, Epema, 2014, p.) and, probably, for adapting system, balancing challenges and providing support accordingly to students skills development.

One of the possibilities to make a gamified learning platform adaptive could be also attached to the system algorithm/scenario that will guide students learning by providing additional supportive materials and opportunities to expand knowledge. An example of such system can be found in Hwang, Wu, Cheng (2012), which included the following scenario: if students faced difficulties in answering questions or failed to answer it correctly, they were guided to search (link to Google was embedded) for additional or needed information on the web; if students were not able to answer the

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questions for a second time, "the learning system will show them the correct answer and the link to access the related supplementary materials" (Hwang, Wu, Cheng 2012, p. 1248).

Similar ideas were also implemented in Sung & Hwang (2013), where the storyline is a kind of scenario that need to be followed by students and will allow them to collect the information needed to develop the repertory grid collaboratively (See, Table 1, pp. 6-10) via discussing with their peers. In case, students fail in passing the test, the system (the fairy) will give them some hints or illustrative examples.

The following scenario as well as students' motivation to search for the information can be also enhanced by utilizing achievement badges or some other reward systems (See, Table 1).

Based on the conducted literature review, it seems that games and game elements can be considered as valuable teaching tools, but the empirical evidence are limited. As it was concluded by Linehan et al., 2011, particularly, it needs to be confirmed that learning outcomes gained in a game-based environment are "reliable, valid and long lasting".

Effective learning environments provide a student with engaging, personally meaningful problems; allow learners to construct their knowledge based on existing one, "they are social experiences that blur boundaries between student and teacher", and constant assessment of the learning process that enables "the learning environment and the students themselves to make adjustments" (Bransford, 2000 in DiGiano, Goldman & Chorost, 2009, p.3).

4. GAME ELEMENTS AND MECHANISMS

The design of games or game-based learning environments is a complex process, where "the target group", "the gamification environment itself", "the context", "motivational power of games" and the impact on "enhancing learning in schools and training" are relevant and need to be considered when analyzing or designing game based or gamified environments (Sailer, Hense, Mandl & Klevers, 2013, p.36).

Some researchers attempted to build lists of the main game elements that can be applied in game designing/gamification (Robinson, 2013; Werbach, & Hunter, 2012; Kapp, 2012; Zichermann, & Cunningham, 2011; Sailer, Hense, Mandl, & Klevers, 2013), others created models for designing game-based or gamified learning environment. The models have different focuses and elements, for instance, Urh, Vukovic, Jereb, Pintar (2015) created a model that includes the main elements and concepts that need to be taken into consideration when designing gamified learning system. Among those elements are:

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- **management of e-learning** - *organizing, planning, staffing, leading and controlling;*

- **important factors in e-learning** - *pedagogical, technological, design, administration, human, learning material, financial, gamification;*

- **elements of user experience** - *project management, user research, usability evaluation, information architecture, user interface design, interaction design, visual design, content strategy, accessibility, web analytics;*

- **phases of development** - *analysis, planning, development, implementation and evaluation;*

- **game mechanics** - *points, levels, badges, achievements, virtual goods, leaderboards, and virtual gifts...;*

- **game dynamics** - *rewards, status, competition, self expression, competition, altruism...*

- **gamification elements in e-learning** - *rule-based system, clear and meaningful goals, small tasks, immediate feedback, positive reinforcements, rewards for accomplishing the tasks, measurable progressive challenge, story behind, voluntary participation;*

- **and, their effects on students** - *motivation, engagement, satisfaction, effectiveness, efficiency, experience, knowledge, acquisition, state of 'flow'.*

More detailed description is provided in the Appendix A.

Based on reviewed studies, the main game elements, mechanisms key critical aspects were identified and are presented in the following list:

Game element Description Impact (theory- influenced categorization)

Feedback Immediate feedback;

Appropriate feedback: "good performance should be rewarded also the progress of not so good players should be somehow supported in order to ensure that they can catch up to better players and complete the game" (Kiili, 2005, p. 16). The utilization of haptic feedback in learning materials-> more realistic experiences and positive impact.

Positive feedback: was identified as a foundation of gamification that "raises the users' self esteem and motivation" (Urh, Vukovic, Jereb, Pintar, 2015, p. 395).

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Instant feedback messages (Domínguez, Sáenz-de-Navarre, de- Marcos, Fernández-Sanz, Pagés, & Martínez-Herráiz, 2013).

The feedback loops were recognised as an important element because they influence users behaviour and the effectiveness of gamification.

The feedback loops involve:

- measuring behavior -> relating it to other behaviors or norms (relevance) ->"illuminating the path ahead" (consequence) and -> action. Scores are "quantitative evaluations of behavior in a game" and "play an essential role in the second stage of this loop" (Scheider, Raubal, Kiefer, Sailer & Weiser, 2015, Introduction, para.1).

Achievements "a virtual or physical representation of having accomplished something" (different levels and scales);

● **Points** - the demonstration of users' achievements;

●**Badges**- "a more robust version of points and a visual representation of some accomplishment/achievement of the user in the system" (Tomé Klock, da Cunha, de Reward, Motivation (extrinsic), self- efficacy.

But, can have different focus Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini, 2015, p. 598);

● **Coins** - some coins are given when registering, but students also can earn more coins by each successful action on choosing correct variable or principle or upon completion of each stag, coins allowed students to buy hints (using hint feature cautiously); losing some coins if using hit and trial method while selecting the correct variable;

● **Badges & trophies** - reward elements for doing exercises; various badges and trophies that highlight different achievements of the students (e.g., levels - Gold, Silver & Bronze; and, some others - Beginner badge (completing first task) and Regular Visitor.

● **Levels** - achieving higher level upon completion of successful attempts in solving each problem (aimed to retain the student engaging with the system in long term);

● **Experience** - gaining experience value for each activity regardless level of activity or success of the activity (aimed to remain motivated emotionally even if students make any wrong attempts which cost those coins or score); (Rasool, Zeeshan Rasool, Nurul F. Mohd Noor, Mohd Nizam Ayub,

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Hannyzzura Affal, 2014)

Levels -> When students collect all the data about plants and complete a test, they can go to the next level (Sung, & Hwang, 2013)

● **Levels** - progress within the system (game level, difficulties level and player levels)(Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini, 2015)

Scores: Different activities/behaviour and their qualities can be chosen to be scored and, thus, it will be stressed then.

The algorithm of designing scores:

1. Choose activity or behaviour and enhance for example: motivation, knowledge construction, reflections, time management, carefulness). Depending on what is or what kind of actions are rewarded.

2. Choose quality that will be scored 3. The quality "need to be evaluated with respect to goals which turns qualities into criteria" that "can be used to obtain scores, i.e., evaluations of behavior" (Scheider, Raubal, Kiefer, Sailer & Weiser, 2015, Score construction, para 1). Scores are "quantitative evaluations of behavior in a game" and "play an essential role in the second stage of this loop" (Scheider, Raubal, Kiefer, Sailer & Weiser, 2015, Introduction, para.1).

Visualisation of progression

Status, Motivation (extrinsic), self- efficacy

Storyline/ Storytelling/ Narrative

● **Rankings** - visualization of the progression; (Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini, 2015)

● **Dashboard** - shows the current progress and status of the achievements in terms of badges and trophies won, the leaderboard (ranking) is also visible.

● **Progress meter** - shows updated status after the student successfully completes each stage.

● **Leaderboard** promotes competition among students;the results of the top students are shown in the system (Score, Levels, Experience, Number of Badges and highest trophies) (Zeeshan Rasool,

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Nurul F. Mohd Noor, Mohd Nizam Ayub, Hannyzzura Affal, 2014) "the story integrates the challenges into a larger task or a Interest - problem"; "the game can be divided to interactive gameplay Motivation events and to the non-interactive story events where the game (intrinsic) designer tells the player important things about subject matter without player having to do anything" (Kiili, 2005, p. 17).

"Ongoing storyline" which allows the transmission of information, the guidance of the users and creating interactive experiences to engage users (Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini, 2015, p. 597);

Storytelling was also included as a motivational tool in the game design: an ancient kingdom in which the people are infected by poisoned water in a river ..., plants are the key to curing people. The storyline is a kind of scenario that needs to be followed by students and will allow them to collect the information needed to develop the repertory grid collaboratively via discussing with their peers (Sung, & Hwang, 2013).

Game play

Playfulness "one or more causally linked series of challenges in a simulated "Entertainment environment" (Kiili, 2005, p. 16); "graphics and sounds entice the Motivation player but the gameplay keeps him or her there" (Kiili, 2005, p. 21). "opportunities to play, exploration, and collaboration toward novel goals" has a potential "to capture the imagination of students and inspire them intrinsically"; in addition, that can be also achieved by including "inserting elements of randomness, integrating a narrative, allowing students the freedom to fail, and integrating authentic opportunities for practicing skills" (Moore- Russo, Wiss and Grabowski, 2018, p. 4).

Rules "games have rules that place the 'play' in context; they are typically thematic and goal-orientated" (Aynsley, Nathawat & Crawford, 2018, p.70); limiting user actions, turning the system manageable (Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini, 2015); Clear understanding; easy to use, Motivation and knowledge construction

Reflection "personal synthesis or appropriation of knowledge, validation of hypothesis laid during playing strategy formation or a new strategy to be tested" (Kiili, 2007, p. 397). Reflection can be facilitated, for example, with conversation tools, intelligent tutorials and computer-based tutors a lack of time to reflect on learning during and after engaging in gamified platform/system can create a negative or conflicting attitudes towards game-inspired instructions (Moore-Russo, Wiss and Grabowski, 2018); Knowledge construction and motivation

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Loops of Engagement

"creating and maintaining motivating emotions that contribute to Motivation, the user to keep motivated and engaged in using the system" socialisation and (Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline possibly, Anton, Gasparini, 2015, p. 598);

reflection – knowledge construction

Customization possibility to transform or personalize items according to user's preferences (by himself); "can promote motivation, engagement, sense of ownership and control over the system" (Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini, 2015, p. 598); however, the amount of items available to custom needs to be balanced;

Control, ownership, motivation

Virtual goods "elements present in the system to enable self-expression, where the user can use the points earned to customize the game in general" (Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini, 2015, p. 598).

Motivation, interaction with others

Goals "External goals need to be associated with user goals in order to facilitate internalizing externally promoted behavior [6] and, furthermore, to assure usability" (Scheider, Raubal, Kiefer, Sailer & Weiser, 2015, Score construction, para 2).

Some important elements and aspects that need to be taken into consideration when designing game-based learning environments.

Collaborative knowledge construction

Collaborative reflection: Repertory grid method, which is Knowledge originated from the Personal Construct Theory proposed by Kelly construction, (1955), was "adopted to serve as a collaborative knowledge socialisation, construction tool of a game-based learning activity"(Sung, & motivation Hwang, 2013, p.45).

- "The significantly better score of the experimental group than that of control groups A and B suggests that the collaborative educational computer game with repertory grid approach has improved the learning attitudes of students toward science" (Sung, & Hwang, 2013, p.48);

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● "the collaborative game-based learning with repertory grid approach had a significant impact on improving the students' learning motivation in the natural science course" (Sung, & Hwang, 2013, p. 49);

● for the experimental group, "the collaborative educational computer game with the repertory grid enhanced the students' self-efficacy of using computers to learn, and their confidence in and expectations of learning collaboratively with their peers" (Sung, & Hwang, 2013, p. 48).

Integration

● of novices through entering and getting involved into the system;

Motivation

Optimizing cognitive load

Knowledge construction

Game balance and game design

"the working memory capacity limits the amount of information that can be processed in each channel at one time" (Kiili, 2005, p. 21); "cognitive load should be optimized in games by cutting down irrelevant multimedia elements, applying modality effect, providing usable user interface and challenges that support

"the working memory capacity limits the amount of information that can be processed in each channel at one time" (Kiili, 2005, p. 21); "cognitive load should be optimized in games by cutting down irrelevant multimedia elements, applying modality effect, providing usable user interface and challenges that support knowledge construction" (Kiili, 2005, p.21-22); "educational games, especially, should be balanced so that the main determining factor for the success of a player is the player's skill level"; game design and educational goals need to be balanced as well (Kiili, 2005, p. 18). game elements have to be connected to learning goals and content in a clear way for students; some additional explanations can be also provided (Moore-Russo, Wiss and Grabowski (2018). One of the pitfalls can also be that there are no real differences between physical learning environment and e-learning gamified environment. For instance, earning points on a leaderboard can be considered as similar to the grading system in the classroom (Moore-Russo, Wiss and Grabowski, 2018).

Adaptivity Matches between provided challenge and skills level: if challenge is significantly higher than skill level -> feeling of anxiety; if challenge is lower -> boredom; "while a player's skills level

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increases the challenges also should become more difficult" (Kiili, 2005, p. 16).

