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Design and evaluation of a gamified system for ERP training

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ABSTRACT

Enterprise Resource Planning Systems (ERP) facilitate the flow of information within a company by storing data in common databases. These systems offer a holistic view of the organization because they reduce information redundancy, offer information in real time, help with process standardization, and improve information flow and communication among employees. Nevertheless, the benefits attributed to an ERP implementation can be lost without an effective user training. Previous studies have observed that common training mechanisms don't provide meaningful learning to users, and that user satisfaction rates range from neutral to low. Therefore, in this paper we study the effects that gamification has on ERP training concerning user learning and user satisfaction. Gamification is the use of game elements and game design techniques in non-gaming environments. Several applications prove that gamified systems increase user engagement and performance. Our hypotheses were that a gamified system for ERP training improve user learning and user satisfaction levels during the training period. To test our hypotheses, we designed and evaluated a gamified system. The results showed that users trained using a gamified system performed better than those trained using a conventional, non-gamified, training mechanism.

1. Introduction

In order to improve decision-making, firms started to store information using different management systems. Nonetheless, these systems lacked integration, which led to difficulties in information flow, and cooperation and communication among business areas (Gupta & Kohli, 2006), so their application did not represent a significant improvement company-wide.

Nowadays, companies maintain their organizational environment tightly integrated through information systems. Indeed, information systems—such as Enterprise Resource Planning (ERP) systems—have become essential for organizational operations, process reengineering and supply chain management (Davenport, 1998). Due to the benefits that an ERP system offers, more enterprises want to implement it. Consequently, the market for ERP systems has increased its profits from $17.2 billion in 1998 to $39.7 billion in 2011 (Seo, 2013).

Enterprise Resource Planning systems unify information and standardize business processes. These systems emerged as a solution to issues concerning fragmentation, redundancy and reliability of the information (Davenport, 1998; Gupta & Kohli, 2006). Thus, decision-makers can timely access the information they need, in order to make decisions based on a global and integrated perspective of the company. ERP systems offer shared management tools, integrate and optimize business processes, and are flexible enough to adapt to future needs (Rettig, 2007). These systems are considered the "digital nerve system of organizations" because they offer fast answers to customers and suppliers (Mabert, Soni, & Venkataramanan, 2001).

Companies perceive the benefits from ERP systems depending on the success of the implementation process. In Rettig (2007) the author states that 75% of ERP implementations are considered a failure. Hence, investing a high amount of money to the implementation project does not guarantee success. The risk of failure is not reserved to small enterprises; large enterprises like FoxMeyer Drugs, Applied Materials, Hershey's, Mobil Europe and Dow Chemical have dealt with this risk as well (Wong & Tein, 2003). So, the implementation process for ERP systems has been compared to a root-canal surgery, since the situation improves after the painful procedure (Mabert et al., 2001).

The challenges during the implementation of ERP systems are rather organizational than technical. Enterprises fail to reconcile the system requirements with business needs (Davenport, 1998).

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The authors in Umble, Haft, and Umble (2003) indicate that failure in ERP implementations can be attributed to insufficient training to end users, lack of commitment from senior management, lack of effective project management, attempts to connect the new system with legacy systems, failures in the selection of team members of the implementation project, failures in the redesign of business processes, and lack of commitment with change.

In order to enjoy the benefits promised with an ERP implementation, it is important to pay attention to the critical success factors (CSFs) of an ERP implementation. CSFs are factors that, when met, contribute to a successful implementation of an ERP system (Wong & Tein, 2003). In Somers and Nelson (2001) the authors agree and add that CSFs have a greater effect if given enough importance at each stage of the ERP implementation process.

The critical success factors for ERP implementation have been identified in previous studies (Bingi, Sharma, & Godla, 1999; Umble et al., 2003; Wong & Tein, 2003). The most noteworthy are: user training, commitment and support from senior management, change management, project management, process reengineering and customization, composition of the implementation team, vision and planning, software selection, and integration of the ERP system.

User training features as one of the major CSFs of ERP implementation. Several authors state that user training is necessary to smooth the implementation process because it helps to reduce resistance to change, to maximize the benefits of the ERP system, and to improve employee satisfaction (Seo, 2013; Somers & Nelson, 2001; Wong & Tein, 2003). In Seo (2013) it is mentioned that uneducated users can be risky: not knowing how to properly use the tool can cause confusion and imprecision, which in turn would reduce user satisfaction and the system's credibility. This view is consistent with that specified in Umble et al. (2003): not understanding the system can lead users to invent their own processes based on the little knowledge they have.

Gradually, organizations have become more aware of the real importance of user training in the implemention process of ERP systems. The authors in Huang (2010) indicate that user training is a CSF that has risen in importance from a ninth position (1998–2002 period) to a first position (2003–2007 period).

Therefore, human resource management is key for an effective implementation of an ERP system. Specifically, user training is highly important, since users will be the ones who determine the usefulness of the ERP system as a decision-making tool for their daily work. User education is essential to maximize the benefits of the ERP system in the organization, especially the benefits related to decision-making under systemic thinking. Only in this way will employees actually use and analyze effectively the information provided by the ERP system to make their decisions.

In this paper we hypothesize that gamification will enhance ERP training by increasing user satisfaction regarding the training process. A greater satisfaction will help users to understand the concept of ERP system and to use it as a daily tool in their job positions. The increased use of the ERP system as a decision-making tool in the workplace would improve the performance of employees in the organization. Better results and user engagement may even have a positive effect on executives who underestimate the impact of user training.

