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12 PEDAGOGICAL PRINCIPLES FOR THE USE OF GAMIFICATION IN HIGHER EDUCATION

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Abstract

Gamification can increase users' engagement with a system. In education, particularly in Higher Education, this strategy has been advocated as promoting students' engagement with a course. Despite a growing body of research on the potential positive effects of gamification in learning contexts, the design of gamification still lacks inputs from educational theories and knowledge. In this paper, we propose a list of pedagogical principles and a model of implementation that can assist teachers and other educators in the gamification of their course units. We also hope to contribute to improving existing gamification experiences and to create evaluation instruments.

Keywords: Gamification, Guidelines, Higher Education, Instructional Design.

1 INTRODUCTION

Gamification refers to the use of game design elements in contexts other than games to increase user engagement with a system [1-3]. This strategy has been used in learning contexts to improve learner's motivation, participation, collaboration, and self-guided learning [4]. Gamification seems to be especially appropriate for higher education, where learners are expected to work autonomously and regulate their learning processes using organization skills, time management and metacognition. Gamification can help to develop these skills by giving optimized feedback and visualization tools that help learners understand their progress and stay motivated. Although research on the effects of gamification in education proves that this strategy can help to create more exciting learning experiences, these results should be viewed with caution since there is a limited view on what are positive learning outcomes [5]. When evaluating the impact of learning methodologies, it is fundamental to go beyond students' grades and look for contributions to meaningful and deep learning [6].

Contrary to games that demand specialized skills and technical resources, gamification is a motivational structure [4] that can be implemented by any teacher willing to do so. However, to be beneficial and have an impact on the learning experience, gamification systems need to be designed with the best practices of instructional design to mediate the learners' actions and learning contents [2].

There are several gamification frameworks available to those who wish to use this methodology in a learning experience. These frameworks describe and categorize the available elements and parts of a game but usually lack the explanation of their pedagogical foundations [5-9]. The purpose that moved us was to contribute to a positive impact in teaching practices, supported by theoretical foundations to improve current teaching practices.

In this paper, we present *12 key pedagogical principles* for the use of gamification in the context of Higher Education. These principles are driven by socio-constructivist and learner-centred learning approaches and adapted for gamification settings. The topics covered by these 12 principles are *motivation, individuality, intentionality, autonomy, interaction, collaboration, challenge, elaboration, relevance, feedback, inquiry, and assessment*.

These principles are to be implemented using an adaptation of the ADDIE model [10] for developing instruction to create effective learning experiences that consider the diversity of the participants and the specificities of content areas [6].

Both gamification developers and researchers conducting evaluation experiments can benefit from the use of these principles guidelines to design and evaluate gamification experiences.

The rest of this paper is as follows: In Section 2 we explain the methodology used to identify the pedagogical principles for the gamification of learning in Higher Education; in Section 3 we present and detail each one of these principles; in Section 4 we suggest a model of application of gamification to course units in Higher Education, and in Section 5 draw the conclusions from our work.

2 METHODOLOGY

To create the set of 12 pedagogical principles for the use of gamification in Higher Education, we have conducted a three-step development methodology (See Fig. 1). First, we conducted a literature review to identify core principles in gamification, adult education, higher education, and instructional design. The criteria used to select principles in the literature were: the possibility of creating innovative and compelling learning experiences; principles driven by socio-constructivist perspectives; and principles based on learner-centred learning approaches.

Second, a design-based research project was conducted to develop a gamification model for Higher Education. This process is still ongoing and will allow us to validate the principles in the different steps of the model implementation.