A scenario or algorithm that provided supportive materials and enhanced learning: a link to a search engine (i.e., Google search) (Hwang, Wu, Cheng (2012) In case, students fail in passing the test, the system (the fairy) will give them some hints or illustrative examples (Sung, & Hwang, 2013).

Motivation, knowledge construction Feedback was mentioned in the majority of the documents. In some documents the role of feedback as well as methods how it can be provided were given. In Kiili (2007), it was specified that "one of the role of the feedback that "game provides from a player's actions" is to support reflective thinking and knowledge construction by focusing a player's attention to relevant information from the learning point of view" (Kiili, 2007, p. 397). The role of reflection for knowledge construction was specifically highlighted in the document. According to the results of the study, **"the fast tempo of the game did not provide enough time for the team to reflect the consequences of their actions** (Kiili, 2007, p. 400), therefore, the meaning of time should be simulated in such a manner that it does not constrain players' reflective thinking" (Kiili, 2007, p. 400).

Urh, Vukovic, Jereb, Pintar (2015) suggested to make the progress and current status of students' activities clear and graphically displayed. Additionally, it was assumed that t**he division of the main objectives into several smaller ones could make the learning process easier and smoother** (Urh et al., 2015).

Achievements were also commonly used. Fitz-Walter, Tjondronegoro & Wyeth (2011) suggested that "the goals of the achievements" has to be aligned with "the goals of the game elements", when "the aim of the achievements is to support the goals of the application" (p. 3).

Badges that are rewarded for students' achievements were also actively applied and tested in some studies (Hakulinen, Auvinen, & Korhone, 2013) and were very popular among students (Iosup, Epema, 2014). According to Hakulinen et al. (2013), achievement badges had a significant impact on some aspects of students' behavior, and a small group of students was especially motivated to pursue them. However, the side effects that badges could have on the learning process were identified, for instance, that **students' attention can be switched from learning goals and content to achievement badges.** Thus, more research is needed **"in balancing the achievement criteria so that they maximize beneficial learning practices while minimizing harmful side effects"** (Hakulinen et al., 2013, p. 48).

Amory, Naicker, Vincent, & Adams (1999) tested 20 existing games and found out that graphics, sound and story line were identified by students as important aspects and perceived skills such as

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visualisation, logic and memory as important skills required to play adventure games. In the document it was concluded that those elements "are integral to adventure games and are also required during the learning process" (Amory, Naicker, Vincent, & Adams, 1999, p. 311).

Burguillo (2010) applied the Competition Based Learning methodology, in which the concepts of "friendly competitions among students" (p. 575) using extra points as a reward but not as punishments was one of the core component. According to the findings, the following advantages of the competitive approach were discovered: "interactivity, collaborative work inside the group, active participation, challenge versus duties, and motivation for the students to explore their own topics, on mathematics and artificial intelligence techniques, to support the challenges" (Burguillo, 2010, p. 575). Deterding, Dixon, Khaled & Nacke (2011) recognised that gamefulness (i.e. the experiential and behavioral quality), gameful interactions (artifacts affording that quality) and, gameful design (designing for gamefulness, typically by using game design elements) are important aspects of gamification.

In Wood, Teräs, Reiners, Gregory (2013), some of the very specific game elements that were used in VR environments were analysed, such as: rewind and ghost images; save points, the control of time and space; replay. However, due to the specific focus they were not included in the list, but are presented in the Appendix A with the description of analysed case studies.

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APPENDIX A: GAME ELEMENTS & GAMIFICATION

Some of the core studies are presented in this part.

1. In Kiili (2005), the theory of flow was applied with an aim to increase learning. It was assumed that the following are key concepts of flow antecedents: **focused attention, a clear set of goals, immediate and appropriate feedback, potential control** (Finneran & Zhang)**, a perception of challenges that are matched to the person's skills, playfulness, speed and ease of use.**

It was assumed that those key concepts will result in flow experience, which can be characterized as a state of **concentration, a sense of control over activity** (Chen et al, 1999), **time distortion, and telepresence** (Finneran & Zhang, 2003); and, as an outcome, in flow consequences - **increased learning** (Skadberg & Kimmel, 2004), **increased exploratory behaviour** (Webster et al., 1993), positive effect, an acceptance of information technology (Ghani, 1991), and perceived behavioral control. Thus, appropriate actions and tools need to be used with an aim to create a flow antecedents.

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Game elements: **The appropriate feedback, continuous nature of learning and storytelling** were especially stressed and used in the model. They were also underpinned with theoretical background (the theory of flow, the pearson-artefact- task model, experiential learning theory (i.e. possibilities to creatively test hypotheses and reflect on outcomes) and ZPD (Vygotsky, 1962).

The game balance and the optimization of cognitive load were also considered as a very important aspects.

The descriptions and explanation of the main elements and key suggestions used in the research:

Adaptivity: Matches between provided challenge and skills level: if challenge is significantly higher than skill level -> feeling of anxiety; if challenge is lower -> boredom; "while a player's skills level increases the challenges also should become more difficult" (Kiili, 2005, p. 16).

Storytelling: "the story integrates the challenges into a larger task or a problem"; "the game can be divided to interactive gameplay events and to the non-interactive story events where the game designer tells the player important things about subject matter without player having to do anything" (Kiili, 2005, p. 17).

Appropriate feedback: "good performance should be rewarded also the progress of not so good players should be somehow supported in order to ensure that they can catch up to better players and complete the game" (Kiili, 2005, p. 16). The utilization of haptic feedback in learning materials-> more realistic experiences and positive impact.

Game balance: "educational games, especially, should be balanced so that the main determining factor for the success of a player is the player's skill level"(Kiili, 2005, p. 18).

Game play: "one or more causally linked series of challenges in a simulated environment" (Kiili, 2005, p. 16); "graphics and sounds entice the player but the gameplay keeps him or her there" (p. 21).

Optimizing cognitive load: "the working memory capacity limits the amount of information that can be processed in each channel at one time" ((Kiili, 2005, p. 21); "cognitive load should be optimized in games by cutting down irrelevant multimedia elements, applying modality effect, providing usable user interface and challenges that support knowledge construction" (p.21-22).

2. The above model was tested in Kiili (2007) and applied with the existing simulation game Realgame (Lainema, 2004).

Target group: University students, School of Economics.

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Key findings:

- students had positive experienced, but mentioned that challenge was not complicated enough; - **"The fast tempo of the game did not provide enough time for the team to reflect the consequences of their actions (p. 400), therefore,"the meaning of time should be simulated in such a manner that it does not constrain players' reflective thinking"** (p. 400); Moreover, according to Edwards (2004) reflections and actions have more positive effect on learning then trials and errors. - "Authenticity, collaboration and learning by doing were found to be most important characteristics of effective educational games" (p.402).

The descriptions and explanation of the main elements and key suggestions used in the research:

Feedback: "The feedback that the game provides from a player's actions should support reflective thinking and knowledge construction by focusing a player's attention to relevant information from the learning point of view" (p. 397).

Reflection and it possible outcomes:"personal synthesis or appropriation of knowledge, validation of hypothesis laid during playing strategy formation or a new strategy to be tested" (p. 397). Reflection can be facilitated, for example, with conversation tools, intelligent tutorials and computer-based tutors.

3. In Hwang, Wu, Cheng (2012), an online multiplayer board game was developed (5th and 6th grades 50 students, natural sciences course).

The flow antecedents (the theory of flow) was included in the theoretical background of the study and explained as: "High flow antecedent indicates that the developed game provides clear goals, unambiguous feedback and a good sense of control that meet most of the students' knowledge levels and computer skills, and hence the students are able to realize the challenges they need to face, focus on the learning objectives, and feel the playability, enjoyment and attraction of the game (p. 1252).

The game included:

- a board game interface,
- a learning management mechanism,
- a gaming mechanism,

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● and, **a link to a search engine (i.e., Google search) -> supported learning.**

The game was aimed to "to guide the students to complete the web-based problem- solving tasks" but, it also included the set of embedded mini-games, which were "designed to help the students learn in depth or link what they have found on the web to the learning content", thus, construct their knowledge (p. 1248).

The mini games (e.g., jigsaw puzzle, matching game or shooting game) included supplementary materials.

One of the scenarios and mechanisms that was applied: When the students correctly answer a question or play a mini-game in the set time, their personal gaming scores increase. But, **when the students fail to correctly answer a question, the learning system guides the students to search for relevant information on the web. If the students fail to correctly answer the questions a second time, the learning system will show them the correct answer and the link to access the related supplementary materials"** (p. 1248).

The implementation was successful and findings were positive.

4. Aynsley, Nathawat & Crawford (2018)

A physical card-based, role-playing team game called 'Braincept' was designed and tested.

Target group: University students, Medical Sciences

The game design and mechanism were not explained precisely in the document.

But, some of the used concepts are interesting:

- "games have rules that place the 'play' in context; they are typically thematic and goal-orientated" (p.70);

- the game "has not been designed to be restricted to one type of teaching session", which, according to authors, "is a strength of good game design when used in higher education" (p. 77).

5. Wood, Teräs, Reiners, Gregory (2013)

Some of the game mechanisms were reviewed in the study, a very practical and detailed information was provided in the document. The focus of the study was on **VR environments**.

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Mechanisms that were analysed:

Rewind and ghost images - can enhance learning by giving a possibility to draw on past experience and analyse the reasons and/or causes of failing or not completing tasks.

Save points - preventing repetition of understood steps.

The control of time and space provides an opportunity to skip some of the long-lasting tasks or actions that are not necessary.

The rewind - gives the the freedom to experiment with new approaches to established problems and at the same time creates a safe environment where failing is not punished (students can rewind and start from the same point).

Replay - "enables learners to gain insight, attempt to solve problems using new methods, and learn from past mistakes in a rapid, iterative process".

Some possibilities **to facilitate "rewind"** were also identified as following: providing a "**feedback**; e.g., by marking potential steps (i.e., mistakes) or showing statistics relating to where rewind was initiated".

The possibility **to record "rewind"** was identified as a benefit because it "can be used later for different kinds of **assessment** (e.g., self-, peer-, or teacher-based) and eventually to improve the learning tasks.

Ghost functions were also analysed and defined as "an on-the-fly replay option where a pre-recorded attempt is overlaid on the environment", they allow to observe what happened and was going on at the same time. That possibility can be connected to "self-based learning building on past performance" and may also have a positive influence on the learning process and, as a consequence, outcomes.

The mechanisms that allow students to redo or restart a task from a specific point or step can be connected to experiential learning that enhance exploring/discovering and knowledge constructing and gives to the learners more chances to succeed as well as achieve their learning goals and feel less anxious.

Assessment:

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● **ghost images** - reflections on learning;

● **save points and multiply lifes** - enable an assessment to be undertaken multiple times in a process of self-assessment or peer-assessment;

● **slow motion** - provide with opportunities "to analyse particular moments in detail and is useful in conjunction with rewinds and save points to support investigation of challenging scenarios to improve comprehension of complex or rapid interactions";

● **time and space control** - observing and reflecting.

In the document, a scenario-based foundation support was mentioned -> " The foundation is provided by the use of scenarios that can be created in a virtual environment with a range of game-based elements incorporated to support learners".

6. Urh, Vukovic, Jereb, Pintar (2015)

The model that includes the core aspects that need to be considered when designing gamified project or learning environment was presented in the document (but, it was not tested).

The following elements were included in the model (p. 392), they were also deeply explained in the document (pp. 391-395):

● **management of e-learning** - *organizing, planning, staffing, leading and controlling;*

● **important factors in e-learning** - *pedagogical, technological, design, administration, human, learning material, financial, gamification;*

● **elements of user experience** - *project management, user research, usability evaluation, information architecture, user interface design, interaction design, visual design, content strategy, accessibility, web analytics;*

● **phases of development** - *analysis, planning, development, implementation and evaluation;*

● **game mechanics** - *points, levels, badges, achievements, virtual goods, leaderboards, and virtual gifts...;*

● **game dynamics** - *rewards, status, competition, self expression, competition, altruism...*

● **gamification elements in e-learning** - *rule-based system, clear and meaningful goals, small tasks,*

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immediate feedback, positive reinforcements, rewards for accomplishing the tasks, measurable progressive challenge, story behind, voluntary participation;

● and, their **effects on students -** *motivation, engagement, satisfaction, effectiveness, efficiency, experience, knowledge, acquisition, state of 'flow'.*

Some important factors in e-learning were also discussed. Among them are (p. 392- 393):

● *pedagogy - the method and practise of teaching;*

● *technology - the basic infrastructure that enables the implementation of e- learning;*

● *administration - e.g. by using Learning Management Systems (LMS);*

● *people - important to know users' characteristics and their needs;*

● *learning materials - "should be properly designed in terms of content and didactics" (p. 393);*

● *and, finance.*

It was highlighted that:

● the objectives of e-learning;

● rules,

● guidelines,

● time frames,

● requirements and limitations of e-learning as well must be presented clearly and precisely.