The rest of the paper is distributed as follows. Research motivation and objectives are presented in Section 2. The design of the gamified system is presented in Section 3. Experimentation results and discussion are shown in Section 4 and 5, respectively. Finally, the conclusions and recommendations are presented in Section 6.

2. Motivation and research objectives

The fact that an ERP system centralizes and organizes the information of a company does not necessarily mean that this information will be well used (Davenport, 1998). For this to happen, the organization needs to go through several changes. Among others, employees have to be trained in the usage of these complex systems.

2.1. Overview of ERP training

There are numerous training methods for any budget: virtual classes, computational programs, videos, self-educational books, etc. (Wheatley, 2000). There are also academic initiatives to educate students about ERP use (Maurizio & Rosemann, 2005; Stewart, Gable, Andrews, Rosemann, & Chan, 1999; Tracy et al., 2001). These training programs are expected to be enough for an effective use of the system, but the most of the learning occurs when the user is using the system in normal operating conditions (Umble et al., 2003).

In Wheatley (2000) the authors mention that, although some experts claim that issues with ERP systems are due to poor user training, companies underrate the impact that training has. They add that: (1) user training is one of the first items to be cut off when price negotiations get difficult among companies and vendors; (2) the last phases of the implementation process are usually done quickly in order to keep up late activities—and so training is covered up quickly as well; and (3) users are not educated enough about the *concept* of ERP system.

A Deloitte survey (Deloitte, 2005) about ERP systems in organizations was completed by 35 individuals from 29 different companies. The results showed that user training was the third most important factor for implementation success. It was also found that there is a strong use of virtual mechanisms for ERP training: 43% of the participants used online training methods and simulations, and 30% of them received training through virtual classes.

Similarly, Michael Management Corporation (Michael Management Corporation, 2014) did a survey to SAP users—consultants, managers, supervisors, IT analysts, developers, and end users. The results were similar to those of the Deloitte survey regarding training mechanisms used and preffered by the users (see Fig. 1). This survey revealed the need to improve current training, too. Results show that 41% of participants considered that they hadn't received enough training to do their job. Also, about half the participants stated that end users are the ones who need the most training.

The survey performed by Panorama (Panorama Consulting Solutions, 2014) revealed that, with respect to user training from third parties and employees adoption of the system, most of participants showed a satisfaction rate ranging from neutral to low. These satisfaction results suggest that common training methods for ERP training are not interesting enough.

2.2. Overview of gamification

Werbach and Hunter (2012) define gamification as “the use of game elements and game design techniques in non-gaming environments.” The authors explain that fun is a valuable tool that firms can turn into a competitive advantage to accomplish organizational goals. Gamification was conceived after a reversed engineering process to understand what makes games effective and how this knowledge would be of utility in a business environment.

Game elements are the components that, together, make up a game. Game design techniques consist on the design decisions

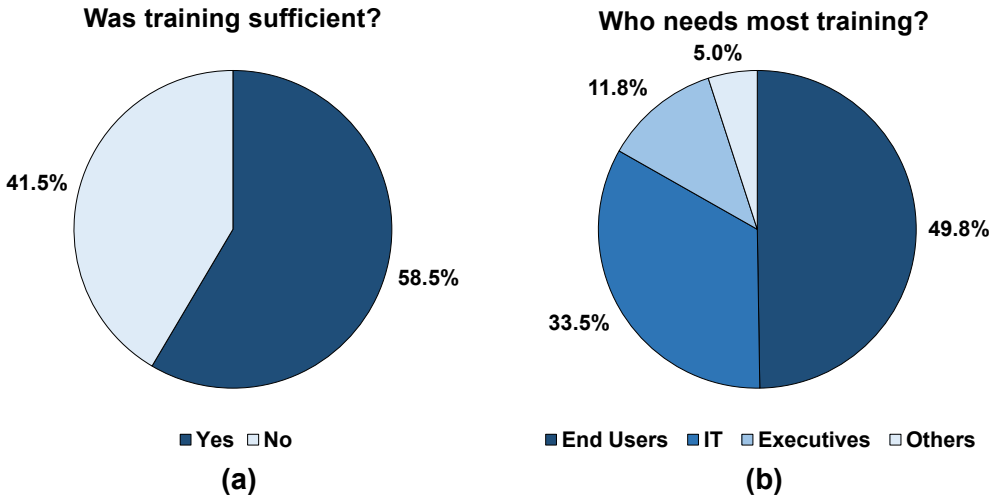

Fig. 1. (a)Participants' perception about the training they have received. (b) Participants' perception about ERP training needs.
Source: Michael Management Corporation.

regarding what elements to choose and how to incorporate them to the system, in order to maximize the experience of users. As for non-gaming environments, it refers to real world situations like business processes, and not videogames. Although gamification uses these elements and techniques, it should not be confused with a game. Also, gamification is not about incorporating game elements with no specific purpose and expect it to improve user engagement and motivation, the system needs to be aligned to the organization's objectives (For The Win Blog, 2012a).