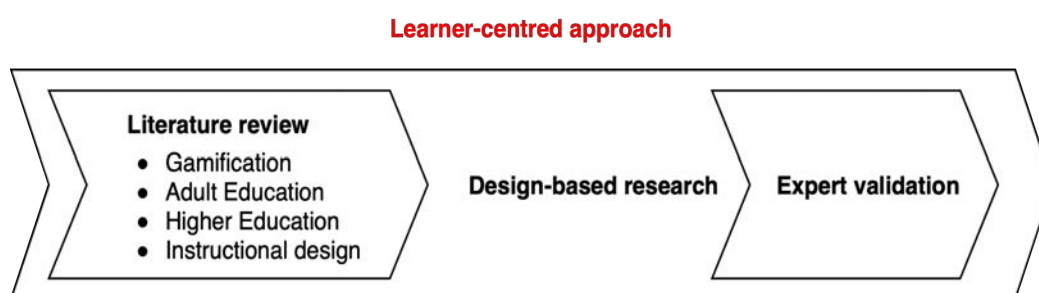


Figure 1. Development methodology

Finally, the selected principles and their definition were submitted to validation by instructional design specialists and experts in higher education pedagogy. The experts' recommendations were compared and the final selection of pedagogical principles for the gamification of learning in higher education was made.

After completing these steps, we could select 12 principals that can provide a pedagogical foundation for the design, implementation, and evaluation of gamified learning experiences in Higher Education.

3 PEDAGOGICAL PRINCIPLES FOR THE USE OF GAMIFICATION IN HIGHER EDUCATION

In this section, we present each one of the principles in an organized way, from the point of view of a rationale for the design and organization of the teaching and learning process.

The goal is to support teachers and learning designers in the decisions they will take regarding the definition of the objectives of learning, the selection of the most appropriate resources to enable students to achieve these goals, and the means of monitoring, supporting, and evaluating the planned learning.

The set of principles is shown in Fig. 2 and each one is described in the next paragraphs. We opted for a presentation on topics to make it easier to read.

#1: Motivation: *Learning is most effective when students are intrinsically motivated and have an interest and enjoyment in what they are learning (content) and how they are learning (the way the activity is structured).*

As with the challenges posed in the games, the involvement of students in activities can lead them to experience a state of absorption and loss of the sense of time. The organization of teaching must create opportunities for challenge and provide sources of pleasure, both through the topics covered and by dynamics created.

#2: Individuality. *Learning is most effective when considering the personal characteristics and individual needs of students, their perceptions, and the way they approach learning, or their preferences regarding how teaching is organized and how knowledge is represented.*

As students are different in terms of personal characteristics, the design and organization of teaching should be flexible and consider individual differences, allowing for multiple, diversified paths and, if possible, adapted to each one. The adaptation or personalization of teaching can take into account different profiles of students regarding their interests and expectations, the way they approach learning tasks, and their preferences regarding learning methods and different ways to represent contents (verbal, visual, auditory, etc.).



Figure 2. 12 principles for the design of gamified learning experiences

#3: Intentionality. *Learning is most effective when it is intentional, and objectives are explicit and understood by students.*

The organization of teaching must start from a clear definition of the learning objectives in articulation with the requirements of a given course.

#4: Autonomy. *Learning is more effective when it is assumed and conducted by students' themselves, mobilizing their higher-level cognitive skills and capabilities, namely those related to metacognition and self-regulated learning.*

Learning is favoured when students have the opportunity to reflect in a structured way on what they are learning and have the possibility to make choices on the way forward. Cognitive self-regulation is a set of skills that can be taught to students in different ways. Educators should provide contexts that inspire, motivate and guide students to define their own learning goals; to select the appropriate learning strategies to achieve them; and to manage time and available resources.

#5: Interaction. *Learning is more effective when students have the opportunity to talk to each other or with other people, benefiting from the presence of multiple perspectives on the topics studied.*

In fact, learning seems to be better achieved when students do have the opportunity to confront their ideas and vision of the world with those around them, whether they are colleagues, teachers or other people related to the topics under study, such as scientists and experts in the topics under study.

#6: Collaboration. *Learning is more effective when students collaborate and cooperate in developing solutions for solving problems, which are relevant skills for the exercise of their future professional activity.*

The organization of teaching must promote the involvement of students in concrete situations that give them the opportunity for collaboration and cooperation, thus contributing to the development of interpersonal skills.