Figure: Urh, Vukovic, Jereb, Pintar, 2015, p. 392.

It was also suggested to make the progress and current status of students' activities clear and graphically displayed.

Additionally, it was suggested that **the division of the main objectives into several smaller ones could make learning process easier and smoother.**

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Positive feedback: was identified as a foundation of gamification that "raises the users' self esteem and motivation" (p. 395).

7. Iosup, Epema (2014)

Some of the gamification techniques were applied in some of the European Universities. (over 450 students participated) in physical environment (some e- learning elements were used).

The following tools were identified and applied in the course:

3 core mechanics:

- Point systems;
- Level, access, and power;
- Leaderboards.

4 core dynamics:

- Badges and other status displays;
- Onboarding (bringing novices);
- Social engagement loops;
- Unlocking content.

Applied gamification tools were based on players classes Players classes (by Bartle, 2003).

- **explorers** are curious and try to understand the word; designing courses for this type can be challenging because " students are interested in both the quality and the quantity of the material";
- **achievers** enjoy achieving goals and completing challenges, can be described as "ambitious, high achieving students, who would strive not only to pass the course, but also to achieve at least a grade of 80%";
- **socializers** mostly value socialisation with other players and past the course if they have the opportunity to be part of the same social circle;

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● **winners** (killers in Bartle's taxonomy) value competition and completing challenge at the expense of other players; challenge is good for them if it can only have one winner; "winners may be self-destructive, in that competitiveness may push them into burn-out, depression, or boredom".

Some of the key findings:

- students were motivated and their satisfaction was increased; - "more students thought more carefully about the course due to gamification (over 90%) than felt more motivated by gamification (only 50%–75%)";

- over 90% of the respondents enjoyed the interactive part of the lectures and enjoyed the exercises at the end of the lectures;

From teachers' perspectives:

- it was difficult to explain practical aspects of gamification to students; - also, it was concluded that "using short end-of-lecture quizzes and continuously asking for student feedback can provide meaningful information for gaming analytics";

Performance-related badges were very popular among students.

8. Hakulinen, Auvinen, & Korhonen (2013)

The empirical study was aimed at evaluating the use of achievements badges in the TRAKLA2 online learning environment and their impact on student' time management, carefulness, and learning results.

The badges were awarded for:

- solving exercises with only one attempt, - returning exercises early, - or completing an exercise round with full points.

Eight different badges were available such as:

a. early bird; fast and furious; speed machine -> time management; b. got it; brainiac; Y U No Make Mistakes? -> carefulness; c. Mission Accomplished; Recap paceR -> learning category.

Unlocked badges were visible gray and blurry images. After unlocking a badge, it was visible in the student's personal TRAKLA2 main page; some simple statistics were also available and showed how

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many badges have been unlocked overall in the course. The unlocked badges of an individual student were not visible to others.

The results of the study shows that:

● achievement badges had an affect on the behavior of students (even with no impact on the grading).

● some badge types affect students' behaviour differently; when the others did not have such an effect.

● there were differences in students' responses to the badges.

● achievement badges had a significant impact on some aspects of students' behavior, and a small group of students was especially motivated to pursue them.

A conclusion was made that "badges may encourage students to self-reflection, or make them aware of their own studying habits such as completing the exercises early and checking the answers before submitting" (p. 53).

The presenter's paradox (Weaver, Garcia, & Schwarz, 2012): "adding an invaluable extra item to a valuable product may make the package appear less valuable" (p. 48) has to be also taken into consideration when designing gamified platform/system.

One of the thoughts was specifically interesting: " Most of the problems are not in the learning itself, but in some side effects this kind of distance learning environments might cause" (p.48).

More research is needed "in balancing the achievement criteria so that they maximize beneficial learning practices while minimizing harmful side effects".

9. Domínguez, Sáenz-de-Navarre, de-Marcos, Fernández-Sanz, Pagés, & Martínez- Herráiz, 2013

A gamification plugin for a well-known e-learning platform was designed and tested in a university course.

The gamification plugin design was based on:

Cognitive area:

● in order to keep gamified task as similar as possible to traditional optional exercises, a

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hierarchical tree following the course topics and optional exercises structure was created; topics and its challenges are freely accessible once it has been introduced in lectures;

● challenges - intermediate and advance levels and at most four trophies per challenge (copper,silver,gold and platinum), each element with an appropriate visual representation;

● "tasks are presented in video game-like fashion" (p. 383);

● task evaluation - the exercises had to be done in an external software, thus, the evaluation methods were limited, it was decided to use screenshots as evaluation mechanism (simple way) but, the problem was that "if students needed to wait for teacher to evaluate their work, it would be impossible to give immediate feedback on task completion in the form of a reward" so, any uploaded screenshot were accepted as correct ones immediately.

Emotional area:

- a virtual reward system: based on Wang & Sun, (2011) eight forms of reward were considered: score systems, experience points, items, resources, achievements, instant feedback messages;

● plot animations, and game content; however, the achievements were considered as the most appropriate;

● competitive mechanisms were included (leaderboard and ranking).

11. Tomé Klock, da Cunha, de Carvalho, Eduardo Rosa, Jaqueline Anton, Gasparini (2015) evaluated some of the e-learning systems and identified the following games elements:

● **Narrative** - "ongoing storyline" which allows the transmission of information, the guidance of the users and creating interactive experiences to engage users (p. 597);

● **Rules** - limiting user actions, turning the system manageable

● **Challenges;**

● **Integration of novices through entering and getting involved into the system;**

● **Reinforcement and feedback;**

● **Loops of Engagement -** "creating and maintaining motivating emotions that contribute to the user to keep motivated and engaged in using the system" (p. 598);

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● **Achievements** are "a virtual or physical representation of having accomplished something" (different levels and scales;

● **Points** - the demonstration of users' achievements;

● **Levels** - progress within the system (game level, difficulties level and player levels);

● **Rankings** - visualization of the progression;

● **Badges** - "a more robust version of points and a visual representation of some accomplishment/achievement of the user in the system" (p. 598);

● **Customization** - possibility to transform or personalize items according to user's preferences (by himself); "can promote motivation, engagement, sense of ownership and control over the system" (p. 598); however, the amount of items available to custom needs to be balanced;

● **Virtual goods** are "elements present in the system to enable self-expression, where the user can use the points earned to customize the game in general" (p. 598).

Based on the analysis, they created a conceptual model to the gamification process of e-learning environments, which included 4 dimensions:

1. Who - the actors: students. teachers and monitors, 2. Why - possible behaviors that gamification can improve during the student's interaction with the system: "(1) Accessing of the concepts, examples, materials and classes; (2) Resolution of exercises and delivery of tasks; (3) Increasing exercise performance; (4) Creating and answering forum threads; (5) Using the chat; (6) Using the message board and; (7) Accessing the system more frequently" (p. 601-602). 3. How - what game elements will be implemented. 4. What - the data that are involved in the gamification process.

12. Grant and Betts (2013)

The study focused on the badges (reward system) in e-learning.

The following badges were analysed in the study (p. 66):

● The silver Strunk & White badge awarded to the authors of the classic writing guide.

● The Elements of Style - to users who have edited 80 posts.

● The golden Copy Editor - to users who have made 500 edits to posts.

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● The silver Archaeologist badge is awarded to a user who has edited 100 posts that were inactive for six months.

The awarding badges for users behaviour were identified as "a form of gamification, defined as the process of game-thinking and game mechanics to engage users and solve problems" (p. 65; see also Zichermann, 2011)

Findings:

● " the users have actively shifted their focus toward completion of the badge in the time before it is awarded, and upon reaching their achievement, see no immediate need to continue the labour-intensive task" (p. 67);

● "a greater number of users spending more time editing posts before the badge" (p. 68);

● "Each of the three badges rewarding edits made to existing posts can be observed to correspond with an increase in edits before the badge when compared to the time period after the badge" (p. 68).

According to the findings, the conclusion can be made that "the badges are working as intended, and motivating users to actively improve the site".

13. Rasool, Zeeshan Rasool, Nurul F. Mohd Noor, Mohd Nizam Ayub, Hannyzzura Affal (2014)

The web based learning environment system for problem solving was gamified. described and tested.

In the study, an existing adaptive learning environment for physics problem solving known as ALEPS was gamified.

Game mechanics/elements & game dynamics/behaviour

Social elements:

Virtual goods -> Self-expression

Leaderboards -> Competition

Virtual gifts -> Altruism

Self-elements:

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Points -> Reward

Levels -> Status

Trophies, Badges -> Achievement

and, Time restrictions.

The following game elements were included in ALEPS:

1. **Dashboard** - shows the current progress and status of the achievements in terms of badges and trophies won, the leaderboard (ranking) is also visible.

2. **Coins** - some coins are given when registering, but students also can earn more coins by each successful action on choosing correct variable or principle or upon completion of each stag, coins allowed students to buy hints (using hint feature cautiously); losing some coins if using hit and trial method while selecting the correct variable;

3. **Badges & trophies** - reward elements for doing exercises; various badges and trophies that highlight different achievements of the students (e.g., levels - Gold, Silver & Bronze; and, some others - Beginner badge (completing first task) and Regular Visitor.

4. **Levels** - achieving higher level upon completion of successful attempts in solving each problem (aimed to retain the student engaging with the system in long term);

5. **Experience** - gaining experience value for each activity regardless level of activity or success of the activity (aimed to remain motivated emotionally even if students make any wrong attempts which cost those coins or score);

6. **Progress meter** - shows updated status after the student successfully completes each stage.

8. **Leaderboard** promotes competition among students;the results of the top students are shown in the system (Score, Levels, Experience, Number of Badges and highest trophies).

Similarly as in previous research (Domínguez, Sáenz-de-Navarre, de-Marcos, Fernández-Sanz, Pagés, & Martínez-Herráiz, 2013), this system targeted at cognitive and emotional aspects, but they added also social aspect; " where leaderboard element is used to address social satisfaction; Coins and Levels covering the motivational and cognitive aspects respectively" (Conclusions, para. 1).

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14. Laubersheimer, Ryan & Champaign (2016)

"InfoSkills2Go" website was designed and tested. The website is a Web accessible series of tutorials, games, and assessments for students to learn and practice information literacy skills and concepts (built by the group of librarians).

The "InfoSkills2Go" was built by using existing resources:

- Based on previously decided goals BadgeOS from LearningTimes was selected

as an existing gamification platform (https://badgeos.org/). - The Wordpress was used as a content management. - Hosting space - Godaddy.com

Findings (after testing the web site):

● no evidence of a correlation between use of the Web site and improvement of scores;

● the pilot study shows limited benefit to the student participants.

The posttest students' results were not better, in some cases, even lower than in pretest. It was concluded that some participants did not take the test seriously.

15. Amory, Naicker, Vincent, & Adams (1999)

Existing games and their elements were tested by 20 students (19 of them had a very little computer experience!).

Selected games were mostly entertaining, but it was not explained clearly in the research.

According the findings:

● for students, the more interesting are 3D-adventure (Zork Nemesis) and strategy (Red Alert) games to the other types ("shoot-em-up", simulation), Zork Nemesis was ranked as the best one;

● such game elements as logic, memory, visualisation and problem solving were ranked as the most important.

● graphics, sound and story line were identified by students as important aspects and perceived skills such as visualisation, logic and memory as important skills required to play adventure games.

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In the document it was concluded that those elements "are integral to adventure games and are also required during the learning process" (p. 311).

The following model was based on the basis of the findings:

Very interesting ideas and conclusions but, the research was conducted almost 10 years ago when the development and implementation of technologies and games in education was different and not so common compared to nowadays. In addition, 19 participants had a very little computer experience which can affect their perception of the game and the research findings.

16. Burguillo, (2010)

The main concepts of the approach applied in the study: "use friendly competitions among students' groups (where the extra points can be considered as a reward, but not as a punishment), locate the tournament at the end of the course (to avoid lack of interest in non-successful players), and adapt the competition to the discipline style and the course contents" (p. 575).

According to the findings:

● the Competition Based Learning methodology motivated "students to improve their work by competing against instructor-defined code and/or the code of other students in a tournament environment".

The following advantages of the competitive approach were discovered: "interactivity, collaborative work inside the group, active participation, challenge versus duties, and motivation for the students to explore their own topics, on mathematics and artificial intelligence techniques, to support the challenges" (p. 575).

17. Deterding, Dixon, Khaled, & Nacke, (2011) conducted literature review with an aim to define gamification in education.

Gamification -> "the use of game design elements in non-game contexts" (p.9)

● gamefulness (the experiential and behavioral quality),

● gameful interaction (artifacts affording that quality),

● and, gameful design (designing for gamefulness, typically by using game design elements).

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Table: Deterding, Dixon, Khaled, & Nacke, (2011)

It is not a case study, but it provides a very solid and interesting theoretical framework and some explanations.