There are three main reasons why gamification should be used in organizations (Werbach & Hunter, 2012). First, gamified systems seek to increase engagement and motivation in users by incorporating elements such as challenges and emotions. Second, these systems provide space for experimentation, so they are not only challenging but let users experience progress and accomplishments. And third, gamified systems work. Despite the recent conception of gamification, there are companies that have successfully implemented gamification in some of their processes, like SAP (MindTickle, 2014) and Deloitte (Deloitte, 2005). OpenPedriatics is a medical application of gamification to strengthen distance education (Schwartz, 2014). There are also some gamified initiatives to help students perform better (Kelle, Klemke, & Specht, 2013; Landers & Callan, 2011; SAP, 2008).

2.3. Gamification and ERP systems

There are several gamification applications to increase the usage of ERP systems. For instance, SAP organized an innovation workshop in 2011 (Herger, 2011). During this event, various teams proposed ideas of how gamification could be used in the company. Among the most remarkable ideas were: using gamification for invoice transactions, performance measurement, and product portfolio management. Thanks to this workshop, various initiatives to use gamification rose up, like SAP Commnunity Network (SCN). This project is a social environment for information sharing, in which contributions to the page (by blog entries or commentaries) are rewarded with points and a leaderboard position (Shaughnessy, 2012). Other SAP gamification projects are the gamified module for payment, and the Gamification Administrative Console (Gamification Blogger, 2012).

Westjet Airlines started one of the most recent gamification projects related to ERP systems; its goal was to increase the use of the system. The pilot project is focused on the expense reports process. It measures the proper sending of expense reports, the approval/rejection of reports, the use of the corporate credit card (if any available) in place of a personal credit card, and the attachment of receipts to the expense reports (Kanaracus, 2014).

Other online articles have exposed that gamification may be useful for ERP systems. A blog entry on the InfoSys site (Bery, 2011) expressed the need of gamification to increase the use of the system and raise awareness of its importance. Panorama mentions in its site that, just as in other business processes, gamification could be effectively applied during an ERP implementation to engage users with the system (Aldrich, 2012).

To the best of the authors' knowledge, although there are publications that consider that the use of gamification improves the results of ERP training, there are no publications that show the effect of gamification in ERP training, or gamified designs for ERP training—the closest initiatives found are simulation games. Then, this paper studies if gamification can improve results regarding user learning and satisfaction in an ERP training process.

2.4. Research objectives

The objective of this work is to show the benefits of applying gamification in ERP training. Specifically, we want to show that gamification has a positive effect in user learning and satisfaction. A better training will help promote the effective use of the ERP as a tool for decision-making.

We formulated two hypotheses for this purpose:

1 There are significant differences in user learning between users receiving a gamified training and users receiving a non-gamified training (H_1).
2 There are significant differences in the satisfaction rate between users receiving a gamified training and users receiving a non-gamified training (H_2).

The first hypothesis corresponds to the effects that gamification has in user learning during training. The second hypothesis corresponds to the effects that gamification has in user satisfaction rates about the training they receive. In order to prove these hypotheses, we first verified that gamification concepts could be used in an ERP training process. Afterwards, we designed a gamified system for

user training, following the design process for gamified systems in Werbach and Hunter (2012). We then tested our gamified system through experimentation in order to verify our hypotheses.

3. Gamified system design

The gamified system we designed is intended for use in companies that have already implemented an ERP software. To verify the feasibility of using gamification for the ERP training process, we used the basic gamification table proposed in Werbach and Hunter (2012). This information is shown in Table 1.

We chose to apply gamification to an online training system (e-learning). The training material corresponds to the *Flya Kite Case*: *Processing transactions through the logistics and support processes of an ERP* (SAP, 2008). Flya Kite is an introductory material on the use of SAP ERP, which was prepared by members of SAP University Alliances Program.[2]

The Flya Kite case study is divided into chapters. The first one is an introduction to ERP concepts. The following chapters are about the six basic modules of SAP ERP: Materials Management, Production/MRP, Sales and Distribution, Financial Accounting, Cost Accounting, and Human Resources Management.

The structure of this case study helps develop an overall knowledge about ERP systems throughout the training process. With this configuration, users will be able to learn about each one of the basic modules on an ERP system, regardless of the business area to which they belong. This training could later be complemented with an additional—more specialized—training focused on the module each user will be using the most. By the end of the training, users will have gained a general knowledge about ERP systems, and they would have also learned specific knowledge for their daily activities.

If the user is asked to use a different module in the future, the specialized training would be easier for the user because he would already know the basic concepts of that new module thanks to the general training he has already received.

3.1. Defining business goals

In order to establish the business goals to be attained with the gamified system, we listed the potential objectives for our gamified system. We then organized those potential objectives in order of importance. The next step was to identify mechanics—the potential objectives that are more of a mean rather than an end. The last step was to justify each of the goals based on the benefits that the company would perceive if they were to use the gamified training system. After following this procedure, the business goals for our gamified system are:

1. Familiarize users with the ERP system and how it is used, to improve user performance and decision-making.
2. Increase user satisfaction with the training process, to motivate them throughout the training and to increase the use of the system on a daily basis.
3. Increase the effective use of the ERP system during daily activities, to reduce the time for decision-making and to reduce unnecessary manipulation of information.

Objectives 1 and 2 concur with the objectives of this paper and their analysis is of interest to verify the hypotheses made. The last objective, although considered during the design phase, will not be validated this time because it falls beyond the scope of this study.

3.2. Delineating target behaviors

During their training, users are expected to learn about the ERP concept and the use of an ERP system. With this in mind, we defined the user behaviors for this system, and the metrics to measure such behaviors (see Table 2). Although “log in the ERP system daily” and “use the ERP system during daily activities” are activities expected from users, these are beyond the scope of this study and hence are not going to be measured at this time.

