Teaching Case of Gamification and Visual Technologies for Education

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ABSTRACT

This paper describes the use of gamification and visual technologies in a classroom for higher education, specifically for university students. The goal is to achieve a major increase in student motivation and engagement through the use of various technologies and learning methodologies based on game mechanics called gamification. Gamification is used to engage students in the learning process. This study adds learning methodologies like Learning by Doing to students' collaborative work, and mixes teacher support with new, accessible technology, such as virtual reality and visualization 3D on the web thanks to webGL. This creates a new management tool, called GLABS, to assist in the gamification of the classroom. Understanding the role of gamification and the technology in education means understanding under what circumstances game elements can drive a student's learning behavior so that he or she may achieve better results in the learning process.

Keywords: *3D Education, Engaging, Gamification, Learning Management System, Mixed-Methods Evaluation, Oculus Rift, Problem Based Learning, Quest Based Learning, Virtual Reality, Web GL*

1. INTRODUCTION

Engagement is the main objective in applying gamification (Kapp, 2012; Huotari & Hamari, 2012; Dixon, 2011). Gamification isn't about turning the classes into a game; although the gamification technique is not truly an academic methodology, it may improve the performance of students in the learning process (Pozo, 1993; Trilla, 2011; Xu, 2012; Carr, 1998). Gamification is about applying game mechanics to any project, idea or situation (Zimmerman, 2003). In our case, we want to implement some game mechanics to make learning (Prieto, 2008) and instruction more fun (Sheldon, 2011; Hamari, 2014); consequently, this will allow longer

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retention of the material among the students. To apply game mechanics and achieve a level of fun, we must first follow some rules. In gamification, rewards can be delivered through the creation of leaderboards, badges, and loyalty programs that encourage students to have fun and perform a learning activity as desired by the teacher. The gamification for learning purposes, we think, is not only about badges, rewards and points themselves; it is about measuring qualification and achieving motivation. Students need motivation when learning; they need the feeling of accomplishment and success of striving against a challenge. They need to feel that they have overcome a difficulty, to push them forward to the next level.

In this paper, a mixed-methods study evaluating the motivation, satisfaction and academic performance of degree students is presented. The methodology is both quantitative (through a structured test) and qualitative (using the Bipolar Laddering, BLA (Pifarré, 2007)), and it is based in the use gamification and the use of technology for 3D arts creation for multimedia purposes such videogames or films.

The working hypothesis to be confirmed is whether students who learn 3D with gamification techniques will obtain better academic results because they are more motivated and satisfied than they are under the classic working system. Our secondary objective is to ascertain through a mixed-methods analysis of quantitative and qualitative data the most positive and negative aspects of the experience, with the aim of adapting the implementation method in future iterations and for other subjects. Our final Objective is solve with a new platform all the needs for gamify a subject. This paper includes an overview of academic performance using gamification and visual technology and discusses how this type of technology can improve students' 3D skills. The main features of quantitative, qualitative, mixed research applied in the educational framework are described in Evaluation section.

The central thesis of the current study is based on two main ideas: 1) making use of the innovations in teaching in the university framework that involve gamification techniques to achieve higher motivation and degree of satisfaction among the students; and 2) discovering a better way of presenting and learning 3D modeling. To achieve this second goal, two techniques are used: the first is delivering the models online, where the 3D model can be uploaded and visualized on the web. In this case, the technology used will be webGL and HTML5 by Sketchfab so that 3D models can be directly uploaded on the web in a simple and effective way.The web allows one to visualize and interact with an object on a web navigator installed on a tablet (Android, iOS) or desktop computer. The second method would utilize Unity for major 3D content playsets that the students could interactively manipulate, explore and share with other students. This type of presentation is useful for directly visualizing a model and evaluating it independently of the modeling tool used. To exemplify the last methodology proposed, the following section of the study will describe a real exercise applied in a Multimedia degree on the subject of "Computer Animation" at La Salle, Ramon Llull University, a five-ECTS-credit course that is taught annually.

For the last objective, we solve some needs for gamification creating a new tool for gamifying education. This new platform, called GLABS has the objective to use Schoology (Friedman, Hwang, Trinidad & Kindler, 2007) as an Learning Management System (LMS) and change its interface to produce a G-LMS (Gamified Learning Management System). GLABS allows users implement quick game mechanics for their courses, such as badges, analytics, progress bars, lives, portfolio 3D, adventure map, avatars, and such like. These elements are essential to produce a good classroom game mechanics. Understanding the role of gamification in education means understanding under what circumstances game elements can drive a student's learning behavior so that he or she can achieve better results in the learning process.

The first section of this paper, includes an overview of good practices in education. The study of gamification for education and the methodology used is described in the implementation of the proposed case study. Section called Glabs includes the design of a new platform for gamify a classroom specifically for 3D subjects. The main features of quantitative, qualitative, mixed research and the User Experience (UX) concepts applied in the educational framework are described in method of evaluation that includes the research results, which are discussed in the last section conclusions.

2. METHODOLOGIES OF EDUCATION AND GOOD EDUCATION PRACTICES

The working hypothesis of the current study is to determine if the experiment has been correctly developed so that students will obtain better academic results through the realization of more engaging and satisfactory tasks than the classic system of learning. To achieve this, we implemented different methodologies: Problem-Based Learning (Branda, 2008), Quest-Based Learning (Haskell, 2013), and gamification techniques in the classroom.

To incorporate IT-based methodology into a specific teaching environment, some recommendations for avoiding student rejection must be considered (so-called "good educational practices" that are primarily focused on virtual rooms, e-learning, and semi-present teaching (Fariña,2010; Salinas,2004)). From the specific characteristics that shape these practices, four points can be extrapolated, as indicated by the following principal objectives:

- Promotion of professor-student relationships, allowing for a more effective feedback process.
- Dynamic development among students, which is made possible by collaborative techniques.
- Contribution to better task realization by heterogeneous learning methods, meeting high expectations.
- Applying teaching/learning methods based on teaching innovation and new IT technologies.