18. Hamari, Tuunanen (2014)

In the study, the literature was reviewed on how players have been classified or typified with an aim "to investigate and clarify the current state of research and to suggest further research avenues" (p. 30).

It was concluded that:

● "The current studies could be synthesized into five key dimensions pertaining to motivations of play/orientation of the player: Achievement, Exploration, Sociability, Domination, and Immersion" (p. 46).

● "in-game demographics" (class and progression) was suggested for typifying players through behavioral measurement.

It is not a case study and it does not provide any information about game-elements or mechanisms, but it can be used for a theoretical background. Moreover, player types can help to create an understanding about their behaviour and learning in game-based environments.

19. Sung, & Hwang, (2013).

A collaborative game-based learning environment was developed and tested in the study.

An elementary school.

The students' performance was examined in terms of:

● learning attitudes,

● learning motivation,

● self-efficacy

● and learning achievements.

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Repertory grid method, which is originated from the Personal Construct Theory proposed by Kelly (1955), was "adopted to serve as a collaborative knowledge construction tool of a game-based learning activity" (p.45).

Figure: Sung, & Hwang, (2013), p. 46.

Storytelling was also included as an motivational tool in the game design: an ancient kingdom in which the people are infected by poisoned water in a river ..., plants are the key to curing people.

Figure: Sung, & Hwang, (2013), p. 46

In the game, students play king's role, they have to go through difficulties and search for detailed information about the plants. The game also includes several elements that make proceeding more challenging for students. When students collect all the data about plants and complete a test, they can go to the next level. In case, students fail in passing the test, the system (the fairy) will give them some hints or illustrative examples.

The storyline is a kind of scenario that needs to be followed by students and will allow them to collect the information needed to develop the repertory grid collaboratively via discussing with their peers.

The repertory grid can be modified via a shared interface.

Main findings:

- "the learning achievements of the experimental group students were significantly better than those of the students in control groups A and B, whereas non-significant difference was revealed between the students in the two control groups (p. 48);

- "The significantly better score of the experimental group than that of control groups A and B suggests that the collaborative educational computer game with repertory grid approach has improved the learning attitudes of students toward science" (p.48);

- "the collaborative game-based learning with repertory grid approach had a significant impact on improving the students' learning motivation in the natural science course" (p. 49);

- for the experimental group, "the collaborative educational computer game with the repertory grid enhanced the students' self-efficacy of using computers to learn, and their confidence in and expectations of learning collaboratively with their peers" (p. 48).

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20. Scheider, Raubal, Kiefer, Sailer & Weiser (2015)

Focus: design of scores that can be used in gamification; also, sketch how user behavior can be influenced by design and communication.

The feedback loops were recognised as an important element because they influence users behaviour and the effectiveness of gamification.

The feedback loops involve:

- measuring behavior -> relating it to other behaviors or norms (relevance) -

>"illuminating the path ahead" (consequence) and -> action.

Scores are "quantitative evaluations of behavior in a game" and "play an essential role in the second stage of this loop" (Introduction, para.1).

Different activities/behaviour and their qualities can be chosen to be scored and, thus, it will be stressed then.

The algorithm of designing scores:

4. Choose activity or behaviour 5. Choose quality that will be scored 6. The quality "need to be evaluated with respect to goals which turns qualities into criteria" that "can be used to obtain scores, i.e., evaluations of behavior" (Score construction, para 1).

"External goals need to be associated with user goals in order to facilitate internalizing externally promoted behavior [6] and, furthermore, to assure usability" (Score construction, para 2).

The qualities can be standardized differently, for instance:

- "by comparing them to: (1) the past, to measure individual change; (2) the behavior of others, based on leaderboards, or other types of statistics; (3) established norms; (4) a set of conceivable alternatives.

21. Moore-Russo, Wiss and Grabowski (2018) (Review of previous research)

Four potential pitfalls that can be encountered by instructors when designing gamified learning activities were discussed in the document.

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Main suggestions:

- game elements have to be connected to learning goals and content in a clear for students way; some additional explanations can be also provided (for more information, see p. 3-4);

- a lack of time to reflect on learning during and after engaging in a gamified platform/system can create negative or conflicting attitudes towards game- inspired instructions; - one of the pitfalls can also be that there are no real differences between physical learning environment and e-learning gamified environment. For instance, earning points on a leaderboard can be considered as similar to grading system in the classroom;

it was suggested that "opportunities to play, exploration, and collaboration toward novel goals" has a potential "to capture the imagination of students and inspire them intrinsically"; in addition, that can be also achieved by including "inserting elements of randomness, integrating a narrative, allowing students the freedom to fail, and integrating authentic opportunities for practicing skills" (p. 4).

APPENDIX B: ADDITIONAL DOCUMENTS WITH POTENTIAL RELEVANCE

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A14: Development of gamification techniques and tools based on feedback from previous experiences

Author: UVT

SUMMARY

Analysis and conclusions from A11 and A12 were used in different courses and different partners in the project, as long as they were exposed in different dissemination activities and multiplier events. One of the main advantages of this project is that every course and experience includes many different theoretical and formal aspects. Since many different adaptive learning techniques are included in pilot experiences, we cannot easily distinguish or isolate a course for being placed in a specific IO. In this case, we have selected one experience that, even including other contents, focused mainly in the development of gamification techniques.

This deliverable contains conclusions on the course "Digital Storytelling" held as transdisciplinary discipline for 2nd and 3rd-year students of the West University of Timisoara (WUT).

Taking into account the Adeaptive project inputs we started from the ideas that:

- Through a transversal course, one student enrolled in a faculty of the WUT has the opportunity to attend 3-7 transversal courses offered by the 10 other faculties from the university. By doing this they have the possibility to gather more skills necessary for their academic path, but also for developing new skills that are required in the nowadays interconnected society.

- Storytelling associated with games and gamification as a method to teach is accessible, dynamic, and can attract students' interest in deepening their understanding of the subjects taught.

- If there were a negative review of a teacher and a positive review of the course taught by said teacher, would the student enroll in the course? Would the student need an additional opinion before enrolling to the course? How can one determine whether the next review is positive or negative? And how would that influence one?

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Thus, we applied an online questionnaire to gain insights from the students enrolled in the "Digital Storytelling" course about the quality of the training, the acquired skills, the utility and the applicability of the course. Based on the questionnaire, we performed a quantitative analysis combined with a sentiment analysis and described the educational challenges encountered during the course. Overall, the students appreciated the Digital Storytelling course as a positive experience.

INTRODUCTION

The current society is one in a permanent change at an economic, social and political level where citizens have to acquire new knowledge, attitudes and skills in various contexts. To keep up with these profound transformations in 21st century society, the educational system at all levels should be redefined so that today's education is suited to the 21st century society and economy [1].

Thus, universities must adapt as quickly as possible, to be the promoters of curriculum change, in order to be able to prepare competitive students for professions that do not yet exist [2] who are capable of collaborating, communicating and solving problems based on critical thinking and creativity [3]. It is noted that besides technical skills and knowledge for a specific job, university graduates must also develop personal transversal competencies that are critical to personal success, graduate employability and professional success [4]; [5].

At national level, strengthening the capacity of universities to develop and deliver relevant programs for the labor market – with a particular focus on transversal skills, appears to be one of the priorities within the National Strategy for Tertiary Education 2015-2020 [6].

In this context, the West University of Timisoara (WUT), faithful to the principles and mission assumed in which it wants its graduates not only to be specialists in a field of study but rather intellectuals with a broad academic background to meet the challenges of a dynamic society, offers its students, from the academic year 2014-2015 onwards, the possibility of assimilating transversal competences by completing complementary disciplines (DCT).

TRAVERSAL COMPETENCES TRAINING THROUGH THE COMPLEMENTARY DISCIPLINE PROGRAM FROM THE WUT.

Transversal competences are acquisitions of values and attitudes that go beyond a specific area / program of study and are expressed by the following descriptors: autonomy and responsibility, social interaction, personal and professional development [8]. Thus, undergraduate study programs include, in addition to the disciplines offered by the department that manages the curriculum, the disciplines offered by other departments or faculties within the WUT, complementary disciplines

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that aim at forming these transversal competences (other than those aimed at developing explicit professional skills).

Transversal competences provide WUT students with: teamwork skills, oral and written communication skills in native / foreign languages; rational / argumentative and critical thinking skills; the use of information and communication technology; problem solving and decision making; recognition and respect for diversity and multiculturalism; learning autonomy; initiative and entrepreneurship; opening up to lifelong learning; respect and development of professional values and ethics; ability to operate in an interdisciplinary manner with methodologies and concepts from the real sciences, socio-human sciences and artistic creation, etc.

The curriculum contains at least three subjects (excluding foreign languages) extending throughout a semester that aim to form cross-cutting skills in the third, fourth and fifth semesters, disciplines offered in other fields, from the same faculty or from another faculty.

For each academic year, these disciplines are offered to students from April to September (prior to the academic year) by events where each complementary discipline teacher will present the educational offer of the discipline and a leaflet presentation of the DCT to be distributed to the participants. In the mentioned period, WUT students opt for two complementary disciplines for each semester, one main and one backup, in accordance with the curricula, the available places, the places of each discipline being occupied on a first-come, first-served basis.

In order to be organized, a DCT has to accumulate at least 80% of the specific minimum threshold of the study group (e.g. minimum 20 options for a group of 25 students). Starting with the current academic year the number of students per discipline cannot exceed 70, the recommendation being 30 students (1 group) / course. Students who opted for non-organized disciplines will be distributed based on the backup option, and those who do not express their option will be randomly distributed, depending on the available locations within the DCT at the WUT level.

DCT dissemination is also done through year-long tutors, which popularize the cross-curricular offer and provide advice on choosing these disciplines by emphasizing the importance of transversal competences in the professional training of the future employee.

As an organization, DCT didactic activities are planned in a unitary way at the WUT level, mainly during the time slots 16.20-17.50 or 18.00-19.30, exclusively on Wednesdays and Thursdays, which facilitates students' access to these courses, integrating DCT in the deferred schedules of study programs.

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It should be noted that, once elected, these courses acquire the status of compulsory subjects, the number of credits being included in the 60 compulsory credits for one year of study [9]. The distribution of the educational offer of the faculties regarding the complementary subjects, by faculties, during the implementation period 2014-2019 is presented in Table 1.

This experiment at the WUT, which proved to be a model of good practice at national level (two more universities from the Universitaria consortium took over from last year the idea of offering optional courses different from the students' specialization) would not have been possible without the involvement of assoc. prof. PhD. Mădălin Bunoiu, Vice-Rector of the Academic Strategy of the WUT, convinced of the necessity that it is good for graduates to be specialists in several fields so that they can be employed more easily.

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Table 1. Distribution of DCT within WUT during 2014-2019

Faculty / Department	# of offered disciplines*				
	May 2018 performed 2018-2019	April 2017 performed 2017-2018	May 2016 performed 2016-2017	April 2015 performed 2015-2016	April 2014 performed 2014-2015
Teacher Training Department	2/2	3/2	1/1	3	-
Art and Design	9/5	10/6	9/5	8	4
Chemistry, Biology, Geography	7/1	8/3	15/4	12	16
Law and Administrative Sciences	7/4	9/3	11/3	9	5
Economy and Business Administration	36/20	32/15	32/11	36	15
Physical Education and Sports	4/2	5/4	5/3	5	4
Physics	5/2	5/3	6/3	8	5
Letters, History and Theology	36/19	32/14	38/13	35	3
Mathematics and Informatics	3/2	5/2	9/2	8	3
Music	6/3	6/3	2/1	2	1
Sociology and Psychology	23/11	19/9	21/11	16	10

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Political Sciences, Philosophy and Communicatio n Sciences	23/13	24/16	26/12	18	12
# of total disciplines proposed*	**161/ sem1 -84**	**158/ sem1-80**	**175/ sem1-69**	**160/ sem1-54/ sem2-53**	**78 sem1-29/ sem2-33**

*Figures from Rector's reports, carried out annually, 2014-2018 [10]

In an interview with Digi24 TV, he explained that in fact, these additional courses have a greater utility for young people who know the career they want to follow. For example, a medical student can easily set up a private clinic if he also has some economics or finance courses. Because he understands better how a business works and how he can attract funds. And a computer scientist can gain enormously from an art course. He develops his imagination, changes his mind-set, and can come up with the next billion-dollar idea in the IT world. In fact, this should be the end result of these cross courses: A more complex thinking and not a richer diploma in specializations voided.

Thus, convinced of the usefulness of such an approach, the first author accepted the challenge of providing a complementary discipline, namely „Digital Storytelling" with the support of the second author.

Digital Storytelling Roadmap

„Digital storytelling" is an introductory course offered from the first year of the program at the WUT as a complementary discipline comprising 1 course and 1 seminar, totaling 2 ECTS. The course offers another dimension and color to telling stories by combining text with pictures, music, movie or voice, to highlight different life experiences, situations and perspectives. It aims at developing skills and knowledge of digital storytelling techniques, in fact learning digital storytelling through storytelling (see the course teaser at https://www.youtube.com/watch?v=aWfRUCmxnOs).