3.3. Describing users

The users of the gamified system will be individuals that require to be trained on how to use an ERP system (e.g., employees). Dividing these users into segments helps create a system that considers the motivations of different groups (Werbach & Hunter, 2012). We defined four user profiles considering Bartle's player types (For The Win Blog, 2012b) and the generational segmentation of employees in companies (Robbins & Judge, 2009). Along with the structure of the Flya Kite case, this information was also used to determine the life cycle of users. The life cycle consists on four stages: Beginner, Apprentice, Master and Expert. User profiles are shown in Table 3 and the life cycle stages are described in Table 4.

3.4. Planning the activity cycles

We devised the engagement loops and progression stairs for this gamified system according to the structure of the Flya Kite case.

The engagement loops consist on the system's description in a micro level. The original Flya Kite case contains proposed quizzes and exercises; these will be considered as objectives to complete in the training system. By the end of each chapter, the user will have completed several objectives that contribute to complete the chapter's global objective (e.g., learn how to manage materials using the ERP system, learn how to use the accounting module,

Table 1
Feasibility analysis prior to applying gamification to the ERP training process.

Criteria	Justification
Motivation	If users feel motivated during the training, they will be willing to learn how to use the ERP system, and will grow conscious of the importance of using it properly.
Significant choices	Users are free to enter their own values in the different activities in the training (some of them will be optional). They can also decide the pace with which to complete their training, creating a sense of autonomy and control.
Structure	The progress and performance of each user will be measured through the answers on tests and exercises completed throughout the training.
Potential conflicts	The activities completed in the gamified system won't interfere with the compensation system of the company, but users who show improvement in their performance after the training could be rewarded according to such system.

[2] SAP University Alliances Program provides access to SAP products to more than 1800 universities.

Table 2
Definition of target behaviors for users of the gamified training system.

Behavior	Metrics
Create an account in the gamification platform	Number of users created in the system
Take a diagnostic test before starting with the training material	Score in the diagnostic test
Create user in the ERP software	User ID in the ERP software
Learn the main concepts of each of the ERP modules	Score on the quiz for each ERP module
Know the progress made in the training system	Total score in the training
Solve the proposed exercises for each ERP module	Screenshots of the solutions for the proposed exercises
Complete optional activities to reinforce concepts	Number of optional activities that are completed
Interact with other users in the training system	Number of commentaries posted
Share accomplishments with other users	Rank position in the leaderboard
Enjoy the training system	Results of the satisfaction survey
Complete the training process successfully	Score on the final test
Log in the ERP system on a daily basis	Number of users logged in per day
Use the ERP system on daily activities	Total queries sent during the day

Table 3
Description of user profiles for the gamified training system.

User profile	Description
Traditionalist	This user is hard working, conservative, satisfied, and shows loyalty to the company. His motivation is to achieve comfort and safety. This user is an Achiever.
Professional	This user is looking for success and accomplishment. He is ambitious and loyal to his professional career. He is motivated by the sense of achievement and social recognition. This user is a Killer.
Social	This user looks for balance between work and personal life. He is team-oriented, does not like rules and shows loyalty to his relationships. He is motivated by social relationships, happiness and entertainment. This user is a Socializer.
Independent	This user is characterized by being confident and looking for success. He is independent but is also team-oriented. He shows loyalty both to himself and to his relationships. This user is motivated by the sense of freedom, social recognition and sense of accomplishment. This user is a mixture of an Explorer and an Achiever.

Table 4
Profile description for users of the gamified training system.

Stages	Description
Beginner	In the beginning, users will want to explore and try the system. They will want to achieve goals, progress, and win rewards. During this stage, users will receive an introduction to the ERP system and will have to set up their accounts on the ERP software in which they will perform exercises during the training.
Apprentice	After becoming familiar with the system, users will have to perform several actions in sequence that will lead them to associate the knowledge they have acquired—either by experience or because they have asked for help from other users. During this stage, they will be introduced to the first two modules of the ERP system: Materials Management and Production Logistics.
Master	The length and difficulty at this stage is higher than in the previous stages. Users that become masters will want to apply and perfect their knowledge, so they will need goals that demand from them to come up with strategies and tactics according to what they have already learned; these may be individual or team goals. During this stage, users will be introduced to three modules of the ERP system: Sales and Distribution, Accounting and Control, and Human Resources Management. Each of these modules make use of the topics learned in the previous two stages.
Expert	Users who evolve into experts would have perfected their knowledge, so they will be looking for special activities that would keep them engaged in the system. These activities include individual and group exercises in the module the users use the most. (e.g., a Sales Analyst will be completing exercises about the Sales and Distribution module.) So, at this stage the training focuses on the daily needs of the ERP, considering its integration with other modules of the system. Since this is also the last stage in the life cycle, users will have to complete a final test.

among others). The user will have feedback everytime he completes an activity.

As for the progression stairs, these consist on a macro description of the user's progress throughout the gamified system. Each level in the gamified system will differ in length and difficulty, both for study material and exercises. This condition helps create a mastery feeling on users, since difficulty and length will not be constant throughout the system. So, at an initial level, ERP basic concepts are introduced, and for the next levels, concepts related to the ERP modules will be explained.