This type of presentation is useful for directly visualizing a model and evaluating it independently of the modeling tool used. To exemplify the last methodology proposed, the following section of the study will describe a real exercise applied in a Multimedia degree on the subject of "Computer Animation" at La Salle, Ramon Llull University, a five ECTS-credit course that is taught annually.

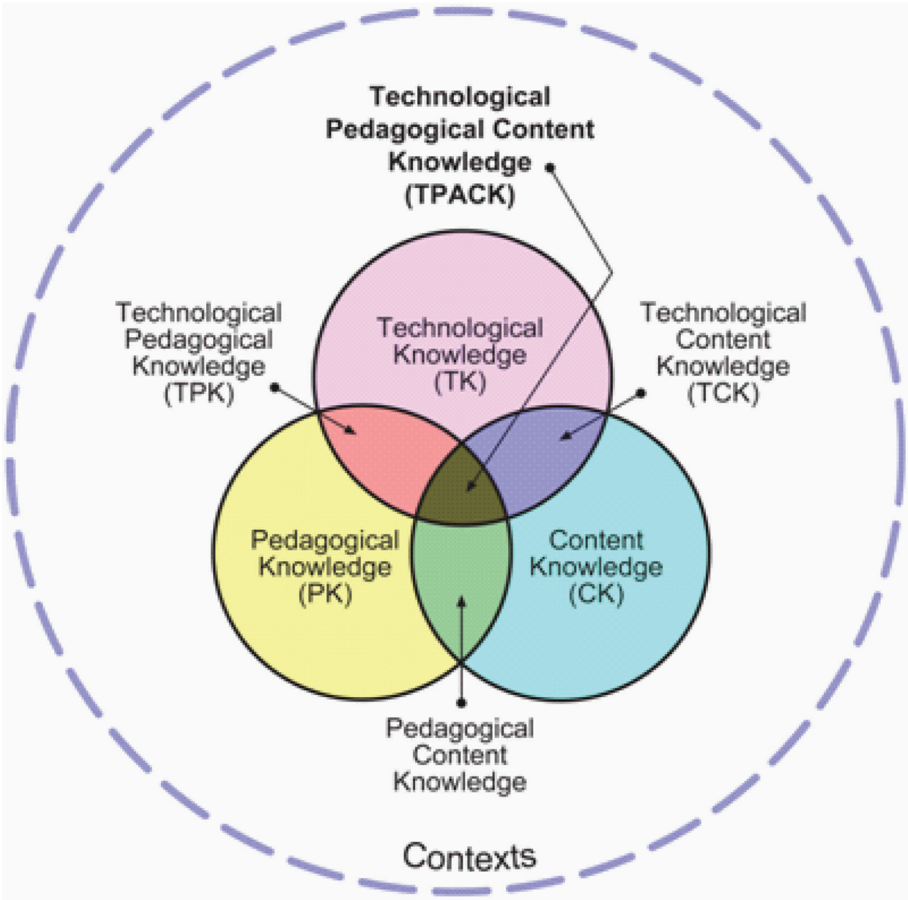
One conceptual method that teachers employ in engaging their students is the TPACK model (Technological Pedagogical Content Knowledge; Shareski, 2013). TPACK (which was established around the same time Shulman's idea of Pedagogical Content Knowledge came into being), describes how an activity that requires technological use must be integrated adequately in the classroom. It must interrelate three knowledge fields: curricular, pedagogic and technologic (see Figure 1).

The summary explanation of the model is based on a current teaching context characterized by a high degree of complexity and a great dynamism making necessary the integration of multiple knowledge:

- The curriculum, which can be understood as the theme, block or contents selected for the technological implementation, without forgetting the objectives to be achieved and the possible prior knowledge to bear in mind.
- The pedagogic, where we will define the activities and their deliveries, teachers and students roles and the evaluation system.
- The technical, where we will define the training needs that make necessary defined technological resources, the selection criteria of the technological devices and how will they be used.

If in the process of designing an educational experience, we include appropriate individual

Figure 1. The TPACK framework and its knowledge components. Reproduced by permission of the Publisher, © 2012 by tpack.org



aspects of the main areas, we will be closer to redefining and integrating any type of technology into teaching activities, moving away from classic approaches that have been used in current and past technology integration efforts (Harris, 2009):

- Software-focused initiatives
- Demonstrations of sample resources, lessons and projects
- Technology-based educational reform efforts
- Structured/standardized professional development workshops or courses
- Technology-focused teacher education courses

These approaches tend to initiate and organize their efforts according to the educational technologies being used (and preferred by the teacher or the institution) rather than the students' learning needs, which is exactly the opposite of our desired approach in which the user is a central element of the experience, due to the user's technological profile, motivation for experiencing new pedagogical methods, and evaluation of both the quantitative and qualitative aspects of the experience. This approach provides primordial data about new models of technological implementation in the teaching field.

The learning methodologies and techniques used in this case study are:

- **QBL** is an instructional design theory that leverages game mechanics and gamer-like learning communities to support students. Quest-Based Learning incorporates game mechanics and game–like learning communities into the lesson. Students (Haskell, 2013) in a quest-based course received higher grades overall when compared to traditional courses. In both video game and Quest-Based Learning architectures, quests are goal oriented (or task-oriented).
- **PBL (Problem-Based Learning)** begins with a problem or a problematic situation which addresses a group of students who must work collaboratively with the support of a tutor to solve the problem (Branda, 2008).
- **Learning by doing** methodology is applied in which students pursue a goal by practicing target skills and using relevant content knowledge to help them achieve their goal (Schank,1999; Winn,1995).
- **Gamification** is the concept of applying game mechanics to any project, idea or situation. We focus on this technique/ process in the next section.