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The course approach is interdisciplinary. Issues related to the theoretical background of the storyteller, technical information and support for the development of digital stories are dealt with. The course also contains practical exercises and online references to other interesting materials and applications / programs to explore in-depth topics to support students' work on digital stories. At the seminar, students receive concrete examples of how to use storytelling in different areas related to their specialization, and are involved in practical activities to learn working techniques with diverse tools and digital applications. The course leads students to create their own stories step by step.

The specific objectives of the discipline are:

- Combining the art of storytelling with digital and multimedia tools along with the specific audio, video, and other object creation software to create digital stories;

- The opportunity to work with personal stories to take part in practical exercises to learn stories and the digital possibilities of the storyteller, build their own digital storytelling and enjoy the creative process by using new technologies;

- Participating students will develop a complex set of competencies related to the analysis and understanding of the storytelling universe, as well as to the digital representation of some subjects from this universe, whether inspired from their own life or from the community or oriented towards their own specialization.

The discipline has its own virtual platform, a closed learning and a content management space on google classroom.

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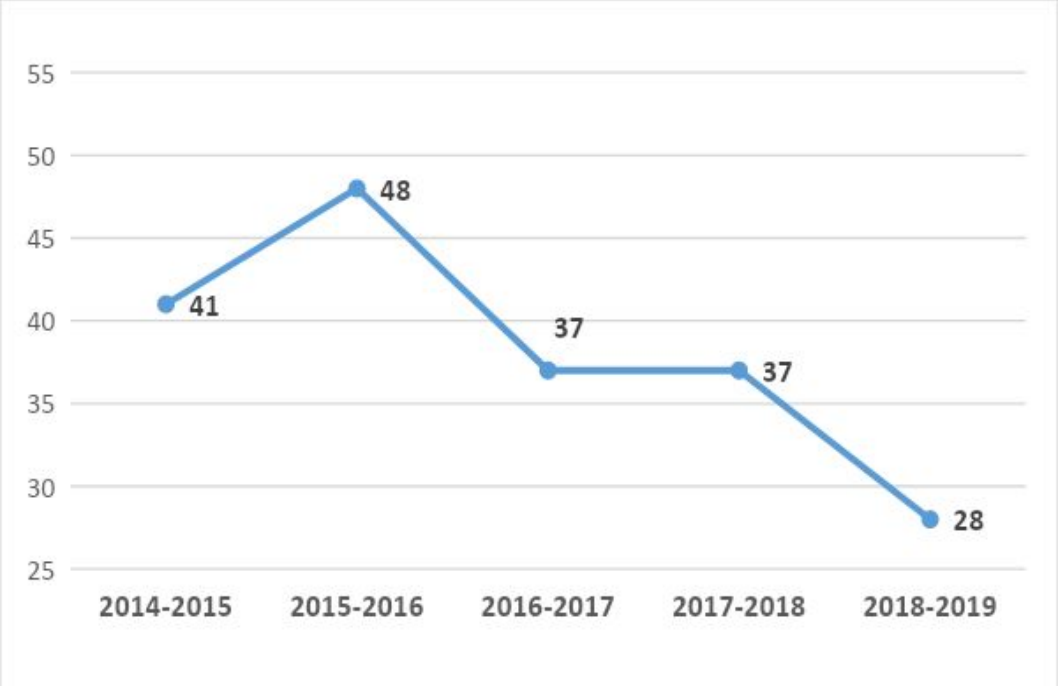

Figure 1. Distribution of students who have completed the „Digital Storytelling" course per academic years

Figure 1 depicts only students who have completed the discipline, the number of enrolled students being much higher. For example, in the academic year 2015-2016, 60 students opted for this discipline but only 48 completed it. The drop in the number of students is due to the fact that the number of complementary disciplines increased from 78 in 2014-2015 to 161 at the beginning of the academic year 2018-2019 as well as the number of students per group (maximum 30 students in a group) to avoid overcrowding of certain courses (see also [9]).

After five years of offering this discipline, the following question naturally emerged:

If there were a negative review of a teacher and a positive review of the course taught by said teacher, would the student enroll in the course? Would the student need an additional opinion before enrolling to the course? How can one determine whether the next review is positive or negative? And how would that influence one?

METHODOLOGY

In order to get an answer to the above identified questions, we used a questionnaire-based survey method combined with a sentiment analysis. This is a branch of the Natural Language Processing

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domain that deals with the study of opinions, feelings, assessments, attitudes, emotions and their characteristics, directed to certain entities such as products, organizations, individuals, events, etc. For quantitative analysis, the instrument chosen was the online questionnaire on the discipline platform in June, after the last course but before the final evaluation session. The sentiment analysis was done using the MonkeyLearn application (https://monkeylearn.com/).

For this reason, the questions addressed were related to the evaluation of the course, such as: organization and resources, attitude (teaching methods, didactic performance, appreciation of the collaboration with the didactic framework), content, didactic methods (integration of various applications, tools and technologies for creating digital stories), utility and suitability (learning outcomes, developed skills), positive aspects, perception of discipline (negative aspects and suggestions for future development) (we did not consider evaluation and notation). The students were reminded that although this may seem to be a process beyond their interest, the quality of the organization and the way a course is taught are directly related to the information they acquire, the skills and the skills they acquire.

Following the received responses, we aimed at developing an intervention project that could be developed to improve the teaching content (as well as the learning environment) as well as to improve the academic performance (but also the competencies) of the students.

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A LOOK AT THE DATA: RESULTS SYNTHESIS AND DISCUSSIONS

The „Digital Storytelling" course was completed by 37 students (25 female 12 male) out of 51 enrolled students, 19 of whom completed the final course evaluation questionnaire. The completion rate was 51.35% (12 female, 7 male). For confidentiality reasons, only synthetic values will be shown.

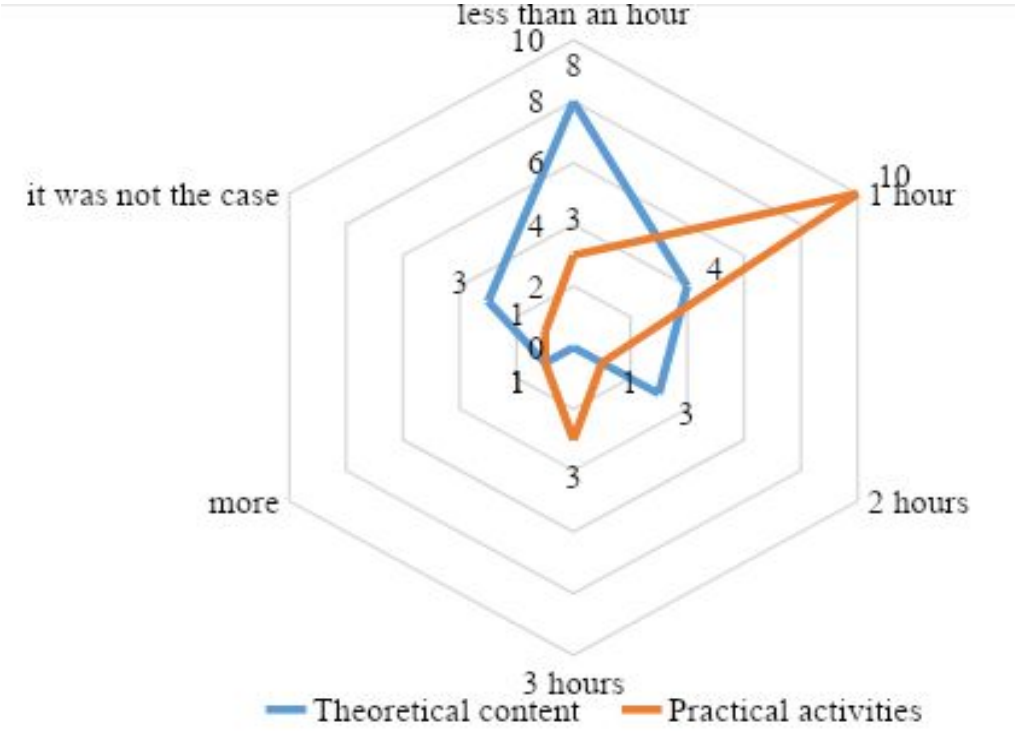

Figure 2 shows the distribution of responses to the question: *„How many times a week do you estimate you have spent on learning a unit for: a) browsing theoretical content and b) performing practical activities"* (on a scale from 1 to 6: less than an hour, an hour, 2 hours, 3 hours, more, it was not the case)

As can be seen from Figure 2, the volume of work devoted to theoretical activities is less than one hour and the one for practical activities is about one hour. This shows / indicates that there is an efficient time management by the students as well as the efficient use of the time allocated to the course / seminar by the teacher. This is due to the fact that there exists an accessible theoretical content and a clear, easy to understand practical activities that are presented in an attractive manner.

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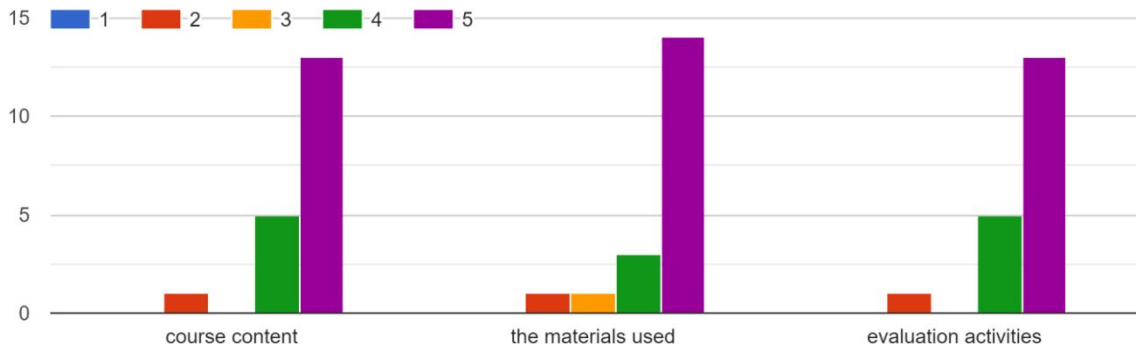

Figure 3 shows the distribution of responses to the question: *„How do you appreciate it? a) the course (and seminar) content; b) the materials used (links to videos, documents, other web resources) c) evaluation activities"* (on a scale from 1 to 5: very dissatisfied, dissatisfied, neither satisfied, satisfied and very satisfied)

The vast majority of respondents appreciate (15/14/13 of 19 are very satisfied) the structuring of subject-matter as having applicative value, in relation to other disciplines, as well as a high degree of interactivity. The course is accessible, captivating, well organized and the information presented at the seminar is up to date.

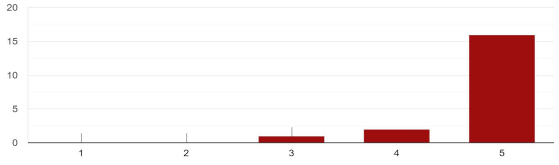

Figure 4 shows the distribution of responses to the question: *„To what extent do you think the learning objectives were clearly expressed at the beginning of each unit?"* (on a scale from 1 to 5: very poor, below average, average, above average, very clear).

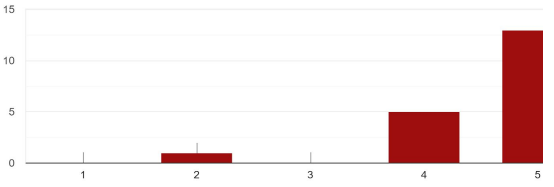

Figure 5 shows the distribution of responses to the question: *„The main purpose/aim of the course was achieved (familiarizing with various tools and digital applications useful in building stories)"* (on a scale from 1 to 5: to a very small extent, to a small extent, to some extent, to a large extent, to a very large extent)

From Figure 4 we can see that 16 of the 19 respondents appreciate (indicated score 5) that the teacher clearly formulates the learning objectives but also the responsibilities of the students.

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Furthermore, they appreciate that the teacher informs on time, in a clear and explicit manner, what are the criteria and ways of evaluating the accumulated knowledge.

Our findings (see Figure 5) indicate that 13 students out of 19 have become familiar with narrative techniques through digital stories and have acquired skills related to building a story linked to the specifics of their specialization. Moreover, they are able to use various ICT tools to develop digital skills working with images, sounds, videos and / or animations needed in the process of creating digital stories. This is in accordance with the professional or transversal competencies, entered in the discipline file (which was consulted by the students prior to their enrolment) – see Table 2.