#7: Challenge. *Learning is most effective when the activities are sufficiently challenging and achievable and when there is a balance between the difficulty of the task and the student's perception of being able to do it successfully.*

Learning is more effective when the student has the perception that carrying out an activity is within his reach. According to Flow theory, only activities perceived by students as sufficiently challenging but achievable can trigger an optimal absorption state that leads them to experience a loss of sense of time.

#8: Elaboration. *Learning is more effective when students have the opportunity to elaborate, create or produce something (learning by doing).*

Learning is more effective when students are encouraged to act on what they are learning and are not limited to reproducing what they read or heard from the teacher. The design of learning experiences should include the development of learning products that incorporate and are representative of the knowledge and skills that students developed. Teachers' responsibility is not the transmission of knowledge, as traditionally. Ultimately, teachers' role is more about creating opportunities for students to elaborate or produce something that implies their active commitment in the search and selection of information considered relevant for the purpose in view.

#9: Relevancy. *Learning is most effective when students deal directly with problems, situations, or authentic real-life phenomena to which they attribute relevance and in which context the knowledge and skills to be developed make sense.*

The authenticity and practical relevance are given by students to what they are learning for their professional future and contribute to their greater involvement in learning.

#10: Feedback. *Learning is more effective when students receive immediate feedback on their performance in completing a task, especially when this feedback is presented in good time and constitutes adequate and relevant information to allow the necessary readjustments and the search for processes or alternative paths.*

In practical terms, feedback is a powerful strategy for monitoring learning, especially on the part of the student. In addition to the incentive that feedback represents, it allows students to have relevant information about what needs to be done to overcome identified difficulties.

#11: Inquiry. *Learning is more effective when students are challenged by problems or questions they need to answer, stimulating the search for relevant and meaningful knowledge, the articulation of ideas and critical reflection.*

According to this principle, learning is favoured when students have the opportunity to question themselves about the world around them and when encouraged to find answers to problems or challenges they are facing. By stimulating critical and creative thinking, the proposed learning activities should appeal to the satisfaction of the students' curiosity, involving them in an active search for solutions to the identified problems. The search for information to understand problems, the conjecture of possible alternative solutions, and the articulation of ideas necessary to find the best solution are factors to consider in the design of activities that promote active inquiry, understanding and problem-solving.

#12: Assessment. *Learning is most effective when assessment practices are designed to support and maximize students' performance, whether through their active involvement in the activities or their academic outcomes.*

Since assessment can play a decisive role in student learning, the design and organization of teaching must include assessment strategies to help achieve the expected results. Furthermore, it should offer students a clear view of the relationship between the defined learning outcomes, the activities, and tasks that students are encouraged to perform, and the modes and criteria used in the assessment of learning.

4 STEPS FOR THE DESIGN OF GAMIFIED LEARNING

To guide the creation of gamified learning experiences in Higher Education, we suggest an adaptation of the ADDIE model for instructional design. Fig. 3 displays the model adapted to gamification and the phases teachers and learning designers can follow to gamify a course unit. These phases are detailed in the next subsections.