In order to satisfy some of the users' needs during each of the evolution stages in the system, we considered the following. For the initial stage when users are Beginners, they will need to complete a diagnostic test and will also set up the ERP software before starting the introduction level. For the following evolution stages, users will be motivated to share any issues and solutions they find while completing activities. This is the way we will encourage cooperation among users. There will also be optional activities that will serve as incentives for those users that are looking to enrich their condition of Experts in the system. The optional material could be about concepts or exercises concerning previous modules. Finally, for the users in the last stage of the training system, a final test will be taken before finishing the training. Depending on how well users do on this test and the score they have obtained up to here, they will receive a special reward for their training completion.

3.5. Incorporating fun to the system

In order to make the gamified training system more engaging to users, we have considered different fun types: hard, easy, serious and social fun. To satisfy the hard fun, users will need to take quizzes and do exercises in order to complete certain objectives for each stage in the user's life cycle. In the case of easy fun, the user will be able to explore the ERP software anytime during the training process, and they will also be able to choose a username and avatar. With regard to serious fun, the gamified training process uses training material that emphasizes the importance of using an ERP system properly, and the need to understand that it is an integrated system where information is shared among modules and that these modules are not isolated from one another. Lastly, social fun is

satisfied by adding discussion spaces in the gamified training system; users can leave comments requesting help to solve certain exercise, and they can also reply to other users' posts and share their progress in the training system. There will also be a performance ranking that will contribute to satisfy the social fun.

In order to reduce the feeling of being controlled, and to promote satisfaction and engagement, users will receive unexpected rewards at random moments during the training period. Additionally, users are not obliged to reveal their true identity in the gamified training system; when they create their accounts, each user is free to use any username, and the administrator will be the only one knowing the user's true identity.

3.6. Deploying the appropriate tools

The last step in designing a gamified system consists on determining which game elements to incorporate. These game elements can be categorized according to their abstraction level as: dynamics, mechanics or components (Werbach & Hunter, 2012). In this section, we describe the dynamics, mechanics and components shown in Fig. 2. We also include details about the system development using a gamification plug-in.

Dynamics are tightly related to the business objectives regarding the gamified system; it is the most abstract of the three categories. The dynamics chosen for this system are described in Table 5.

Mechanics are the means by which dynamics are fulfilled. The mechanics selected for this gamified system are described in Table 6.

Lastly, components are the least abstract, and are those tangible elements that let mechanics to be completed. The components chosen for this system are described in Table 7.

3.7. Building a prototype of the system

We built a prototype of the gamified design in order to evaluate the hypotheses presented in Section 2.4. Depending on how well this prototype performs, the gamified system could then be developed completely for use in a company.

First, we built a training website managed with WordPress 4. We called this site “ERP Training Project.” We incorporated gamification elements to the training site using BadgeOS—a free WordPress plug-in. We also installed two BadgeOS add-ons. BadgeOS Congratulations Modal Add-On was used as a feedback measure to notify users about the completed activities, missions, levels and evolutions they were having in the system. BadgeOS Leaderboards Add-On was used to incorporate a leaderboard in the site. Other plug-ins used were: Basic User Avatars, to incorporate the option of choosing your own avatar; Avatar Manager, to incorporate default avatars to new users; Open Badge Designer, to design the icons for evolution stages, levels, activities, missions, and badges; Profile Builder, to built the Registration and Edit your profile pages; User Login Log, to keep registry of users' logs to the system; and Quiz Master Next, to create the quizzes and tests for the training system.

4. Experimental results

We compared two independent samples that were randomly formed by students from an Industrial Engineering undergraduate program. By training two groups we determined the effect that gamification has on ERP training. Participants in Group 1—the control group—received a non-gamified training. As for Group 2—the experimental group—participants received a gamified training using the gamified design that was described in Section 3. Both groups used the same training material and training mechanism; the only difference was the application of gamification in Group 2. A total of 34 students registered for the experimentation, and were randomly split (17 participants per group).

4.1. Response variables

We selected the following variables to evaluate our hypotheses:

- **Differences between diagnostic test and final test scores.** We compared the differences between the diagnostic and final tests, obtained for Group 1 and Group 2 to determine if there is any effect in user learning due to the application of gamification.
- **Overall score in the satisfaction survey.** At the end of the training process, participants were asked to fill in a satisfaction survey. We used the overall score in this survey to determine if there is any effect in user satisfaction due to the application of gamification.

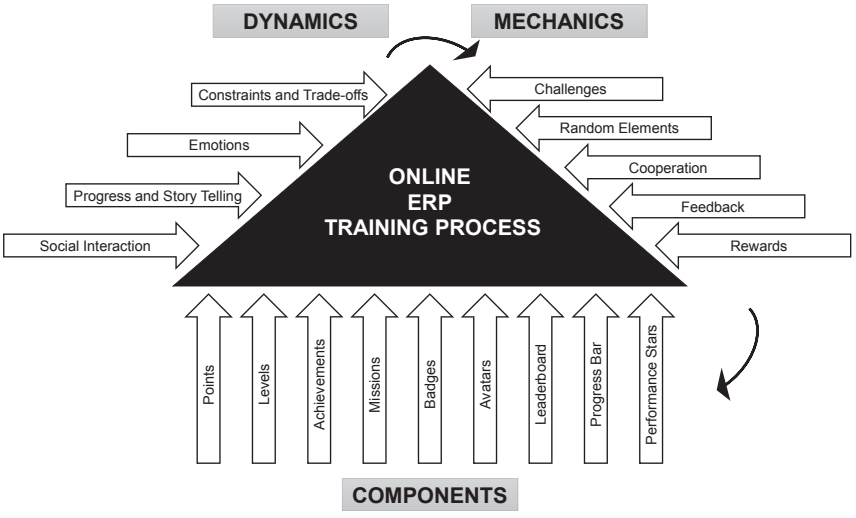

Fig. 2. Game elements that were incorporated to the ERP training process.