3. GAMIFICATION ON EDUCATION

To gamify a classroom we must to follow some principal rules (Sheldon, 2011):

- Feedback! Encourage student-generated content. Every week the professor should deliver a problem (PBL), Quest (QBL) or any mission; to do that, it is very important provide quick feedback of the student's work. The teacher's role is to offer constructive feedback and to help guide student learning.
- Collaboration. It is important for the learning process to follow the game mechanics of multiplayer games: challenging students with collaborative quests with real people to achieve a common goal speeds the learning process significantly. For instance, the students could be challenged with exercises that they must complete together, and missions with group of several students that compete with one another. Working together is the goal of a challenge, a win-win strategy.
- Scorekeeping, leaderboards, levels and rewards! Any effective implementation of gamification is clear on the rules of the game, as well as the rewards for participation. That means students need to learn how to achieve recognition and how to advance. Rewards are just like currency; instead of monetary value, however, it is social value—prestige and influence.

The clearer method is using an experience points (XP) to Class Grade method. At the end of the semester, a teacher could make a student's grading scale coincide with his or her XP. For instance, if you dish out 2000 XP by the end of the nine weeks, the student would have had to earn 1800 XP to achieve an "A," or to "level-up." Levels, for instance, could be gained in increments of 1000 XP each. This provides the students with instant feedback on their level of knowledge, and clarifies the progress that they have achieved in class. For get the recognition for skills learned and displayed anywhere. We have created several badges with the LEGO® theme for thus purpose. For instance, in Figure 2 will show degrees for a modeing 3D skills with two different type, light and dark side. Graphically, the LEGO® character, for standard level is a jedi or sith of Star Wars™ LEGO® theme that is simply geometric 3D. The second level, called "editable poly" is more detailed model. And the best level, called "turbosmooth" show a more complicated model for modeling.With the same idea is achieved for the main sections of the subject of 3D computer tools.

Figure 2. Badges with LEGO® Star Wars™ characters

- **Quests:** No game can be without quests! A quest is a task-based journey with obstacles that students must overcome. Here we implement a QBL methodology. So, what does a Quest look like in a classroom? Simply, a quest can be a class project, a collaborative presentation, or the designing of a webpage, to name a few. Virtually any activity that involves solving problems to reach a final, tangible goal could be considered a quest.
- **Storyline:** Every video game has a storyline. In the Computer Animation class we will turn the class into a production firm of 3D effects that contracts different work to us. Several companies would hire us for modeling, texturing and creating animation videos for the web or cinema. A story line links the tasks together to create a cohesive whole.
- **Knowledge Map:** A Knowledge Map is simply a guide that illustrates the progression of the class content.

4. GAMIFICATION AND VISUAL TECHNOLOGY: UNITY, SCKETHFAB AND OCULUS RIFT

In the initial phase of the project and for the selection of the system to implement the already established platforms or tools that could be useful for our 3D animation course. For multimedia 3D arts were selected as work systems integration Unity, Sketchfab, and Oculus Rift.

Unity is a game engine that allows you to develop any kind of game with relative ease. This engine allows you to create virtual worlds of high quality and realism for later upload to the web. In our case it has been used to create these worlds with the material created by the students in their missions. Once created, students can visit these worlds to see the work of their peers. This process generates a highly interactive classroom and promotes the work remain more detailed and a better level, because it is something that create and work to show their knowledge.This combined with Oculus Rift activity generates increased quality experience as the latter as virtual reality viewer lets you view generation stereoscopic 3D content.

It also allows to create first-person experiences simulating the movement of the head. Finally, in this case study for gamification and the use of technology, we use Sketchfab, which as a web platform that allows its users to upload 3D models using WebGL for viewing from any Windows, Mac or Linux platform, but is not currently available due to restrictions in iOS Safari browser. With Sketchfab integrate into a 3D platform portfolio, allowing students to upload their work as a public system portfolio. As developers, we firstly study which platforms or tools can be useful for an animation subject. Unity is a game engine creator that allows users to create amazing games and virtual worlds and then upload them to the web. We use this software to create worlds with the content generated by the students, after which students can access and visit this world to view their colleague's works. This experiment, combined with Oculus Rift, creates an amazing experience. Sketchfab is a web platform that allows users to upload their 3D models and makes them available to be visited by all the users of the site.

5. METHODOLOGICAL APPROACH

The methodological approach of this work allows the end users (in this case, students of the first course of the Multimedia degrees at La Salle Campus Barcelona, Ramon Llull University) to participate in the definition of the final product. This is a pedagogical proposal that allows them to be creative during the design process.

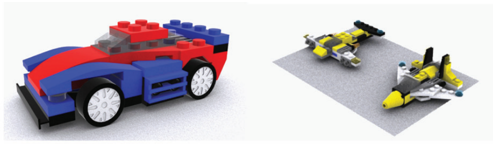
The study will be performed during the 2013–2014 academic year, with students in their second year of a Multimedia Engineering degree. The experimental framework will be completed in the course "Computer Animation I" a five ECTS-credit course that is taught annually. "Computer Animation I" is divided into 30 weeks, comprising about 3 hours each week, giving an evaluated total of 90 hours of classroom time, although the overall equates to 150 hours of workload. Also, qualitative methods will explore their motivations, needs and goals when they are learning computer 3D animation. The methods that will be applied to evaluate this approach are a combination of objective methods based on an empirical model and subjective gathering techniques inspired by constructivist psychology interviews. This way, the active participation of end users will be a reliable guide in establishing a proposal to enhance creativity in each end user's field (Piaget, 2001). We want to teach 3D arts using different methodologies to regular classes, or, following them, magistrate tutorials that are less engaging and with a slower learning curve.

The actual methodology—using exercises in which students try to follow what the teacher is explaining on the classroom projector—will give good results but we believe that performance can be optimized much more. It can also save the students who are failing or leaving the course. This requires a lot more activity in the classroom, collaboration, and learning in an enjoyable way.