Table 2. Specific skills acquired (excerpt from the discipline file)

Professional competences	training on narrative techniques through digital stories // building a story related to the specialization (therapeutic, organizational, urban, educational, business, etc.) // use of ICT to develop digital skills working with images, sounds, videos and animations // creating a script and a storyboard // creating a digital story // developing students' creative abilities (developing talented talent) // developing the skills of digital processing of various content / resources // developing digital communication skills
Transversal competences	cultivating interest in using stories in the future profession // fostering trust and motivation to work in multidisciplinary teams // participation in social learning activities // involvement in institutional development // innovation and creativity // unique learning experiences / raising students' awareness of the situations of everyday life // employability // developing a digital culture

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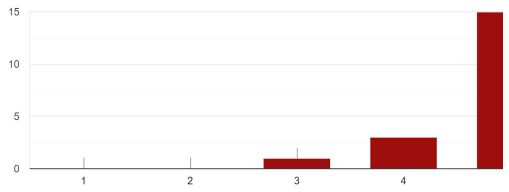

Figure 6 shows the distribution of responses to the question: *„Do you think that you have made progress on the knowledge gained following the Digital Storytelling course"* (on a scale from 1 to 5: to a very small extent, to a small extent, to some extent, to a large extent, to a very large extent)

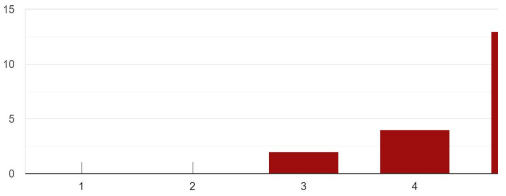

Figure 7 shows the distribution of responses to the question: *„Considering that we are talking about online content, how do you appreciate the teacher's effort throughout the semester to increase the accessibility of the course"* (on a scale from 1 to 5: not at all, slightly, moderately, very, extremely)

From Figure 6 we can see that 15 out of 19 students said they had the opportunity to participate in an interesting, well-structured and organized, interactive course that gave them an authentic learning and training and gave them the opportunity to enrich their knowledge through the topics proposed, the teaching approach and the working atmosphere. They stated that the activities were intense and consistent, extremely varied and interactive, and the theoretical part was ingeniously alternated with practical applications. However, only 4 students said the expected progress was not up to their expectations, hoping to more easily integrate the proposed content to strengthen the discipline-specific competencies.

The vast majority of students (13, see Figure 7) are pleased with the efforts of the teacher to increase the accessibility of the course. For example, they have pointed out favorably that the examples used have addressed real or close issues in everyday situations. Moreover, they have been pleased with encouraging active participation and developing the skills to make stories on their field of expertise.

Overall, the performance of the teaching staff was appreciated with high scores both at the course and at the seminar. Only a relatively small number of students (6) scored a lower score and voiced concerns about the low feedback received about their performance, as well as the minimal degree of dedication of the teaching staff (the same degree of acceptance towards all students, knowing that they have a different background).

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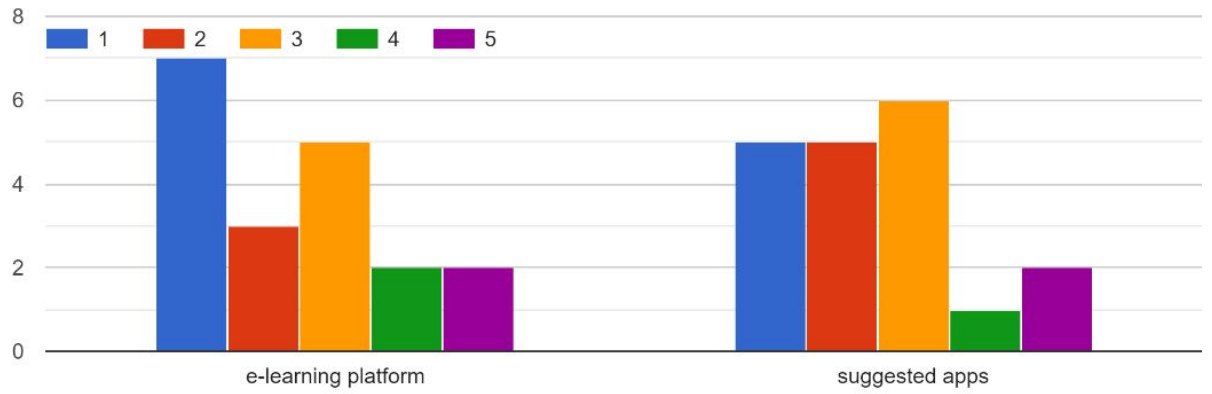

Figure 8 shows the distribution of responses to the question: *Please appreciate the difficulty of: a) the e-learning platform, b) suggested apps*" (on a scale from 1 to 5: very simple, easy, neither, difficult, very difficult)

During the semester, students were encouraged to create different types of stories: multimedia (whether based on images, sound or video or combined), social media / web 2.0 based, data-based, maps-based, interactive (with or end-to-end), conversational virtual-based, virtual reality-based, augmentative-based or game-based.

Besides the applications dedicated to each type of story (suggested at the seminar), we also used applications to enhance writing, creative writing, storyboard creation to include the elements of a story (decor, theme, narrative thread, solution, etc.) to organize the ideas of a story, metaphors and analogies, style figures and their role in stories, etc.

Furthermore, students have been familiarized with a range of communication, collaboration, content creation tools (for text, audio, video, animation, etc.), sharing, brainstorming, public opinion polling, debate, etc.

The favorite device was the mobile phone. In addition, students were instructed how to assign to their stories a Creative Commons license.

The most used applications were (see Figure 9): Commaful, Spark (Adobe), FlipGrid, Coggle, Sutori, Telegraph, StoryBoardThat, StoryBird, BookCreator, Justapose, WriteAStory, PowToon, Moovly, MakeBelifsComics, Lumen, Beautiful .ai, Biteable, Visme, Piktochart, UTellStory, Opinion Stage, Aviary, AnswerGarden, Canva, Instagram, Facebook, StoryMaps (ESRI), Twine, Poly, Loopy, Rebot.me,

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Kahoot, Mentimeter, GoogleForms, Padlet, Dotstorming, Kialo , Blabberize, and of course the GAFE suite of applications (GoogleApssForEducation) and Office365.

The opinions of the participating students as a result of the question *„Any other suggestions or comments that would help us improve content, activities, app selection"?* were divided into five categories (see Table 3).

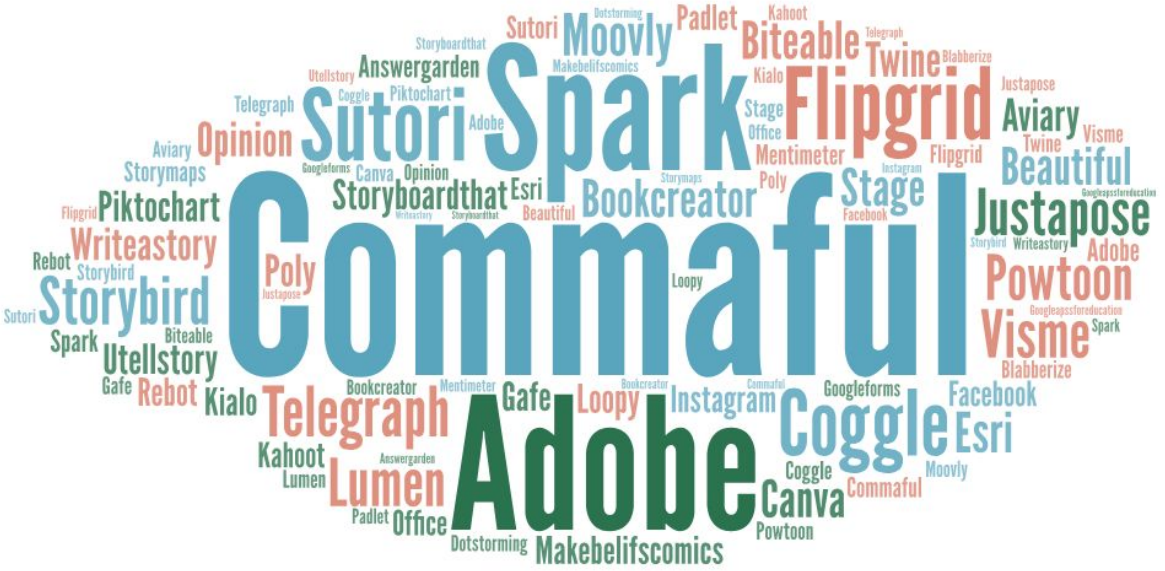

Figure 9. Applications favored by students in working with digital stories

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Important positive aspects	Moderate positive aspects	Neutral aspects	Moderate negative aspects	Important negative aspects
the course integrates well with the disciplines offered by the faculty	attractive, intuitive and accessible way of teaching	more interactive games	although the teacher accepted different points of view than his own feedback during the semester was low	the reduced time spent on practical activities
the content and methods of work used made this course efficient, instructive, interesting and useful	dynamic atmosphere	more creative writing exercises	willingness to answer questions and help students	accessibility of learning content (for various disabilities)
The course is useful for students'	pleasant experience	The teacher awoke the interest of the	moderate flexibility of the teacher	
specialization and careers		students and stimulated their participation		
respect towards the students	usability of the materials			

Table 3. Respondents' opinions

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The negative aspects, along with the neutral ones, have a relatively low frequency and mostly target the physical framework as well as the question and answer sessions, including the feedback given to the students. This is quite difficult to offer because there are many themes and exercises. For example, a simple calculation leads us to at least 370 exercises (considering only 10 weeks of schooling): 37 students * 10 topics / semester, with at least 10 different applications / tools.

From the sentiment analysis made with MonkeyLearn it can be seen that the polarity of the corpus collected during the students' survey is positive (14 positive, 3 neutral and 2 negative). Thus, the students appreciated the Digital Storytelling course as a positive experience.

Table 4. Polarity results

What other suggestions or comments would you like to do to help us improve content, activities, app selection, etc.?	*Classification*	*Confidence*
I'm glad I chose "Digital Storytelling" as a cross-discipline! I really can say that I have learned many useful things, which will be of great help to the next projects in college!	Positive	0.988
I think that when you ask a question and suddenly is silent in the room, because ... who knows why. You can defuse silence by specifically naming a student to have a say on the question	Neutral	0.508
For me, the course was very interactive! I would recommend 😁	Positive	0.974
I am very pleased with the content of this course!	Positive	0.999
It looks very well structured as it is now.	Positive	0.976

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I have nothing to comment on. I liked it the way it was.	Positive	0.973
You are wonderful. I hope that your activities will be equally inventive in the long run.	Positive	0.936
Introducing as many practical games as possible.	Positive	0.767
I think it was a nice course and I'm glad I participated in it, having the opportunity to learn many new things.	Positive	0.959
I liked it a lot, I would not have anything to object to.	Positive	0.832
More interactive games like the one with the interactive story	Positive	0.939
I think it was very good. I do not have a suggestion to recommend.	Positive	0.935
More imagination games	Neutral	0.738
I have learned many beautiful and interesting things.	Positive	0.922
With the applications you used in class I liked the fact I found a place for creativity and determination to get a flourish idea all the way. Good luck! Thank you very much for those new experiences!	Positive	0.987
for me all (activities) were ok	Neutral	0.811
I have no suggestion of improvement.	Negative	0.783
Continue to do what you like, you're	Positive	0.983

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doing fine!		
I do not want to make any comments	Negative	0.609

We also used Keyword Extractor method from the corpus to identify the important topics in the course content (see Table 5). It can be used to index data, generate tag clouds or for searching (Figure 10).

Table 5. Extracted keywords by confidence attitude

Positive	**Neutral**	**Negative**
nice course// opportunities//	questions//	suggestions of improvement//
many new things// great help//	activities//	comments//
long run// fine//	imagination games//	silence//
many practical games//	way//	room
interactive games//	next project	
interactive story//		
interesting things//		
application// fact//		
creativity// determination//		
flourish idea// good luck//		
new experience//		

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Figure 10. The MonkeyLearn output having a positive polarity

Even though the degree of attendance of the students was not optimal, the information gathered was relevant and useful. Evidence that at the time of writing this material, when DCT is offered for the 5th year, we considered the suggestions we received, for example by reducing the number of topics to provide feedback.

Strong points:

- As positive aspects we point out: teachers' solid training, well-structured course material, coherent, good communication with students, application of modern teaching methods, current bibliography proposed to the students;
- Students are encouraged to participate in their own training through motivation, stimulation, encouragement of dialogue, team and individual activities, initiation in research, debates, study recommendations;
- Students are involved in carrying out practical activities by encouraging teachers to participate actively in classes;
- The didactic framework makes efficient use of the teaching materials in the educational process.

Weaknesses

- At the opposite end, there is a correlation between the teaching activities and the very diverse profile of the students – which is very difficult to achieve within a DCT.

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- The teacher-student relationship is based on mutual respect, empathic understanding, but although there is availability for dialogue and differentiated approach, consultancy, etc., the interest of the teacher for students' understanding is not very high, confirmed by the low feedback from the assessment made by the students.