Table 5
Dynamics incorporated to the gamified training system.

Dynamics	Description
Constraints and trade-offs	Users will face constraints while completing the quizzes and exercises inside the Flya Kite case, and will need to do trade-offs in order to finish the training in the time given. For example, users may prefer to spend more time understanding the proposed exercises rather than solving the quizzes. They could also decide to spend more hours a day in order to finish the training in less days.
Emotions	As users progress, they will experience emotions such as curiosity, competitiveness, pressure, and desire for status.
Progress and story telling	Users will be able to see their progress in the training system, considering their overall progress and the progress they do inside each level.
Social interaction	The gamified system will let users interact among themselves. They will be able to request help from other users to solve any issue they have, or to share the progress they have made in the training system (comparing their progress with other users).

Table 6
Mechanics incorporated to the gamified training system.

Mechanics	Description
Challenges	During the training system, users will have to overcome the following challenges: (1) Learn what is an ERP system and what are its basic elements; (2) Learn how to manage procurement logistics through the use of the Material Management module; (3) Learn how to manage production processes through the use of the Production Logistics module; (4) Learn how to manage sales and product distribution through the use of the Sales and Distribution module; (5) Learn how to use the Financial Accounting and Cost Accounting modules to manage expenses in the organization and to set financial strategies; (6) Learn how to use the Human Resources Management module as a support for the other ERP modules; (7) Familiarize with the transactions than can be performed in the module the user uses the most (depending on the business process he belongs) so that the user can use the ERP system to make better decisions and reduce errors; and (8) Obtain the required score in the final test to complete the training process.
Random elements	Users will receive unexpected rewards during the training period.
Cooperation	Users will be able to assist other users with any issue they have concerning reading material, quizzes and exercises.
Feedback	Users will receive feedback to every activity they complete, so that they can evaluate their decisions and improve their learning throughout the training process.
Rewards	Users will receive positive rewards for the completed activities and for user interaction.

Table 7
Components incorporated to the gamified training system.

Components	Description
Points	Points will serve as the metric for progress, and users will receive them depending on the achievements they accomplish. The total score will serve to rank users from top performers to lower ones.
Levels	Each level in the training system will correspond to the study of one of the ERP modules covered in the study case. These levels are associated to the challenges previously defined when choosing mechanics. As a Beginner, users need to complete Level 1: Introduction to the ERP system. In the Apprentice level, users will have to complete Level 2: Materials Management, and Level 3: Production Logistics. As Masters, users will have to complete Level 4: Sales and Distribution, Level 5: Financial Accounting and Control, and Level 6: Human Resources Management. Finally, as Experts, users will need to complete Level 7: Most used module, and Level 8: Final test and Satisfaction Survey, to finish the training process in the system.
Achievements	For levels 1 to 7, users will have to complete the reading activities, exercises and quizzes; for level 7, exercises. For level 8, users will need to take the survey and the final test. Other achievements are: completing more levels, and positioning as the best trainee compared to other users. Users will be awarded points for these achievements.
Missions	Missions will be complimentary and optional, and can be completed at any time during the training period. These missions consist on small trivia questions or exercises about the modules of the ERP system. Users will be awarded points.
Badges	Users will be awarded badges, depending on how well users do on quizzes (Gold, Silver or Bronze Medals), and for missions (Mission Starter, Mission Legend, or Mission Killer), user interaction (Active User) and returning to the training system (Frequent User).
Avatars	Users will be able to choose an avatar to personalize their profile in the training system.
Leaderboard	Users will be able to see their progress with respect to other users on a leaderboard that shows the top best performers in the system.
Progress bar	For each level, users will be able to visualize how much progress they have done by level, considering completed activities versus total activities. In a similar way, users will be able to visualize their progress in the system, considering completed levels and user evolution.
Performance stars	At the end of each of the quizzes, the user will receive 1, 2, or 3 stars, depending on how many questions they answered correctly. Excluding the diagnostic and final tests, users can retake the quizzes in order to get the 3 stars.

4.2. Statistical tests

We chose to use Student's *t*-test for independent (unpaired) samples. This statistical test is robust for small sized samples—like those from this experiment.

In order to determine if there were any significant differences between the two samples with regard to user learning during the training process (H_1), we first determined the difference d in knowledge for each of the participants by comparing their scores on the diagnostic test ("before training" state) and final test ("after training" state). We then compared $\overline{d_1}$ and $\overline{d_2}$, where $\overline{d_1}$ and $\overline{d_2}$ are the average values of the differences between the tests for Group 1 and Group 2, respectively (see Fig. 3a).

As for Hypothesis 2 (H_2), we compared $\bar{x}_1$ and $\bar{x}_2$, where $\bar{x}_1$ and $\bar{x}_2$ are the average values for the satisfaction survey for Group 1 and Group 2, respectively (see Fig. 3b).

4.3. Materials

The following materials were used for our experimentation purposes.

- **Gamified training system**.[3] We created a gamified site with the prototype we built. This site was used to train Group 2.