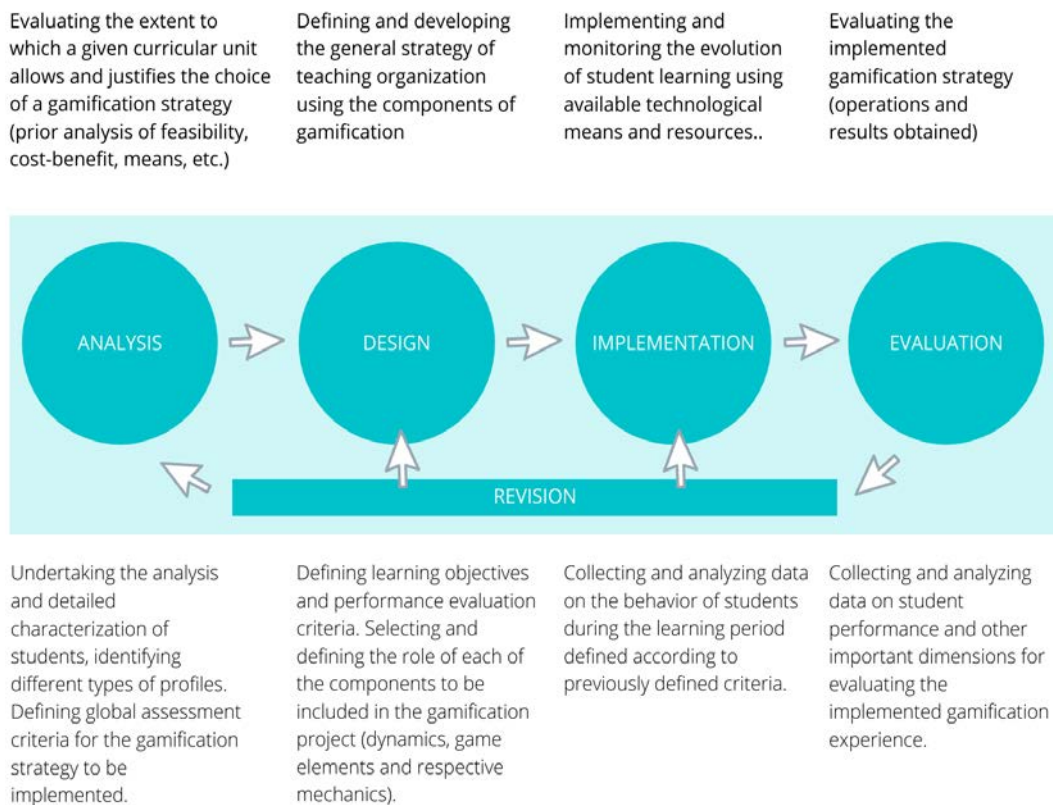


Figure 3. Steps for the design of gamified learning

4.1 Analysis

During the Analysis phase, it will be necessary to collect the information available to assess whether the project of the course unit gamification will move forward. It is important to reflect upon the following topics:

- Why is gamification considered a good alternative for organizing the teaching and learning process in this course unit?
- How much time will be necessary to dedicate to this project?
- What kind of resources need to be guaranteed?
- What is the role of the course unit in the set of units of the course?
- What external professional standards must be met?

The effort necessary to develop this project and to monitor its implementation is a sensitive aspect that should be carefully considered at the beginning of the process as the decision to move forward will depend heavily on this.

In the Analysis phase, the teacher or learning designers should focus on studying the syllabus of the course unit to be gamified and reflect on the adequation of gamification to the objectives and contents of the course unit program. For the detailed analysis of the Program, teachers must have a thorough knowledge of the scientific content. This will help to identify curriculum sequencing and the dependencies and interrelationships that may be established between the parts of the content and where segmentation makes sense. Teachers should also have the pedagogical knowledge to identify the most appropriate learning tasks and assessment methods. Afterwards, it will be possible to identify which content should be part of a common strategy for all students and which ones can be part of different learning paths to be chosen by the students.

For the Analysis phase, it may also be useful to understand how students usually react to learning tasks, the topics of content in which they have more difficulties, what are some frequent errors and the best ways to overcome them.

Once the decision to move forward is made, teachers or learning designers should begin the second moment of the analysis, i.e., the detailed characterization of the students. This task is fundamental to ensure a student-centred approach and generate alternative learning pathways instead of the one-size-fits-all approach.

4.2 Design

In the Design phase, teachers will make use of the principles presented in Section 3. These should be translated into decisions on the organization of teaching. It is also the moment to mobilize knowledge about the potential of the gamification elements to create a pleasant, stimulating environment in which the student feels the support they need to achieve the planned learning.