6. IMPLEMENTATION OF THE PROPOSED CASE STUDY

The objective of the course is to introduce the creation of 3D content, emphasizing 3D modeling, texture and lighting 3D scenes, and basic knowledge of computer animation, model-driven for design, videogames and audiovisual production. We will conduct one test at the beginning of the course to ascertain the students' attitudes and thus better understand their personal goals. The learning process will take place predominantly in groups, focusing on collaborative challenges and interaction with peers. In the classroom, we will facilitate discussions between groups and hold contests for each group to compete in. The storyline of the game that we will "play" is that the class is a production company specializing in 3D modeling for both the toy industry and for mobile app games. Students will be "hired" for a series of jobs, where they can gain experience and even money. Each model presented will be assessed, and students will gain points. Students

Figure 3. First exercise: A virtual LEGO® car and jet for basic skills



will learn how much they win weekly. It is important to assess the work each week and update the results on a website/blog, so that when the student performs positively he or she automatically receives a reward.

We chose The LEGO® Group as the first firm to employ our classroom for a new product line of toys. The the teacher will show the class what needs to be done, while the whole class will be required to resolve some problems using a new 3D tool (see Figure 3). For instance, we want the students to learn how to move, rotate, scale, snap reference, unit measure, clone and use basic modeling tools. To do this, we will deliver real boxes of LEGO® Creator 3 in 1 and deliver files in 3DS max format with all pieces of LEGO® in 3D, to construct six objects that we will assemble.

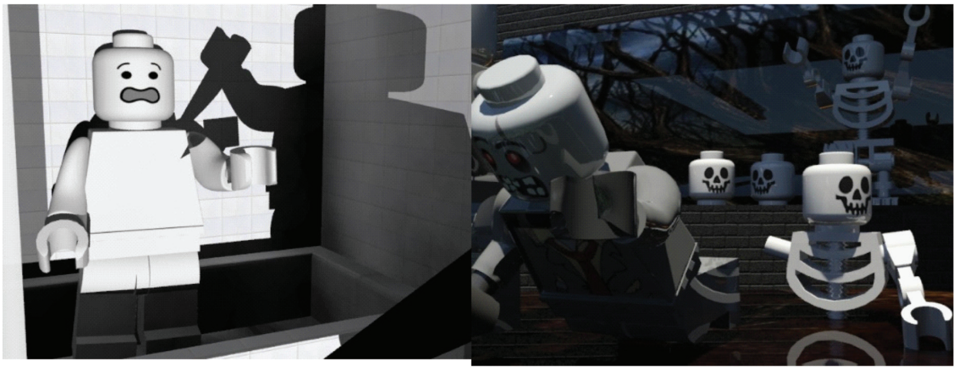
With an interactive list, each student in the class will write down what object they want to build in order to avoid constructing the same objects. It seems certain that some students will want to build with their own hands before building in 3D virtual space. However, the more practice students get with using the virtual 3D tool the better. This is a good way to identify how each student learns and adapts (Gardner, 2000). Before starting the next class, students will be given 10 minutes to resolve any doubts they might have or problems with the instructions. Those who help others resolve an issue in this time will gain points. During this short time frame, assessment is extremely important and motivates the other students to help their classmates. The object modeled, the image rendered or something will be delivered via Moodle and uploaded to Sketchfab for small models. Unity will be used for large playsets for a major interactive experience and major share capability.

In addition to such projects, problems will be designed for students to learn 3D arts, and companies will hire us for three big jobs that we will distribute among different groups.

For example, for the first major task, called P1, we will pretend that LEGO® has hired us to design themed sets (such as Lord of the Rings, Star Wars™, Heroes, Cities, Monsters, etc.), and we will split the class into teams of five or six students, each choosing what theme they would like to take on. At least one student should make a character from LEGO® and a vehicle or structure. The principal idea in such initiatives is collaborative work. For the modeling job of the set, every student can gain 1250 points. Every student may work a lesser set with a minimum of one character and a structure or vehicle. If a student works on more models in their allotted time, they earn more points. Collaborative work is essential, and they will deliver the 3D scene online with Unity, so that one may see it with any mobile device or desktop platform.

Completing a task through quests and in a collaborative way is the principal goal in this type of exercise. All of the characters modeled by the students will be shared with all the other students thanks to the university's computer server. The best texture for instance could receive more points and share it with others groups and students. This is expected to raise the quality of the production and provide an incentive to win, thus engaging every student to share his or her work. LEGO® already have a rich and varied catalog, but to avoid boredom, the "game" will progress through new contracts, each more ambitious and complex with other toy firms (Hasbro®, Mattel®, etc.) or app games. These apps require more complex models, and this incremental complexity will increase the student's skill in 3D modeling, texturing and

Figure 4. Halloween contest



lighting. Also, we will launch different competitions and contests to encourage even more work at home, so the students will take their education beyond just 3D modeling (although we would be careful not to overstep the designated 150 hours of work load). For instance, we will have a contest called "Halloween Contest," with a prize, points and a real objects such as LEGO® figures (Figure 4). The best work will win a giant LEGO® head container. The real price is not very important for engaging the students, but the addition of a real competition and a trophy that persists and the students can see.

Other practices that can be gamified are, for instance, the modeling of organic 3D models (see Figures 5 and 6). Students will have to model the head of itself. Then in class, with all the heads modeled, we will play, "Guess who?" This will allow us to engage the process of organic modeling, analyze overall errors, and clarify these in a relaxed and friendly environment and focus with itself.

In addition, when introducing edge technology we will use Unity and Virtual reality to add all the 3D models with another level for interaction. We will add all the LEGO® sets into Unity and export these for web player and iOS/Android for interaction purposes, far away of view static renders, and this will engage students a little more that will set in the quests quantitative and qualitative. Also, we have an Oculus Rift VR and will set with the glass to establish an interaction experience with the students. The objective of this to see other outputs and videogames or experiences, as well, of course, to increase overall engagement.

We also created a series of badges to introduce on Schoology in this manner. However, the platform is not good enough for this. Therefore, we created an entirely new tool to gamify a management System called GLABS.

7. GAMIFICATION PLATFORM FOR EDUCATION: GLABS

To make this experiment possible we decided to use Schoology (Friedman, Hwang, Trinidad & Kindler, 2007). Schoology is an LMS (Learning Managing System) which allows for the management of course information using a social network aesthetic (Manning, Brooks, Crotteau, Diedrich, Moser & Zwiefelhofer, 2011). We have created a web app that acquires this information and displays it in a gamified format. We called this GLABS (Gamified LABoratorieS; see Figure 7).