[3] http://erptrainingpr.byethost3.com/training.

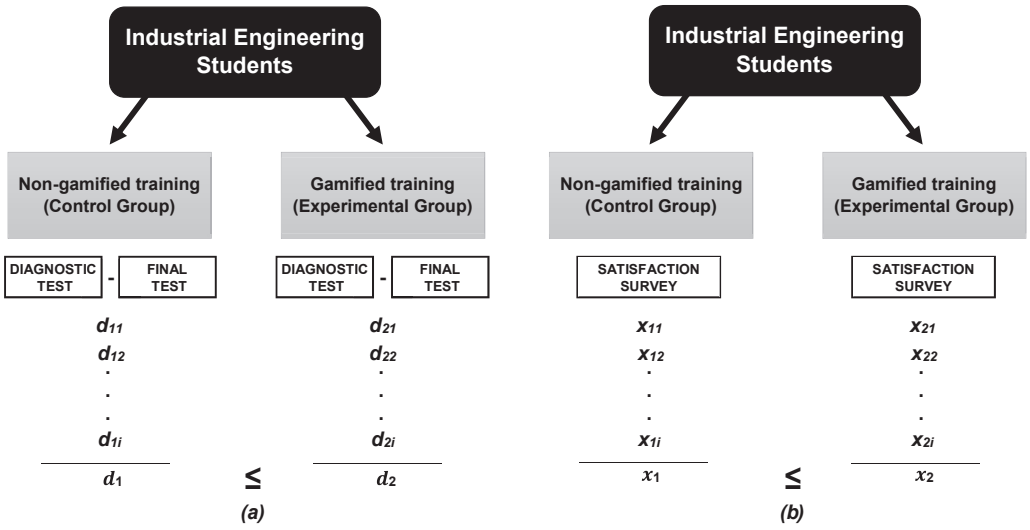

Fig. 3. Hypothesis testing for (a) Hypothesis 1 and (b) Hypothesis 2.

- **Non-Gamified training system**.[4] We also created a site that contains the same training material as the gamified site, but without the gamification elements. This site was used to train Group 1.
- **Odoo ERP Software**.[5] Odoo is an open source ERP that uses a variety of applications for enterprise management. Its interface is user friendly, which is favorable for beginners.

4.4. Evaluation tools

We used the following tools to measure our variables.

- **Diagnostic test.** The questions for this test were chosen from the total amount of questions at the end of each chapter of the Flya Kite case. This test contained 20 questions and participants took it only once.
- **Final test.** The questions for this test were chosen from the total amount of questions at the end of each chapter of the Flya Kite case. This test contained 20 questions and participants took it only once.
- **Satisfaction survey.** This survey was designed considering the suggested questions for satisfaction surveys. Participants took this survey only once.

4.5. Experimental procedure

This procedure was followed by both experimental groups. The total training period was 18 days, although participants could complete the training in less time. The steps were as follows:

1. Take the diagnostic test before starting the training.
2. Set up the ERP software for the exercises. Install the following applications: Accounting, Sales Management, Warehouse Management, MRP, Purchase Management, Recruitment Process, Leave Management, and Employee Appraisals.
3. Complete training requirements as stated in the corresponding training site (non-gamified site for Group 1 and gamified site for Group 2).
   - Complete the reading material of the module.
   - Solve the exercises for each module.
   - Take the module quiz.
4. Fill in the satisfaction survey of the training.
5. Take the final test of the training.

4.6. Data analysis and results

Table 8 shows the results for tests scores and Table 9 shows the results for the satisfaction survey, both for participants in Group 1 and Group 2. The fields with no values correspond to incomplete data of participants that withdrew from the training or that did not completed it. These incomplete observations were not considered for the statistical analysis.

We used the Levene test to check if the samples have equal variances (see Table 10). The Levene test is used to determine whether k samples have equal variances, and is less sensible to

Table 8
Tests results for Group 1 and Group 2.

Observation	Group 1			Group 2		
	Diagnostic test	Final test	d_1	Diagnostic test	Final test	d_2
1	–	–	–	55	80	25
2	45	55	10	40	80	40
3	55	80	25	20	70	50
4	40	60	20	40	80	40
5	–	–	–	0	–	–
6	50	75	25	30	65	35
7	50	60	10	30	–	–
8	45	70	25	50	–	–
9	–	–	–	55	80	25
10	25	75	50	35	70	35
11	35	60	25	50	60	10
12	55	60	5	35	80	45
13	–	–	–	50	80	30
14	45	–	–	–	–	–
15	–	–	–	50	80	30
16	40	–	–	30	–	–
17	30	60	30	25	60	35

[4] http://erptrainingpr.byethost3.com/project.

[5] Although the Flya Kite study case is intended to be solved using SAP ERP, we adapted the exercises so that they could be solved using an open source software like Odoo, since we did not have a SAP ERP membership.

Table 9
Survey results for Group 1 and Group 2.

Observation	Group 1	Group 2
	x_1	x_2
1	50	42
2	46	44
3	15	44
4	39	54
5	40	47
6	43	55
7	53	49
8	45	47
9	39	54
10	49	41
11	–	55
12	–	54
13	–	–
14	–	–
15	–	–
16	–	–
17	–	–

Table 10
Verification of t-test assumptions. Levene test for equal variances.