In this phase, teachers will focus on each of the unit program components:

- 1 The learning goals, i.e., what students are supposed to acquire during a given learning period;
- 2 The contents, i.e., the knowledge that will be the object of study;
- 3 The strategies, modes of work and activities in which students and professors will be involved;
- 4 The resources necessary to carry out the different activities;
- 5 Assessment, i.e., the different types and modalities of monitoring academic work and assessing learning.

Regarding the learning objectives (and their intrinsic relationship with contents and work strategies), two essential questions arise: What students should be able to do by the end of the course? What knowledge students need to acquire to do so? The first question leads us to the identification of the skills to be acquired or developed; the second one is about identifying the essential knowledge for the development of those skills.

Concerning assessment, and bearing in mind the learning objectives previously defined, the task now is to decide which information needs to be collected to measure to which extent students have achieved the expected results. Besides this, it will be necessary to identify the types of learning assessment and moments assessment they will be applied to students. The Learning assessment strategy should consider the results obtained by the end of the course but should also consider continuous and formative assessment over the learning path that each student will carry out in the form of feedback. The teacher or team of teachers must define and explain the criteria that will confirm whether a particular acquisition takes place (assessment criteria). These criteria should be known by students since the beginning of the course. This way, it will be easier for them to organize their study and to make decisions regarding the most appropriate learning strategies for the expected performances.

Finally, this is when teachers combine the previous decisions and start idealizing the architecture of the gamified system. It's now time to decide the following:

- How will the gamified learning experience develop over time?
- Which dynamics will be used so that the process resembles a game?
- What will happen during the game?
- Which game elements will be used?
- What will be the rules to earn points and progress in the established sequence (game mechanics)?
- What will be the rewards needed to guide each student's progression towards the expected learning?

4.3 Implementation

In the Implementation phase, the work of the teachers or learning designers will be to execute the activities planned and to follow up and monitor the evolution of students' learning and engagement. The use of platforms makes it possible to use automatic data collection about students' behaviour should also be considered in this phase. The implementation of automation processes can be helpful to assess and anticipate changes in students' engagement and predict student dropout.

4.4 Evaluation

The purpose of the evaluation phase is to understand to what extent the learning gamification experience was successful according to the results obtained. Some of the questions to ask during this phase are:

- To what extent was the effort made to implement the gamified learning experience rewarding?
- To what extent the project made visible positive changes related to the reasons that led to the gamification strategy (increasing students' engagement and motivation; favouring autonomous learning; improving students' performance, etc.)?
- What were the main obstacles or difficulties to the implementation of the gamified learning design?

Answering these questions will generate a set of suggestions and recommendations to be used in the next phase (Revision) to reconfigure and improve the new instances of the course unit. This analysis should be complemented by inquiring the students about their learning experience and their perception of the activity they had the opportunity to develop. For this, it will be necessary to conduct interviews or inquiries with the students at the end of the unit. Students can also be asked to rate the learning activities over the semester. Other data sources that can be used for the evaluation task are motivation and engagement indicators and the feedback generated in online forums.

4.5 Revision

The Revision phase is usually performed at the end of each instance of the application of the course unit. This task should be based on the information collected over the semester and consists in making the necessary adaptations to the gamification settings to maximize the strategy the next time it takes place (next year or semester).

However, the implementation of a gamified course unit demands extra effort from teachers, and, for this reason, it may be wiser to perform the revision task throughout the implementation process, collecting data continuously.

Some of the questions to ask during the revision process are as follow:

- Is the gamified course being implemented according to what was planned?
- How are the students reacting to each element of the game?
- Are students engaged in the course?
- How are students performing?

In summary, these steps will allow educators and/or learning designers to answer to the challenge of gamifying learning.

5 CONCLUSIONS

In this paper, we have presented a curated list of principles and an implementation set of steps to assist Higher Education teachers or other educators in the gamification of learning for a course unit. These proposals are part of an ongoing project to generate a model for gamification in Higher Education that will still be implemented, submitted to an evaluation process, validated, and made public. This set of principles can be used by teachers and learning designers to create gamified learning experiences, improve ongoing experiences and create evaluation instruments of those gamified learning experiences.

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