The objective of GLABS is to use Schoology as an LMS and to change its interface to create a G-LMS (Gamified Learning Management System). This year we decided to gamify an animation course using a LEGO® theme, although the platform allows any thematic implementation the user may want. Technically,

Figure 5. Practice 1 renders with collaborative work composition

Figure 6. Practice 1 renders and prepared for virtual reality

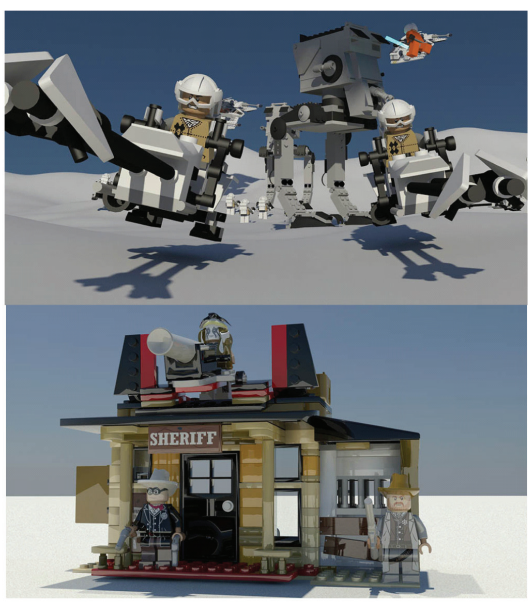


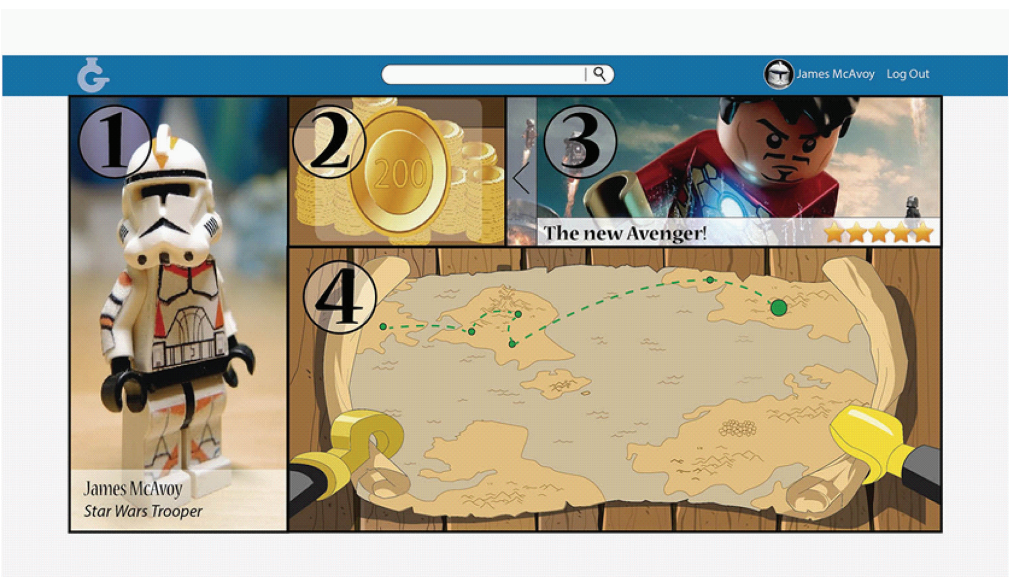
Figure 7. GLABS logo

the platform implementation contains two layers: mechanical and thematic. The mechanical layer contains the rules and all standard elements for its operation. This layer is the same for all courses. The thematic layer is composed of all the content related to a particular course. Using this, teachers can create their own virtual world related to their students' interests. These layers allow an easy customization of all types of courses. GLABS allows game mechanics implementation quickly and easily (such as badges, analytics, progress bars, points, lives, 3D portfolio, adventure map, avatars). These elements are essential for good gamification (Sheldon, 2011).

The image of the Figure 8, shows the profile page. There are four areas distinguished on it:

1. Avatar shows user information (student name, avatar character and avatar name).
2. Score gives the information about grades and class analytics.

Figure 8. GLABS interface profile with LEGO® theme



3. Mission displays all exercises and exams in the course.
4. Adventure Map show global information of the course using a game aesthetic.

7.1. Avatar

The students can create their own avatar in 3D and use it as their profile icon. With HTML5 and WebGL GLABS, one can use a canvas to display this avatar in a 3D model. A 3D model allows it to be viewed from all sides. Students can also use an avatar name.

7.2. Analytics and Points

The platform uses a scoring system and is similar to the analytical games. There is a change the conventional system score. This system will be like the teacher. Instead of scoring students with a score between 0 and 10, you can choose a metric according to the history and themes of the course. The application will allow you to assess students with points, virtual money or even bricks if so desired. For example, if you have chosen for a theme a classic role-playing game, one can use as a scoring system points (P) and life (HP). The platform is also responsible for generating analytics to promote competitiveness among students. Anonymous graphs allow students to check what their position is relative to the rest of the course. With this information, the user will see what is happening in the course and know immediately whether or not he or she needs to do more feedback. It has been shown (reference) that competition promotes greater effort among users, creating a need for improvement. If the user sees that he is in 5th position and needs only 300 points to advance to 4th, he will make a greater effort in the next installment to reach his desired new position. It is possible to disable the option of anonymity, such that students can see that their peers have qualifications, but by default this option is enabled, for privacy reasons and for the standards of each school.

7.3. Missions

In the platform, exercises are translated into missions. A mission will have a title, a related image and a score. Students can swop between missions. The mission selected is marked on the map with a big circle. Non-selected missions are shown with little circles on the map. Red circles indicate that the mission has not been completed, and completed missions are marked with green circles. If an exercise has not yet been delivered, rather than a score, the deadline appears. Clicking on side arrows, one can display earlier and subsequent missions, allowing the student to observe their ratings of all previous years.