	Group 1	Group 2	p-value
$s_{\overline{d}}$	12.7	10.5	0.781
$s_{\overline{x}}$	10.6	5.4	0.422

deviations from normality (NIST, 2013). For the differences in test scores, with a p-value of 0.781 there is no sufficient statistical evidence to reject the null hypothesis of equal variances at a significance level of $\alpha = 0.05$. Then, the variances for both groups can be assumed to be equal. For the differences in satisfaction scores, with a p-value of 0.422, there is no sufficient statistical evidence to reject the null hypothesis of equal variances at a significance level of $\alpha = 0.05$. Then, the variances for both groups can be assumed to be equal.

The assumption of independence is satisfied because the samples were formed under a randomized process. With respect to the assumption of normality, it can be shown that a t-test is robust enough to moderate deviations from normality (Montgomery, 2009), so this assumption will be taken as satisfied as well.

4.7. Verification of hypotheses H_1 and H_2

We did a t-test for unpaired samples, assuming normality and equal variances (see Table 11). With a p-value of 0.020, there exists sufficient statistical evidence to reject the null hypothesis of no differences in learning between Group 1 and Group 2 at a significance level of $\alpha = 0.05$. Thus, applying gamification to the ERP training process contributes to better results in user learning. Similarly, with a p-value of 0.030, there exists sufficient statistical evidence to reject the null hypothesis of no differences in satisfaction between Group 1 and Group 2 at a significance level of $\alpha = 0.05$. Then, applying gamification to the ERP training process contributes to better results in user satisfaction.

Table 11
Verification of the hypotheses, H_1 and H_2

	Group 1	Group 2	p-value
$\overline{d}$	22.3	33.3	0.020
$\overline{x}$	41.9	48.8	0.030

5. Discussion

From this study, we concluded that gamification can improve the results of a training process. In this case, we showed that applying gamification elements to an ERP training system have positive effects on user learning and satisfaction. Although both experimentation groups were subjected to the same training material, participants in Group 2 performed better.

Participants in Group 2 used more the option of retaking the quizzes to obtain higher scores. Gamification seems to motivate users to retake quizzes in order to improve their scores on each level. This extra dedication, then, led them to obtain a higher score on the final test—which was taken only once. The structure in levels of the gamified system and the visualization of progress throughout the system helped participants in Group 2 to complete the activities in an orderly manner. It was observed that most of participants in Group 2 completed all the exercises and the quiz of each level before going to the following level. In contrast, participants in Group 1 tended to solve all the exercises first and then take all of the quizzes.

Regarding the satisfaction levels, Group 2 showed a higher level of satisfaction. Participants in both groups gave a low satisfaction score to the length of the reading material. Nevertheless, compared to Group 1, the satisfaction scores concerning structure and elements in the training system were higher for Group 2—these are the fields directly related to the application of gamification in the training system. Thus, the dynamics, mechanics and components incorporated helped to keep users engaged throughout the training process.

In our work, the gamified system was perceived as more enjoyable, and the gamified group showed a better performance in learning and in satisfaction. These findings are consistent with the work done by Van der Heijden (2004), where it is concluded that user acceptance of an information system is related to its hedonic (pleasant) nature. There is also consistency with findings in research regarding experiential consumption and how consumer behavior is enriched when considering both information processing and consumption experience (Holbrook and Hirschman, 1982). In retail research, higher satisfaction levels are related to a hedonic experience, too (Arnold & Reynolds, 2003). In the videogame industry, users show greater engagement when their experience is hedonic, since it has been found that hedonic consumption impacts positively game purchase and usage (Davis, Lang, & Gautam, 2013).

6. Conclusion and recommendations

We designed a gamified system for ERP training, and built a prototype of this system. By training two groups we showed that gamification has a positive effect on ERP training. One group was trained using a non-gamified system, and a second group was trained using a gamified system (our prototype). We found significant differences between the two groups, with the second group showing better results with respect to user learning and satisfaction. Thus, we conclude that gamification serves as a tool that enhances the training on ERP systems. The benefits of gamification in ERP training could be further studied by testing the prototype with employees to see if the results are similar. The third objective of the gamified design “Increase the effective use of the ERP system during daily activities” could be validated as well during a real implementation of the gamified system in an organization. Additionally, future work could analyze the effectiveness of gamification when the training material is more advanced. This time, we were dealing with an introductory training to ERP systems; results may maintain or differ when the training material is more advanced and users have prior knowledge about the ERP system. Finally, the effect

of gamification in other training processes or using different training mechanisms could be further studied as well.

We provide the following recommendations for the future development and implementation of the gamified design. Although BadgeOS served its purpose for the prototype, it is limited in options. Thus, other softwares would be more suitable for a full development of the system. Among the highly recommended gamification platforms for organizations (Jong, 2014), we consider that MindTickle and Badgeville would work the best, since MindTickle is a gamification platform specialized in user learning and engagement, and Badgeville is thought for increasing customer loyalty and employee performance. The development team should be conformed by a system developer in charge of the system implementation in the gamification platform and with the configuration of the ERP system. This development team should include a game designer to improve details of the gamified system, so that it is kept updated and aligned with the organizational objectives. To contextualize the content of the database that feeds the training environment in the ERP system, customized case studies could be built, so that the training process uses real information of the company. Finally, to satisfy even more user requirements, group exercises could be incorporated, as well as locked content for expert users, and "consulting" activities to motivate cooperation among users while generating a sense of expertise in users on the stage of Experts.

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