Conclusions

Being aware of the need for effective student training for today's technological and computerized society, and in particular the magnitude of the MOOC (Massive Open Online Course) phenomenon in education, the authors would like the acquisition of transversal skills to be achieved through this complementary course in a MOOC format. It would be a premiere for Romanian higher education – but so is the DCT program. See the first steps at https://west-university-timisoara.teachable.com/p/povedig.
As suggestions for improving the teaching activity, **students indicated the introducing of many games as possible (both online and offline) as well as interactive applications and exercises.**

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A18: Development of friendly-user and free Access versions of the applications

Authors: UCLL, JYU, EURECAT

SUMMARY

This project is based in three main kind of activities. The first one is the analysis and identification of adaptive useful techniques, such as gamification in this first IO. The second one is the development of pilot experiences where we can test the work done. For doing so, we need the third kind of activities: the development of platforms for the courses. We have overcome the initial objectives of the project and we have developed three platforms instead of one. In this section, we describe the platform that has been mainly used in pilot experiences related to gamification.

Since platform is online and fully available through the project webpage, only a brief description is given here.

Access to the platform through: www.adeaptive.com

Introduction

Fresh start course and others in the project are created using Moodle Learning Management System (LMS). In Figure 1, a fragment of the Fresh start Course can be seen. The questionnaires have been designed using the questionnaire functionality of Moodle, which enables the restriction of questions according to the results of other questions.

Many other reasons have led us to choose Moodle as the most appropriate platform to implement this project. Firstly, it is the most used e-learning platform in the world, which demonstrates its reliability and sustainability, which are both very important factors for this project. It is an open source environment, and this allows us to adapt it to our needs in an optimal way and implement a completely customized graphic and structural configuration, even having the possibility of easily adding new features. Furthermore, a large community of Moodle developers accompany users throughout the entire process, and that has driven a great evolution of the platform, offering plenty

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of options that allow users to create a great variety of online training environments. In addition, the platform is specially used as a training tool for diverse social groups, such as universities, public organisations, NGOs and other non-commercial operations.

Thanks to this, it offers many possibilities focused on boosting the motivation of the participants. Consequently, we can create the necessary adaptive itineraries and personalized training paths in order to reach the pedagogical objectives.

Moodle is also specially prepared for the configuration of collaborative environments, among the participants themselves and with the tutors or advisors who participate in the student's training course. Moreover, it allows the implementation of gamification strategies based on rubrics related to objectives and / or in the personalized evolution of the participant's avatar.

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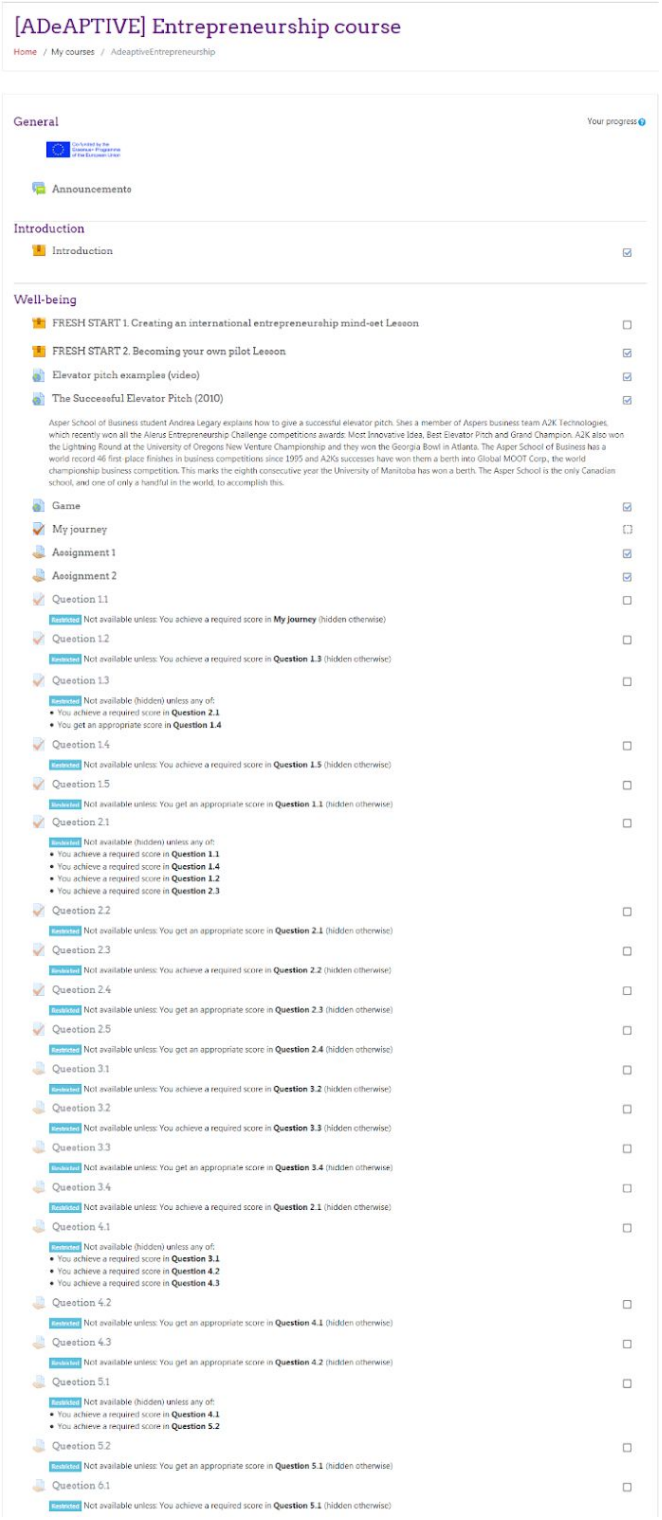

Figure 1: Fresh start Course in moodle-based platform

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A13, A15, A17: Piloting experiences on gamification

A22, A23, A24, A25: Successful gamification techniques and gamer profiles

A21, A26: Pedagogically meaningful use of gamification

Contributors: JYU

SUMMARY

This deliverable combines the results of several activities under Intellectual Output 1.

- Activities A13, A15, and A17 are related, respectively, to first-, second- and third-year pilots focusing on gamification. In this deliverable, the piloting experiences are described and reported.

- Activities A22, A23, A24 and A25 pertain to successful gamification techniques in relation to gamer profiles. This deliverable presents related findings based on the aforementioned pilots.

- Activities A21 and A26 refer to pedagogically meaningful use of gamification. The first pilot identified the main purposes for gamification in the case of our project (A21). The conclusions of the deliverable summarises the findings and recommendations based on the pilots (A26).

It is worth noting that pilot experiences of first year were used for analysing and identifying gamification techniques as shown in A11 and A12. For that reason, the porpoise of that first year experiences were more related to identifying potential problems and how gamification could help in student's performance.

Starting point

The first pilots (A13) described in this deliverable were implemented concurrently with the literature reviews on gamification (deliverables 1.2 and 1.4). Their role was to identify the key needs and

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pedagogically relevant purposes specific to gamification in this particular context. The second (A15) and third (A17) pilots, for their part, explored the use of game elements selected based on these needs (A23, A24) and the opportunities for using player types (A22, A25) as an approach to implement adaptive gamification.

Next steps

Our findings suggest that for certain user groups, such as teacher students, the collaborative and social aspects are highlighted in gamification contexts. Therefore, one of our future steps based on the findings of the ADeAPTIVE project is to run pilots with these groups using extended reality (XR) as a platform for pedagogical activities. XR provides plenty of affordances for the social and collaborative dimensions of learning, and therefore it will be interesting to explore how it matches the motivational orientations of the students in reality.

1. METHODOLOGY

Gamification-related piloting activities were conducted in three cycles. The first-year pilots aimed to discover specific needs to be addressed through gamification (A21), and the second- and third-year pilots experimented with game elements embedded in online learning platforms (A23, A24) and explored the relevance of user types (A22, A25) in planning gamification solutions.

First-year pilots (A13)

Context and participants: The first pilot was conducted at UAM during the academic year 2017/2018. The course was related to chemistry and chemical engineering, and 23 fourth-year students participated.

Setting: The pilot focused on the use of adaptive testing tool, with the aim of finding out its effect on grades. From the gamification point of view, the goal of this pilot was to identify potential challenges pertaining to student motivation in the use of an online learning and self-evaluation tool. The aim was to use the result as one starting point to developing game elements for online learning platforms.

Data collection: The pilot was based on the usage data of the testing tool as well as the students' grades.

In addition, a small-scale trial related to gamification was conducted in spring 2019 at JYU. The context was a course related to the basics of educational theory for ICT students. Qualitative feedback was collected from the students.

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Second-year pilots (A15)

Context and participants: The second-year pilot was carried out in autumn 2019 in the context of teacher education. It was implemented in the course *Information and Communication Technology* intended principally for first-year teacher students (N = 79) at JYU. The aims of the course were related to learning to use the university ICT services and tools, using cloud-based services individually and collaboratively and learning the basics of the ethical use of ICT both as students and as professionals. In addition, the students learned about the role of ICT in the field of education and familiarised with different applications and acquiring information.

Setting (gamification of the platform): The online learning platform used in the course was Moodle. During the first half of the course, Moodle was used without gamification, and halfway through the course, a gamified version was introduced. The gamified version included three main game elements (see Figure 1), implemented using the standard tools provided by Moodle.

1) First, a *background narrative* about a School of Digital Wizards was presented to the students. The theme was reflected also in the visual appearance of the gamified Moodle course. The purpose of the narrative was to enhance the users' *immersion* in the gamified learning environment.

2) Second, each student had an *avatar* that was related to the background narrative. As the students completed compulsory course tasks, the wizard avatar progressed from one level to the next. When a student's avatar reached the final level, this meant that the student had passed the course – and within the background narrative, a completed avatar indicated that the Digital Wizard was ready to step into the digital world on their own. The purpose of the avatar was both to visualise *progress* and to enhance *immersion*.

3) The third game element used in the pilot were *badges*. When students completed non-compulsory extra tasks related to different topics, they were awarded topic-specific badges such as "Programmer" or "Copyright Guru". The purpose of the badges was, on the one hand, to encourage the students to practice more, and on the other hand, to meet the preferences of achievement- or competition-oriented users.

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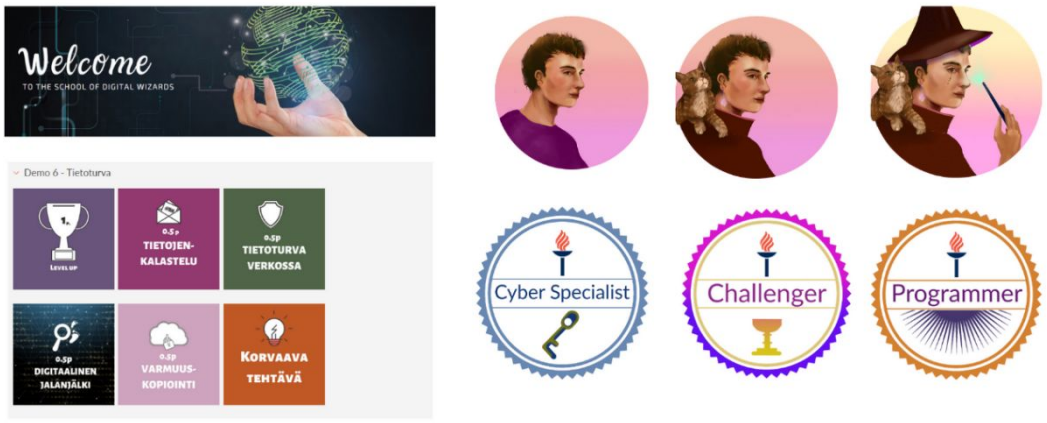

Figure 1. Examples of the game elements: Wizard school banner (top left), avatar development (top right), icons for different tasks (bottom left), badges (bottom right)

Data collection: Data was collected via two online questionnaires, one at the beginning and one at the end of the course. The *initial survey* included questions about the users' experience, expectations and attitudes regarding online learning and game playing prior to the course. An important part of the survey was a player type questionnaire aiming to provide us with information of the most typical player types of this particular target group. For this purpose, we used the *Gamification User Types Hexad* scale (Tondello, Mora, Marczewski & Nacke, 2019) that is tailored especially for gamified environments. This instrument allows us to identify six different user types:

- *Philanthropists* (motivated by purpose, being altruistic and willing to give without expecting a reward),
- *Socialisers* (motivated by relatedness, wanting to interact with others and create social connections),
- *Achievers* (motivated by competence, seeking to progress by completing tasks or prove themselves by tackling challenges),
- *Free Spirits* (motivated by autonomy, wanting to create and explore),
- *Players* (motivated by extrinsic rewards, despite the type of the activity), and
- *Disruptors* (motivated by the triggering of either negative or positive change, wanting to test the boundaries of the system) (Tondello et al., 2019).