GLABS introduces the mission concept at its mechanics. In the traditional method, missions are the equivalent of exercises and exams. Analyzing these elements we note that an exercise comprises a goal and a score. In games, we can see that missions also have this format. It is for this reason that the platform implements a system in which students undertake not boring class exercises, but live adventures, and try to achieve the highest score in each of the obstacles encountered along the way. Changing the traditional method, suggesting a problem, GLABS creates a space in which witty stories through pictures conduct the user to perform their exercises in the most entertaining way. Although this system platform is easy to use, one must not forget that for a correct gamification it is essential that the exercises have a wrapping-gamification format and also game mechanics. At this point the teacher of the subject must use his or her imagination to create an exercise with which to finalize, acquire essential knowledge and ensure the student entertainment.

7.4. Adventure Map

The adventure map (Figure 9) presents a design in which the entire course, encompassing exercises, is presented in a visual format in the style of a map of platform games. The map shows different islands, each of which has a name and a set of missions associated

Figure 9. Adventure map shows the last mission of the first selected island

with them. We can understand these islands as blocks within courses. In each block is an overarching theme of the course and within this all exercises related to the topic appear. The missions within these islands are marked with a circle of different color according to its current state. The tasks yet to be completed are shown in red, while exercises and events are displayed in green. If we find ourselves in a mission we will see a pop-up with the information related to that period. This information is the same as that which appears on the homepage of the application. The mission will show its title, a descriptive image and punctuation.

7.5. Ubiquitous Platform

We are now in the era of mobile and tablets devices, so we decided to make GLABS a responsible web platform. This means that the design is adaptable to the device screen width and height, so one can see all the course information on one's tablet, mobile or computer.

The platform is programmed with HTML5, CSS3, JavaScript, PHP and MySQL. This allows one to make a resizable web and establish communication with Schoology Data and save all content in a private database (see Figure 10).

8. GLABS WITH SCHOOLOGY API

Schoology allows teachers to manage their courses online. Schoology has developed an API on it webpage for users who wants develop an app or another network using Schoology content. Schoology is perfect as an LMS, but it is incomplete if we want to gamify a subject. For this reason, we decided to use Schoology API to develop an external network, with our gamified thematic, using Schoology database content. The idea is simple: teachers will manage all course data in Schoology and the students will consult/see this information in the new network. Anybody who wants to make an app via Schoology or have access to the webpage content needs a Schoology oAouth Request Key and oAouth Request Secret. Schoology gives to their developers these two codes. For security, Schoology API uses the oAouth protocol. OAuth is an authentication method used to identify the user behind a request to the API. It works as a security ward, defending against web attacks before allowing access to the API.

The user uses the Consumer Key and Consumer Secret (Schoology ID) to obtain a request "token" (Step 1 to Step 6, Figure 11). After that, the user has to accept the conditions of Schoology, converting the "request token"

Figure 10. GLABS adapts to multiple devices

to an "access token" (Step 7 to Step 12, Figure 11). These conditions are preset by oAouth. With an access token, we can call Schoology API to obtain all the necessary information of the course (students, grades, exercises).

9. METHOD OF EVALUATION

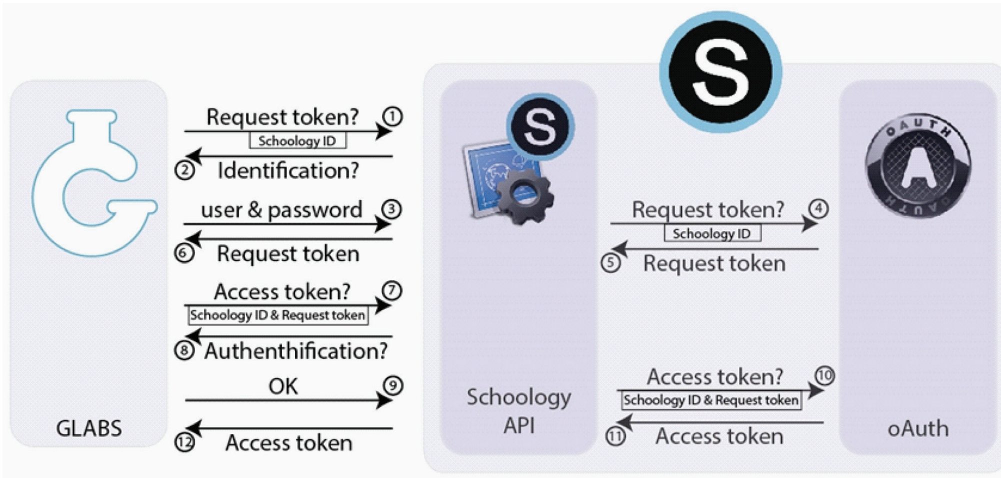
The methodology to evaluate both quantitative (through a structured test), and qualitative (using the Bipolar Laddering (Pifarré, 2007), using gamification. We used two methods to evaluate the results in applying all methodologies:

9.1. Quantitative

Will deliver at first a quest to achieve the student's profile and tastes. This test, and following the planned methodology, will carry out once finished the second phase of the course, and prior to the review and publication of final marks.

The objective of this test returns to be threefold: on the one hand compare the efficiency. On the other hand get the degree of perception of the student in the use of the technologies used in the exercises. And finally, assess the degree of usability in general of the student with the content, structure and methodology followed in the subject. To evaluate correctly the progress and determine if the objectives in the hypothesis represent an improvement in student involvement and greater learning due to the increment in motivation. With these types of surveys we obtained a subjective motivation, efficiency and satisfaction that the student has perceived using this new methodology, and basic data about the elements to improve. The survey will be a questionnaire that will be presented to the participants in paper format. The questions of efficacy and efficiency have been created using a Likert scale (Likert, 1932; see Figure 12). Each question will be assigned a numerical value. The value assigned will indicate the degree of accordance or disagreement with the question one a five-point scale, so that the questionnaire is answered with accuracy in terms of the degree of accordance over the affirmations. The graphical interface will be adapted to the LEGO® theme for the gamification.

Figure 11. GLABS connection with schoology API



9.2. Qualitative (BLA)

Qualitative methods are commonly employed in usability studies and, inspired by experimental psychology and the hypothetical-deductive paradigm, employ samples of users who are relatively limited. Nevertheless, the Socratic paradigm from postmodern psychology is also applicable and useful in these studies of usability because it targets details related to the UX with high reliability and uncovers subtle information about the product or technology studied. This migration from the hypothetical-deductive paradigm to the Socratic paradigm was inspired by the paradigm shift in clinical psychology away from constructivism and toward other post-modern schools of psychotherapy. This psychological model defends the subjective treatment of the user, unlike the objective hypothetical-deductive model (Guidano, 1989). Starting from Socratic paradigm basis, the BLA system (Bipolar Laddering) has been designed. BLA method could be defined as a psychological exploration technique, which points out the key factors of user experience. The main goal of this system is to ascertain which concrete characteristic of the product entails users' frustration, confidence or gratitude (between many others). BLA method works on positive and negative poles to define the strengths and weaknesses of the product. Once the element is obtained the laddering technique is going to be applied to define the relevant details of the product. The object of a laddering interview is to uncover how product attributes, usage consequences, and personal values are linked in a person's mind. The characteristics obtained through laddering application will define what specific factors make consider an element as strength or as a weakness. BLA performing consists in three steps:

Figure 12. LEGO® Likert scale

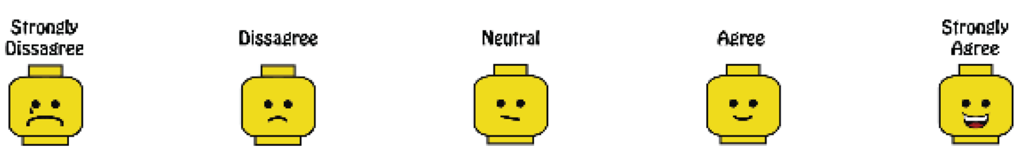


Table 1. Positive common (PC) elements

	Positive Common (PC)	Av.Score (Av)	Mention Index (MI)
1PC	LEGO® theme helps learning curve	8,40	50
2PC	Learning by doing methodology	8,86	70
3PC	Gamification techniques and awards	8,50	60
4PC	Organic modeling	8,50	20
5PC	Collaborative works with big groups	8,00	10
6PC	Gamification contests- competition	8,50	20
7PC	Use of visual technology like sckechfab, Unity, Oculus Rift	9,00	40

1. **Elicitation of the Elements:** The implementation of the test starts from a blank template for the positive elements (strengths) and another exactly the same for the negative elements (weaknesses). The interviewer (in this case an academic tutor) will ask the users (the student) to mention what aspects of the subject and experiment they like best or which help them in their tasks. The elements mentioned need to be summarized in one word or short sentence. This first step may be open or limited, i.e., positing a number of aspects without limits or reducing them to a specific number, as in our case where every student was asked to indicate three positive aspects and three negative ones.
2. **Marking of Elements:** Once the list of positive and negative elements is done, the interviewer will ask the user to mark each one from 0 (lowest possible level of satisfaction) to 10 (maximum level of satisfaction).
3. **Elements Definition:** Once the elements have been assessed, the qualitative phase starts. The interviewer reads out the elements of both lists to the user and asks for a justification of each one of the elements performing laddering technique. Why is it a positive element? Why this mark? The answer must be a specific explanation of the exact characteristics that make the mentioned element a strength or weakness of the product.

Once the element has been defined, the interviewer asks to the user for a solution of the problem he just describes in the case of negative elements or an improvement in the case of positive elements.

From the results obtained, the next step was to polarize the elements based on two criteria:

1. **Positive (Px) / Negative (Nx):** The student must differentiate the elements perceived as strong points of the experience that helped them to improve the type of work proposed as are useful, satisfactory, or simply functional aesthetic (see Table 1), in front of the negative aspects that did not facilitate work or simply need to be modified to be satisfactory or useful (see Table 2).
2. **Common Elements (xC):** Finally, the positive and negative elements that were repeated in the students' answers (common elements) according to the coding scheme shown in Tables 1 and 2:

The common elements that were mentioned at a higher rate are the most important aspects to use, improve or modify (according to their positive or negative sign).

The particular elements, due to their citation by only a single user, may be ruled out or treated in later stages of development.

Once the features mentioned by the students were identified and given values, the third step defined by the BLA began the qualitative stage in which the students described and provided

Table 2. Negative common (NC)

	Negative Common (NC)	Av.Score (Av)	Mention Index (MI)
1NC	3h/week classroom is divided 1:30 one day and 1:30 another day	5,00	20
2NC	Application crash	4,60	50
3NC	Lose track of contents in classroom	5,40	50
4NC	Group grades versus Individual grades	5,00	20
5NC	Extra contents possibilities: Hair, Fx,…	5,00	20
6NC	Gamification grades with points	5,20	50
7NC	LEGO® theme is repetitive	7,00	20
8NC	Gamification is not serious	6,00	10

solutions or improvements to each of their contributions in the format of an open interview.

Table 3 shows the main improvements or changes that the students proposed for both positive and negative elements.

At this point, before discussing the results, it is interesting to identify the most relevant items obtained from the BLA, by high rates of citation, high scores or a combination of both. Because we are working with an open-ended method, some of the above elements were further from the central focus of the study: the evaluation of new visual techniques in the teaching field. Thus, we will only highlight elements closest to the motive for the study. Concerning positive remarks, we will highlight the Learning by doing methodology (MI: 70%, Av: 8.86), Gamification techniques and awards (MI: 60%, Av: 8.5), and Learning curve with LEGO® (MI: 50%, Av: 8.40) and the use of technology like Unity or Iculus Rift (MI: 40%, Av: 9). In the Proposed Common Improvements web remark Unified web portal with a better gamification (MI: 60%).