The instrument consists of 24 statements (four statements representing each of the six user types), and the respondents indicate their agreement or disagreement with the statements on a seven-point Likert scale. Thus, the highest total score for each user type is 28 and the lowest is 4.

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In the *final survey*, the students evaluated their experience and gave feedback on the gamified online learning platform.

In addition to the questionnaires, *usage data* was gathered from Moodle.

Third-year pilots (A17)

Context and participants: The third-year pilot was carried out in spring 2020, and the context was very similar to that of the previous pilot. The pilot course, *Information and Communication Technology and Acquiring Information 2*, was intended for teacher students who are in the Master's stage in their studies (N = 59). The course aimed to deepen the students' ICT competencies through addressing the use of ICT from the perspective of curricular goals, familiarising the students with children's media environment, deepening their knowledge regarding ethics and copyright issues, and introducing novel digital applications for teaching.

Setting (gamification of the platform): As in the previous pilot course, Moodle was used as the learning platform. In this pilot, the course was gamified from the start with similar game elements as in the first pilot: narrative, avatar development and badges. Furthermore, building on the results of the user type survey, the students were provided more opportunities for collaboration and teamwork.

Data collection: Data collection followed the same overall procedure as in the previous pilot. The *initial survey* (that included the user type scale) was identical to that of the second-year pilot. The *final survey* was partly identical to that of the previous pilot but some of the questions were adapted to fit the particular context of this pilot. As the online environment was gamified from the start of the course, questions related to comparing the gamified and non-gamified environment were no longer relevant. They were replaced by questions related to the extent to which the students felt the environment matched their user type and to what degree they made use of the opportunity to do tasks collaboratively. The questionnaire data was complemented by similar *usage data* from Moodle as in the earlier pilot.

2. RESULTS

First-year pilots: Meaningful purposes for gamification (A21)

The first-year pilot at UAM identified a set of main challenges pertaining to student motivation. The first one was the need to increase the students' attention to task, which means that instead of only

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cursorily going through the tasks when practicing with the tutoring system, they should focus on the items more closely.

Another challenge was related to enhancing the regular use of the tutoring system already from the beginning of the course instead of only practicing with it a few days before the exam.

In the small-scale trial conducted at JYU, the qualitative feedback collected from the students revealed very similar findings to those of the UAM pilot. The main observation was that there was a need for more gamification and that the users tended to use the platform only before deadlines.

Second-year pilot: Gamification techniques and user profiles (A22, A23, A24)

According to the background questions presented in the initial survey, the participants played games on a monthly basis on average, and most of them had at least some previous experience with online learning platforms before the course. Their expectations regarding studying on an online platform fell between neutral and somewhat positive, averaging at 3.5 on a scale of 1 (very negative) to 5 (very positive).

In the final questionnaire, the students were asked about their experiences regarding the gamification of the course. The gamified version of the course was slightly favoured over the non-gamified one. As to specific game elements, the results were in line with the overall preference: each of the three main game elements was seen to have increased the students' motivation slightly. Table 1 presents the results in more detail.

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Table 1. Students' experience regarding the gamified course

Item	Scale (1 to 5)	Average	Standard deviation
Gamified elements were introduced to the Moodle platform halfway through the course. Which version did you prefer?	1 = strong preference for the non-gamified version, …, 5 = strong preference for the gamified version	3.7	0.83
To what extent did the following elements affect your motivation?: *1) Visualisation of progress via the avatar*	1 = decreased motivation significantly, …, 5 = increased motivation significantly	3.7	0.68
2) Collecting badges		3.6	0.68
3) Digital Wizard narrative		3.5	0.64

The students also answered open-ended questions regarding which of the course tasks they saw as particularly motivating. Their answers highlighted especially tasks that allowed them to be creative and produce something.

All tasks where you could make e.g. presentations, animations, code and to use your creativity!

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I thought it was fun to make your own animation or game and to play others' creations afterwards. Making my own website was fun too because I was very satisfied with the topic I chose.

Table 2 presents the results of the user type scale (Tondello et al., 2019). In this group, the Socialiser (mean score 24.9) and Philanthropist (24.3) types had clearly higher total scores than any other user types. The distinctly lowest score (13.6) was in the Disruptor category.

Table 2. User type distribution in the second-year pilot

User Type	**Mean Score (min 4, max 28)**	**S.D.**
Socialiser	24.9	2.54
Philanthropist	24.3	2.26
Free Spirit	22.3	3.01
Achiever	21.5	2.96
Player	20.8	2.57
Disruptor	13.6	3.39

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As described in the Methodology section, the purpose of the user type survey was to understand the preferences of this particular user group, which in turn would guide us in improving the gamified platform and developing it further to better suit these preferences.

Whereas Tondello et al. (2019), whose study was conducted as a general online survey, found that the most common user types were Philanthropists, Free Spirits and Players, our pilot with teacher students revealed a stronger focus on the social dimension. The results suggest that providing collaborative opportunities can be seen as a priority when developing the gamification and adaptivity of an online course intended for teacher students. On the platform used in this pilot, social and collaborative elements were still in a somewhat small role, and the development of such features can be seen as one key goal in the future.

Third-year pilot: Gamification techniques and user profiles (A22, A23, A24)

In order to verify the assumption regarding the importance of social elements in gamification with teacher students, we administered the user type survey also to the students participating in this pilot course. Table 3 presents the user type results. They are closely aligned with those from the second-year pilot: again, Socialiser (mean score 23.4) and Philanthropist (24.4) were the two most common types, Philantrophist scoring higher in this group. The Disruptor (13.8) type scored again significantly lower than the other types. In other words, the assumption based on the previous pilot was largely confirmed.

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Table 3. User type distribution in the third-year pilot

User Type	Mean Score (min 4, max 28)	S.D.
Philanthropist	24.4	2.12
Socialiser	23.4	3.56
Free Spirit	22.1	2.97
Achiever	20.8	3.00
Player	20.8	3.16
Disruptor	13.8	3.92

The students' background regarding game-playing was similar to the participants in the previous pilot: on average, they played games on a monthly basis. Compared to the previous group, however, they were more experienced users of online learning platforms, almost all of them having studied more than one course using an online platform. Their expectations regarding studying on an online platform were also slightly more positive, averaging at 3.9 on a scale of 1 (very negative) to 5 (very positive).

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It should be noted that in the case of the third-year pilot, the COVID-19 confinement started halfway through the course. This is an issue that needs to be considered when interpreting the results. Firstly, the main problem caused by the situation was that the response rate of the final survey was significantly lower compared to the initial survey; fewer than half (N=27) of the students responded to the final survey despite reminders. Secondly, we cannot isolate any results related to this course from the broader context where the study circumstances changed dramatically overnight, which may have affected student motivation in general.

Table 4 presents the students' preferences related to the specific game elements; as we can see, the average ratings were slightly lower than in the previous pilot. In this pilot, the results of the gamification user type survey (and the idea of the user types in general) were presented to the students and discussed with them. The students assessed the Moodle environment (including the game elements and more collaboratively oriented tasks) to have matched their personal gamification preferences somewhat well (average 2.1 on a scale where the value 1 corresponds to "very well" and the value 4 to "not at all").

Table 4. Students' experience regarding the gamified course

Item	Scale	Average	Standard deviation
To what extent did the following elements affect your motivation?: *1) Visualisation of progress via the avatar*	1 = decreased motivation significantly, ..., 5 = increased motivation significantly	3.4	0.75
2) Collecting badges		3.3	1.07

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3) Digital Wizard narrative		3.1	0.80
Different player types were discussed in class. In your opinion, to what degree did the Moodle environment of this course match your personal preferences in terms of gamification?	1 = Very well, 2 = Somewhat well, 3 = Not very well, 4 = Not at all	2.1	0.43

The students' views on particularly motivating tasks were very similar to those in the previous pilot: they were motivated especially by tasks where creativity, active exploration, and challenging oneself played a significant role.

In fact, all tasks where you could do things and be active instead of just passively observing were motivating.

3. CONCLUSIONS AND DISCUSSION

Pedagogically meaningful use of gamification considering user profiles (A25, A26)

The pilots highlighted motivation-related issues that lend themselves to be addressed by gamified solutions in the use online learning platforms. Students' overall experience on gamification was positive, and the user type survey – supported by qualitative feedback – revealed that for this particular target group, socially oriented elements were important.

User type data can help us develop adaptive gamification: with the aid of user profiles, it is possible to recommend a specific, tailored version to a particular subgroup. For example, our results suggest that the *Philanthropist* and *Socialiser* user types are very typical with teacher students. Based on the

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user profiles, we can determine which game elements or task types should be emphasised and to whom these should be offered. In the case of teacher students, a more socially and collaboratively oriented version can be recommended, for example, to all students whose combined Philanthropist and Socialiser score is higher than the combined average score of the whole group.

There are still many practical challenges, however, when it comes to implementing such solutions on a larger scale. Our pilots aimed to develop and apply the adaptivity of basic Moodle tools, and to a large extent, this goal was met and we were able to find new ways of using these tools. However, there were still challenges related to implementing automated recommendations based on user types. Furthermore, organisation-specific restrictions can hinder the use of some useful plugins, which may limit the possibilities for developing dynamic game-based elements.

From the gamification perspective, it is important that the game elements not appear contrived to the users. Gamification is not the goal per se; its purpose is to support motivation and engagement. In some cases, task types and contents might play a more significant role than actual game elements when it comes to responding to the needs and preferences of a particular user type.

Furthermore, especially with respect to our main target group (teacher students), it is worth exploring some more collaboratively oriented approaches as well. For teacher educators, we can suggest two ways forward:

In the first one, the question is "what can we do on Moodle-based courses"; after all, for administrative reasons, Moodle is often the go-to platform for course material and activities. Firstly, we can tap into the motivational potential of gamification and implement some small-scale game elements, such as visualising progress through avatar development – which is both useful for the student and more fun than a basic progress bar. Secondly, we can make sure that the learning tasks and activities are versatile and offer opportunities for using one's creativity.

In the second approach, we look outside traditional learning platforms: Virtual Reality provides whole different affordances for the social and collaborative dimensions of learning. When we look at the things that were important for teacher students, Virtual Reality ticks many boxes: collaboration, social interaction, exploration, immersion, creativity.

These approaches do not cancel each other out; rather, they complement one another. Traditional learning platforms work well as platforms for course material and assessment, whereas more immersive environments open up new opportunities for collaborative pedagogical activity.

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4. PUBLICATIONS

Publications related to gamification in the pilots presented in this deliverable:

- Nousiainen, T., Vesisenaho, M., Ahlström, E., Peltonen, M., Fort, S., & Gómez, S. (2020). Gamifying Teacher Students' Learning Platform: Information and Communication Technology in Teacher Education Courses. In F. J. García-Peñalvo & A. García-Holgado (Eds.), *TEEM'20 : Proceedings of the Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 688–693). ACM.

- Nousiainen, T., Vesisenaho, M., Ahlström, E., & Peltonen, M. (2020). Moodlea pelillistämässä: kokemuksia opettajaopiskelijoiden tieto- ja viestintäteknologian kurssilta. [Gamifying Moodle: Experiences from an ICT Course for Teacher Students.] Yliopistopedagogiikka [University Pedagogy], 27 (1).

- Comas-Lopez, M., Hincz, K. P., Gámez, A., Yáñez-Mo, M., & Sacha, G. M. (2018). Adaptive tests as a supporting tool for self-evaluation in theoretical and practical contents in Biochemistry. In *Proceedings of the Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'18)* (pp. 180–184). ACM.

- Comas-Lopez, M., de la Rubia, M. A., & Sacha, G. M. (2018). Adaptive test system for subjects that simultaneously include theoretical content and numerical problem solving. In *Proceedings of the 2018 International Symposium on Computers in Education (SIIE)* (pp. 1-5).

Publications related to gamification in the context of other ADeAPTIVE pilots:

- Subirats, L., Fort, S., Martín, Á., Huion, P., Peltonen, M., Nousiainen, T., Miakush, I., Vesisenaho, M., & Sacha, G. M. (2019). Adaptive techniques in e-Learning for transnational programs. In M. Á. Conde González, F. J. Rodríguez Sedano, C. Fernández Llamas, F. J. García-Peñalvo (Eds.), *TEEM'19: Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 879–884). ACM.

- Subirats, L., Fort, S., Hernández, C., Pérez, L., Vesisenaho, M., Nousiainen, T., Peltonen, M., Miakush, I., & Sacha, G.M. (2019). Intelligent Tutoring System in Archaeology. In T. Bastiaens (Ed.), *Proceedings of EdMedia + Innovate Learning 2019.* Association for the Advancement of Computing in Education (AACE).

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In addition, there is presently a Master's Thesis in progress pertaining to the gamification user types, based on the data from second- and third-year pilots (expected completion by the end of the spring semester 2021).

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