Table 3. Proposed common improvements (CI) For both positive and negative elements

	Description	Mention Index
1CI	Lot of people in class. Small groups	20%
2CI	Unified web portal with a better gamification	60%
3CI	Starts with more easy exercise	10%
4CI	More 3D for design or films versus videogames	10%
5CI	Beginning of the subject, clarify minimun specs	20%
6CI	More detailed grades.Rubrics for collaborative works	40%
7CI	Web Site with tutorials, and maps for find the path again	50%
8CI	Better weight. Rounded numbers.Unified web portal with a better visualization of grades	30%
9CI	Modeling real things	10%
10CI	Contests	20%
11CI	LEGO® theme	10%
12CI	Serious Gamification	10%

10. DISCUSSION

This good academic performance can be attributed in part to the gamification techniques, the methodology of learning by doing and quest-based learning that it provided in working in 3D, all of which resulted in positive data obtained from the BLA. However, there are a number of negative aspects (Table 2) and solutions proposed (Table 3) by students that have a direct impact: the lack of horse-power in computer that let work with more detailed models and a lack of stability of the applications and models in some software under certain circumstances. Comparing the academic results with all of the negative aspects and improvements that were cited in the BLA, it is clear that the students appreciated and were highly motivated to work in 3D with gamification and need a new tool for join all the data, create a portfolio in 3D, visualize the grades and have a knowledge map with the jobs and missions that the student have to do. In the Proposed Common Improvements web remark Unified web portal with a better gamification (MI: 60%). In this case, the creation of GLABS responds to this demands. The BLA method has shown us that we need to increase the time for other complement tools for create 3D and the use of edge technology like Oculus Rift, would help them to improve and engage the final quality of the work.

11. CONCLUSION

In this paper we have reviewed and conceptualized teaching 3D arts using gamification techniques in a higher education setting, specifically for university students. To gamify a classroom successfully the teacher must engage the students themselves. This type of recognition is the most important element when considering using gamification. It is much more difficult and time consuming to implement a gamified classroom than a preparing a traditional lesson plan. Every aspect of the class will have to be perfectly matched in order to provide students with immediate feedback, and to allow them to “level up” their skills. It is also important to build a storyline and use tools for the teacher to contextualize the game mechanics applied in the classroom. This can be achieved by introducing and tracking XP, points, virtual money, or anything that uses scoring and evaluates the progress of the students. The use of gamification in a classroom increase the engagement and the motivation of students when compared with traditional methods. It is important to engage the students with collaborative work in the classroom, very similar to a multiplayer game in two ways: competing with one another in groups, or developing a team that solves one goal together in a collaborative way.When a teacher meshes gamification with other teaching methodologies, like PBL and QBL, and with new technologies like virtual reality and webGL, they are creating the perfect environment for students to engage in a lesson. Not only does it increase their performance on exams, but it encourages them to perform better if they are behind. Overall, it increases the effectiveness of the learning process for all students.

GLABS is created with the aim of improving the performance and skills of students through innovation and making the class a space where students have the interest and attraction to enter to see what challenges, problems and missions are presented. The system integrates all the functionality of other LMS standard and adds game mechanics, becoming a system that facilitates the deployment of courses with a gamificacion and implementation of technology such as virtual reality or creation of 3D with webGL (sketchfab) with a high level of success. Thanks to this integration, the student make a good follow-up to the subject and see upcoming work (missions) that you must perform or you can even see the grades obtained (points) for previous missions and display all the data on an interactive map and the learning progress, all of this with a concept of learning with engaging. GLABS approximates and makes easy the task of the professor to telling stories for the next mission and generate graphically the exercises to provide the essential contents of a more attractive way and also help those students who quit the subject or find it difficult to keep on track. In addition, the system saves all work submitted, for this case study, the subject of computer animation I, where the creation of 3D models is part of the techniques that have to be learned, is basic to create a dynamic library, interactive and in constant updates. In the final analysis are obtained interactive 3D models in Sketchfab integrated at GLABS, visible through virtual reality created with Unity, and combinable with still images and other resources that they complete in a single platform, a compendium of the work that can be displayed and viewed as digital portfolio. GLABS, has enhanced the collaborative participation that we were looking for and helps the inclusion of other teaching methodologies. This collaborative participation in class has been very high, thanks to discussion forums that gives us Schoology and that enables us to interact in class, by web or mobile, but in addition, GLABS provides a system for collaborative work that has further increased the participation of the student, to be able to share the completed missions, the achievements and the progress that performs each student. In addition, the system ensures the participation of the class without exception for personal reasons (Piaget, 2001). For students that has faults of attendance, GLABS guide what they should do next and that mission need to be done if the student want to recover points, and achieve the goal. In addition, the interactive map has been a great help to motivate the student to perform missions or optional extra works for acquire more knowledge. Another important point of the platform is the simplicity of viewing the grades help to the connection to the LMS Schoology. Very quickly, the student gets feedback, which is basic to maintain motivation and progression of the student. For example, GLABS has implemented a leaderboard that the student see its position on the class (only the ranking, no names). GLABS also presents a system for viewing public badges and achievements, as well the best missions achieved by some students appear in the main page.

All these concepts, GLABS gives us great improvement and flexibility, providing the ability to generate and change the images and the interfaces to the thematic more appropriate to the subject. In this case study, the subject of creating 3D models, has been working intensively with models of the LEGO® Company, which has been the central theme of the course, and for this reason, icons, and in general all the elements of gamificacion and maps, and other elements in GLABS and the missions, are inspired in parts of LEGO®. This has helped to create an atmosphere more appropriate and help us to generate stories and missions in a more engaging way. This template with all its resources of LEGO® may be selected by default when you start another course or start another template and resources from scratch. Each year, if the teacher think that it is necessary or if it is for another subject, the subject must be changed and generate their resources to enter easily. GLABS aims to improve the interest in the students but also introduces a cost for the professor, because it must generate gamificated material and this means a higher cost in time.

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